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Environmental Protection
Agency

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Regulations and Standards (WH-585)
Washinton, DC 20460

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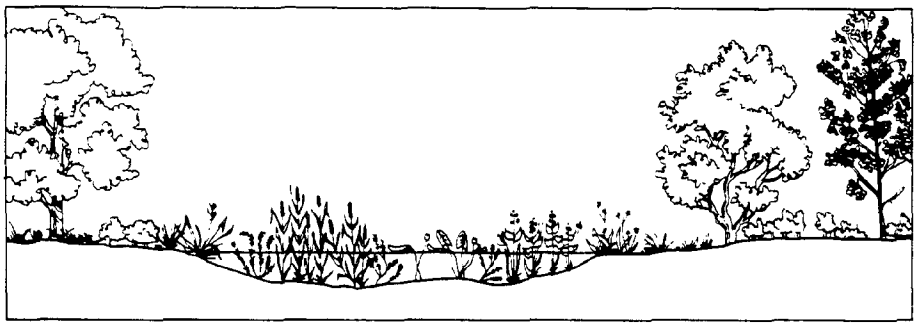
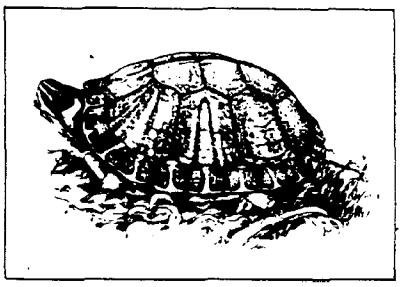
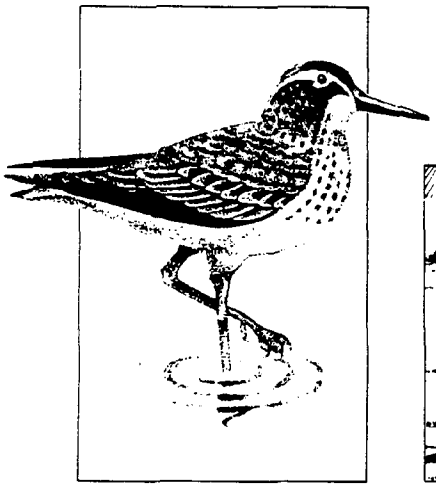
July 1990

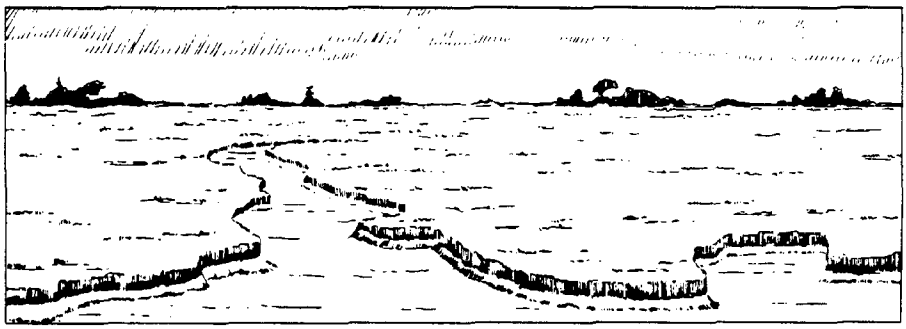
Water Quality Standards for Wetlands

National Guidance









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WATER QUALITY STANDARDS FOR WETLANDS

National Guidance

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Prepared by:

U.S. Environmental Protection Agency
Office of Water Regulations and Standards
Office of Wetlands Protection

This document is designated as Appendix B to Chapter 2 - General Program Guidance of the Water Quality Standards Handbook, December 1983.

Table of Contents

Page

Transmittal Memo v

Executive Summary vii

1.0 INTRODUCTION 1

1.1 Objectives 2

1.2 Organization 2

1.3 Legal Authority 3

2.0 INCLUSION OF WETLANDS IN THE DEFINITION OF STATE WATERS 5

3.0 USE CLASSIFICATION 7

3.1 Wetland Types 8

3.2 Wetland Functions and Values 10

3.3 Designating Wetland Uses 11

4.0 CRITERIA 15

4.1 Narrative Criteria 15

4.1.1 General Narrative Criteria 16

4.1.2 Narrative Biological Criteria 16

4.2 Numeric Criteria 17

4.2.1 Numeric Criteria - Human Health 17

4.2.2 Numeric Criteria - Aquatic Life 17

5.0 ANTIDEGRADATION 19

5.1 Protection of Existing Uses 19

5.2 Protection of High-Quality Wetlands 20

5.3 Protection of Outstanding Wetlands 20

6.0 IMPLEMENTATION 23

6.1 Section 401 Certification 23

6.2 Discharges to Wetlands 24

6.2.1 Municipal Wastewater Treatment 24

6.2.2 Stormwater Treatment 24

6.2.3 Fills 25

6.2.4 Nonpoint Source Assessment and Control 25

6.3 Monitoring 25

6.4 Mixing Zones and Variances 26

7.0 FUTURE DIRECTIONS 29

7.1 Numeric Biological Criteria for Wetlands 29

7.2 Wildlife Criteria 30

7.3 Wetlands Monitoring 30

References 31

Appendices

A - Glossary A-1

B - Definition of "Waters of the U.S." B-1

C - Information on the Assessment of Wetland Functions and Values C-1

D - Regional Wetlands Coordinators
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service D-1

E - Example of State Certification Action Involving Wetlands under CWA Section 401 ..... E-1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF WATER

JUL 30 1990

MEMORANDUM

SUBJECT: Final Document: National Guidance on Water Quality Standards for Wetlands

FROM: Martha G. Prothro, Director
Office of Water Regulations and Standards

David G. Davis, Director
Office of Wetlands Protection

TO: Regional Water Division Directors
Regional Environmental Services Division Directors
Assistant Regional Administrator for Policy and Management, Region VII
OW Office Directors
State Water Quality Program Managers
State Wetland Program Managers

The following document entitled "National Guidance: Water Quality Standards for Wetlands" provides guidance for meeting the priority established in the FY 1991 Agency Operating Guidance to develop water quality standards for wetlands during the FY 1991-1993 triennium. This document was developed jointly by the Office of Water Regulations and Standards (OWRS) and the Office of Wetlands Protection (OWP), and reflects the comments we received on the February 1990 draft from EPA Headquarters and Regional offices, EPA laboratories, and the States.

By the end of FY 1993, the minimum requirements for States are to include wetlands in the definition of "State waters", establish beneficial uses for wetlands, adopt existing narrative and numeric criteria for wetlands, adopt narrative biological criteria for wetlands, and apply antidegradation policies to wetlands. Information in this document related to the development of biological criteria has been coordinated with recent guidance issued by OWRS; "Biological Criteria: National Program Guidance for Surface Waters", dated April 1990.

We are focusing on water quality standards for wetlands to ensure that provisions of the Clean Water Act currently applied to other surface waters are also being applied to wetlands. The document focuses on those elements of water quality standards

that can be developed now using the overall structure of the water quality standards program and existing information and data sources related to wetlands. Periodically, our offices will provide additional information and support to the Regions and States through workshops and additional documents. We encourage you to let us know your needs as you begin developing wetlands standards. If you have any questions concerning this document, please contact us or have your staff contact Bob Shippen in OWRS (FTS-475-7329) or Doreen Robb in OWP (FTS-245-3906).

Attachment

cc: LaJuana Wilcher
Robert Wayland

EXECUTIVE SUMMARY

Background

This document provides program guidance to States on how to ensure effective application of water quality standards (WQS) to wetlands. This guidance reflects the level of achievement EPA expects the States to accomplish by the end of FY 1993, as defined in the Agency Operating Guidance, FY 1991, Office of Water. The basic requirements for applying State water quality standards to wetlands include the following:

- Include wetlands in the definition of "State waters."
- Designate uses for all wetlands.
- Adopt aesthetic narrative criteria (the "free froms") and appropriate numeric criteria for wetlands.
- Adopt narrative biological criteria for wetlands.
- Apply the State's antidegradation policy and implementation methods to wetlands.

Water quality standards for wetlands are necessary to ensure that the provisions of the Clean Water Act (CWA) applied to other surface waters are also applied to wetlands. Although Federal regulations implementing the CWA include wetlands in the definition of "waters of the U.S." and therefore require water quality standards, a number of States have not developed WQS for wetlands and have not included wetlands in their definitions of "State waters." Applying water quality standards to wetlands is part of an overall effort to protect and enhance the Nation's wetland resources and provides a regulatory basis for a variety of programs to meet this goal. Standards provide the foundation for a broad range of water quality management activities including, but not limited to, monitoring under Section 305(b), permitting under Sections 402 and 404, water quality certification under Section 401, and the control of NPS pollution under Section 319.

With the issuance of this guidance, EPA proposes a two- phased approach for the development of WQS for wetlands. Phase 1 activities presented in this guidance include the development of WQS elements for wetlands based upon existing information and science to be implemented within the next triennium. Phase 2 involves the further refinement of these basic elements using new science and program developments. The development of WQS for all surface waters is an iterative process.

Definition

The first and most important step in applying water quality standards to wetlands is ensuring that wetlands are legally included in the scope of States' water quality standards programs. States may accomplish this by adopting a regulatory definition of "State waters" at least as inclusive as the Federal definition of "waters of the U.S." and by adopting an appropriate definition for "wetlands." States may also need to remove or modify regulatory language that explicitly or implicitly limits the authority of water quality standards over wetlands.

Use Designation

At a minimum, all wetlands must have uses designated that meet the goals of Section 101(a)(2) of the CWA by providing for the protection and propagation of fish, shellfish, and wildlife and for recreation in and on the water, unless the results of a use attainability analysis (UAA) show that the CWA Section 101(a)(2) goals cannot be achieved. When designating uses for wetlands, States may choose to use their existing general

and water-specific classification systems, or they may set up an entirely different system for wetlands reflecting their unique functions. Two basic pieces of information are useful in classifying wetland uses: (1) the structural types of wetlands and (2) the functions and values associated with such types of wetlands. Generally, wetland functions directly relate to the physical, chemical, and biological integrity of wetlands. The protection of these functions through water quality standards also may be needed to attain the uses of waters adjacent to, or downstream of, wetlands.

Criteria

The Water Quality Standards Regulation (40 CFR 131.11(a)(1)) requires States to adopt criteria sufficient to protect designated uses that may include general statements (narrative) and specific numerical values (i.e., concentrations of contaminants and water quality characteristics). Most State water quality standards already contain many criteria for various water types and designated use classes that may be applicable to wetlands.

Narrative criteria are particularly important in wetlands, since many wetland impacts cannot be fully addressed by numeric criteria. Such impacts may result from the discharge of chemicals for which there are no numeric criteria in State standards, nonpoint sources, and activities that may affect the physical and/or biological, rather than the chemical, aspects of water quality (e.g., discharge of dredged and fill material). Narratives should be written to protect the most sensitive designated use and to support existing uses under State antidegradation policies. In addition to other narrative criteria, narrative biological criteria provide a further basis for managing a broad range of activities that impact the biological integrity of wetlands and other surface waters, particularly physical and hydrologic modifications. Narrative biological criteria are general statements of attainable or attained conditions of biological integrity and water quality for a given use designation. EPA has published national guidance on developing biological criteria for all surface waters.

Numeric criteria are specific numeric values for chemical constituents, physical parameters, or biological conditions that are adopted in State standards. Human health water quality criteria are based on the toxicity of a contaminant and the amount of the contaminant consumed through ingestion of water and fish regardless of the type of water. Therefore, EPA's chemical-specific human health criteria are directly applicable to wetlands. EPA also develops chemical-specific numeric criteria recommendations for the protection of freshwater and saltwater aquatic life. The numeric aquatic life criteria, although not designed specifically for wetlands, were designed to be protective of aquatic life and are generally applicable to most wetland types. An exception to this are pH-dependent criteria, such as ammonia and pentachlorophenol, since wetland pH may be outside the normal range of 6.5-9.0. As in other waters, natural water quality characteristics in some wetlands may be outside the range established for uses designated in State standards. These water quality characteristics may require the development of criteria that reflect the natural background conditions in a specific wetland or wetland type. Examples of some of the wetland characteristics that may fall into this category are dissolved oxygen, pH, turbidity, color, and hydrogen sulfide.

Antidegradation

The antidegradation policies contained in all State standards provide a powerful tool for the protection of wetlands and can be used by States to regulate point and nonpoint source discharges to wetlands in the same way as other surface waters. In conjunction with beneficial uses and narrative criteria, antidegradation can be used to address impacts to wetlands that cannot be fully addressed by chemical criteria, such as physical and hydrologic modifications. With the inclusion of wetlands as "waters of the State," State antidegradation policies and their implementation methods will apply to wetlands in the same way as other surface waters. State antidegradation policies should provide for the protection of existing uses in wetlands and the level of water quality necessary to protect those uses in the same manner as provided for other surface waters; see Section 131.12(a)(1) of the WQS regulation. In the case of fills, EPA interprets protection of existing uses to be met if there is no significant degradation as defined according to the Section 404(b)(1) guidelines. State antidegradation policies also provide special protection for outstanding natural resource waters.

Implementation

Implementing water quality standards for wetlands will require a coordinated effort between related Federal and State agencies and programs. Many States have begun to make more use of CWA Section 401 certification to manage certain activities that impact their wetland resources on a physical and/or biological basis rather than just chemical impacts. Section 401 gives the States the authority to grant, deny, or condition certification of Federal permits or licenses that may result in a discharge to "waters of the U.S.' Such action is taken by the State to ensure compliance with various provisions of the CWA, including the State's water quality standards. Violation of water quality standards is often the basis for denials or conditioning through Section 401 certification.

Natural wetlands are nearly always "waters of the U.S." and are afforded the same level of protection as other surface waters with regard to standards and minimum wastewater treatment requirements. Water quality standards for wetlands can prevent the misuse and overuse of natural wetlands for treatment through adoption of proper uses and criteria and application of State antidegradation policies. The Water Quality Standards Regulation (40 CFR 131.10(a)) states that, "in no case shall a State adopt waste transport or waste assimilation as a designated use for any 'waters of the U.S.'." Certain activities involving the discharge of pollutants to wetlands may be permitted; however, as with other surface waters, the State must ensure, through ambient monitoring, that permitted discharges to wetlands preserve and protect wetland functions and values as defined in State water quality standards. For municipal discharges to natural wetlands, a minimum of secondary treatment is required, and applicable water quality standards for the wetland and adjacent waters must be met. EPA anticipates that the policy for stormwater discharges to wetlands will have some similarities to the policies for municipal wastewater discharges to wetlands.

Many wetlands, through their assimilative capacity for nutrients and sediment, also serve an important water quality control function for nonpoint source pollution effects on waters adjacent to, or downstream of, the wetlands. Section 319 of the CWA requires the States to complete assessments of nonpoint source (NPS) impacts to State waters, including wetlands, and to prepare management programs to control NPS impacts. Water quality standards for wetlands can form the basis for these assessments and management programs for wetlands.

In addition, States can address physical and hydrological impacts on wetland quality through the application of narrative criteria to protect existing uses and through application of their antidegradation policies. The States should provide a linkage in their water quality standards to the determination of "significant degradation" as required under EPA guidelines (40 CFR 230.10(c)) and other applicable State laws affecting the disposal of dredged or fill materials in wetlands.

Finally, water quality management activities, including the permitting of wastewater and stormwater discharges, the assessment and control of NPS pollution, and waste disposal activities (sewage sludge, CERCLA, RCRA) require sufficient monitoring to ensure that the designated and existing uses of "waters of the U.S." are maintained and protected. The inclusion of wetlands in water quality standards provides the basis for conducting both wetland-specific and status and trend monitoring of State wetland resources. Monitoring of activities impacting specific wetlands may include several approaches, including biological measurements (i.e., plant, macroinvertebrate, and fish), that have shown promise for monitoring stream quality. The States are encouraged to develop and test the use of biological indicators.

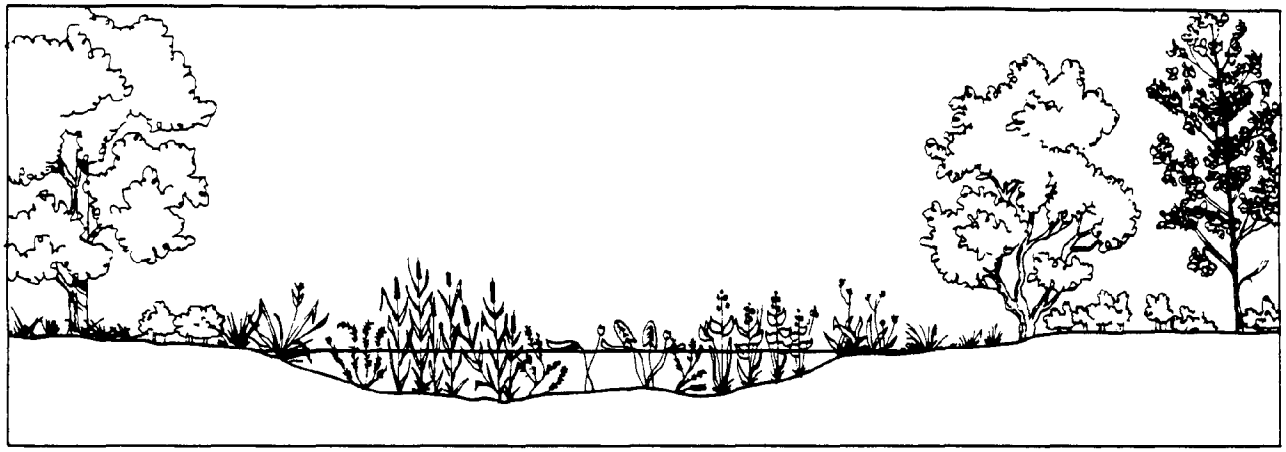
Future Directions

Development of narrative biological criteria are included in the first phase of the development of water quality standards for wetlands. The second phase involves the implementation of numeric biological criteria. This effort requires the detailed evaluation of the components of wetland communities to determine the structure and function of unimpaired wetlands. Wetlands are important habitats for wildlife species. It is therefore also important to consider wildlife in developing criteria that protect the functions and values of

wetlands. During the next 3 years, the Office of Water Regulations and Standards is reviewing aquatic life water quality criteria to determine whether adjustments in the criteria and/or alternative forms of criteria (e.g., tissue concentration criteria) are needed to adequately protect wildlife species using wetland resources. EPA's Office of Water Regulations and Standards is also developing guidance for EPA and State surface water monitoring programs that will be issued by the end of FY 1990. Other technical guidance and support for the development of State water quality standards will be forthcoming from EPA in the next triennium.

Chapter 1.0

Introduction



Our understanding of the many benefits that wetlands provide has evolved rapidly over the last 20 to 30 years. Recently, programs have been developed to restore and protect wetland resources at the local, State, and Federal levels of government. At the Federal level, the President of the United States established the goal of "no net loss" of wetlands, adapted from the National Wetlands Policy Forum recommendations (The Conservation Foundation 1988). Applying water quality standards to wetlands is part of an overall effort to protect the Nation's wetland resources and provides a regulatory basis for a variety of programs for managing wetlands to meet this goal.

As the link between land and water, wetlands play a vital role in water quality management programs. Wetlands provide a wide array of functions including shoreline stabilization, nonpoint source runoff filtration, and erosion control, which directly benefit adjacent and downstream waters. In addition, wetlands provide important biological habitat, including nursery areas for aquatic life and wildlife, and other benefits such as groundwater recharge and recreation. Wetlands comprise a wide variety of aquatic vegetated systems including, but not limited to, sloughs, prairie potholes, wet meadows, bogs, fens, vernal pools, and marshes. The basic elements of water quality standards (WQS), including designated uses, criteria, and an antidegradation policy, provide a sound legal basis for protecting wetland resources through State water quality management programs.

Water quality standards traditionally have been applied to waters such as rivers, lakes, estuaries, and oceans, and have been applied tangentially, if at all, to wetlands by applying the same uses and criteria to wetlands as to adjacent perennial waters. Isolated wetlands not directly associated with perennial waters generally have not been addressed in State water quality standards. A recent review of State water quality standards (USEPA 1989d) shows that only half of the States specifically refer to wetlands, or use similar terminology, in their water quality standards. Even where wetlands are refer-

enced, standards may not be tailored to reflect the unique characteristics of wetlands.

Water quality standards specifically tailored to wetlands provide a consistent basis for the development of policies and technical procedures for managing activities that impact wetlands. Such water quality standards provide the goals for Federal and State programs that regulate discharges to wetlands, particularly those under CWA Sections 402 and 404 as well as other regulatory programs (e.g., Sections 307, 318, and 405) and nonregulatory programs (e.g., Sections 314, 319, and 320). In addition, standards play a critical role in the State 401 certification process by providing the basis for approving, conditioning, or denying Federal permits and licenses, as appropriate. Finally, standards provide a benchmark against which to assess the many activities that impact wetlands.

1.1 Objectives

The objective of this document is to assist States in applying their water quality standards regulations to wetlands in accordance with the *Agency Operating Guidance* (USEPA 1990a), which states:

> *By September 30, 1993, States and qualified Indian Tribes must adopt narrative water quality standards that apply directly to wetlands. Those Standards shall be established in accordance with either the National Guidance, Water Quality Standards for Wetlands...or some other scientifically valid method. In adopting water quality standards for wetlands, States and qualified Indian Tribes, at a minimum, shall: (1) define wetlands as "State waters"; (2) designate uses that protect the structure and function of wetlands; (3) adopt aesthetic narrative criteria (the "free froms") and appropriate numeric criteria in the standards to protect the designated uses; (4) adopt narrative biological criteria in the standards; and (5) extend the antidegradation policy and implementation methods to wetlands. Unless results of a use attainability analysis show that the section 101(a) goals cannot be achieved, States and qualified Indian Tribes shall designate uses for wetlands that provide for the protection of fish, shellfish, wildlife, and recreation. When extending the antidegradation policy and implementation methods to wetlands, consideration should be given to designating critical wetlands as Outstanding National Resource Waters. As necessary, the antidegradation policy should be revised to reflect the unique characteristics of wetlands.*

This level of achievement is based upon existing science and information, and therefore can be completed within the FY 91-93 triennial review cycle.

Initial development of water quality standards for wetlands over the next 3 years will provide the foundation for the development of more detailed water quality standards for wetlands in the future based on further research and policy development (see Chapter 7.0.). Activities defined in this guidance are referred to as "Phase 1 activities," while those to be developed over the longer term are referred to as "Phase 2 activities." Developing water quality standards is an iterative process.

This guidance is not regulatory, nor is it designed to dictate specific approaches needed in State water quality standards. The document addresses the minimum requirements set out in the Operating Guidance, and should be used as a guide to the modifications that may be needed in State standards. EPA recognizes that State water quality standards regulations vary greatly from State to State, as do wetland resources. This guidance suggests approaches that States may wish to use and allows for State flexibility and innovation.

1.2 Organization

Each chapter of this document provides guidance on a particular element of Phase 1 wetland water quality standards that EPA expects States to undertake during the next triennial review period (i.e., by September 30, 1993). For each chapter, a discussion of what EPA considers to be minimally acceptable is followed by subsections providing information that may be used to meet, and go beyond, the minimum requirements during Phase 1. Documents referenced in this guidance provide further information on specific topics and may be obtained from the sources listed in the "References" section. The following paragraphs introduce each of the chapters of this guidance.

Most wetlands fall within the definition of "waters of the U.S." and thus require water quality stand-

ards. EPA expects States by the end of FY 1993 to include wetlands in their definition of "State waters" consistent with the Federal definition of "waters of the U.S." Guidance on the inclusion of wetlands in the definition of "State waters" is contained in Chapter 2.0.

The application of water quality standards to wetlands requires that States designate appropriate uses consistent with Sections 101(a)(2) and 303(c)(2) of the Clean Water Act (CWA). EPA expects States by the end of FY 1993 to establish designated uses for all wetlands. Discussion of designated uses is contained in Chapter 3.0.

The WQS regulation (40 CFR 131) requires States to adopt water quality criteria sufficient to protect designated uses. EPA expects the States, by the end of FY 1993, to adopt aesthetic narrative criteria (the "free froms"), appropriate numeric criteria, and narrative biological criteria for wetlands. Narrative criteria are particularly important for wetlands, since many activities may impact upon the physical and biological, as well as chemical, components of water quality. Chapter 4.0 discusses the application of narrative and numeric criteria to wetlands.

EPA also expects States to fully apply antidegradation policies and implementation methods to wetlands by the end of FY 1993. Antidegradation can provide a powerful tool for the protection of wetlands, especially through the requirement for full protection of existing uses as well as the States' option of designating wetlands as outstanding national resource waters. Guidance on the application of State antidegradation policies to wetlands is contained in Chapter 5.0.

Many State water quality standards contain policies affecting the application and implementation of water quality standards (e.g., variances, mixing zones). Unless otherwise specified, such policies are presumed to apply to wetlands in the same manner as to other waters of the State. States should consider whether such policies should be modified to reflect the characteristics of wetlands. Guidance on the implementation of water quality standards for wetlands is contained in Chapter 6.0.

Application of standards to wetlands will be an iterative process; both EPA and the States will refine their approach based on new scientific information as well as experience developed through State programs. Chapter 7.0 outlines Phase 2 wetland standards activities for which EPA is planning additional research and program development.

1.3 Legal Authority

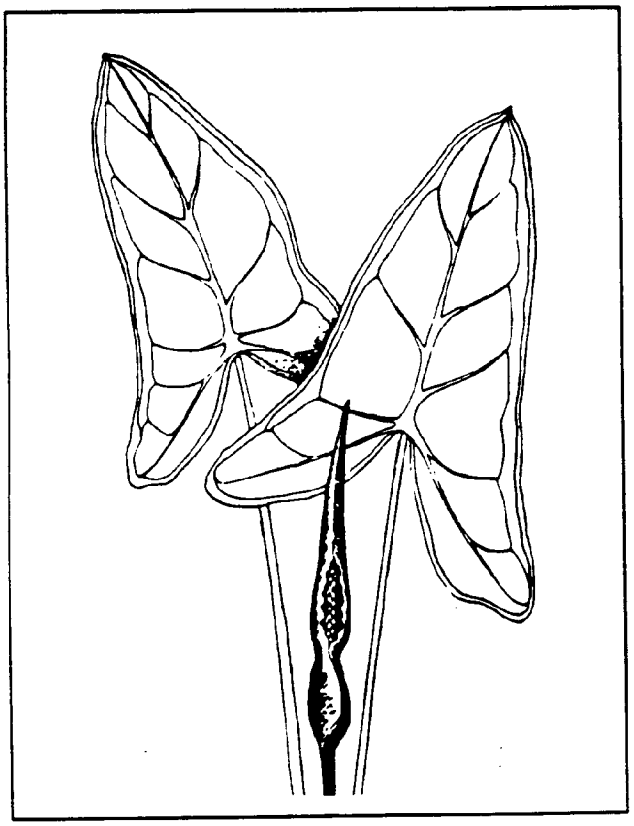
The Clean Water Act requires States to develop water quality standards, which include designated uses and criteria to support those uses, for "navigable waters." CWA Section 502(7) defines "navigable waters" as "waters of the U.S." "Waters of the U.S." are, in turn, defined in Federal regulations developed for the National Pollution Discharge Elimination System (40 CFR 122.2) and permits for the discharge of dredged or fill material (40 CFR 230.3 and 232.2). "Waters of the U.S." include waters subject to the ebb and flow of the tide; interstate waters (including interstate wetlands) and intrastate waters (including wetlands), the use, destruction, or degradation of which could affect interstate commerce; tributaries of the above; and wetlands adjacent to the above waters (other than waters which are themselves waters). See Appendix B for a complete definition.

> The term "wetlands" is defined in 40 CFR 232.2(r) 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.*

This definition of "waters of the U.S.," which includes most wetlands, has been debated in Congress and upheld by the courts. In 1977, a proposal to delete CWA jurisdiction over most wetlands for the purpose of the Section 404 permit program was defeated in the Senate. The debate on the amendment shows a strong congressional awareness of the value of wetlands and the importance of retaining them under the statutory scheme. Various courts have also upheld the application of the CWA to wetlands. See, e.g., *United States* v. *Riverside Bayview Homes*, 474 U.S. 121 (1985); *United States* v. *Byrd*, 609 F.2d 1204 (7th Cir. 1979); *Avoyelles Sportsmen's League* v. *Marsh*, 715 F.2d 897 (5th

Cir. 1983); *United States* v. *Leslie Salt* [1990 decision]. The practical effect is to make nearly all wetlands "waters of the U.S."

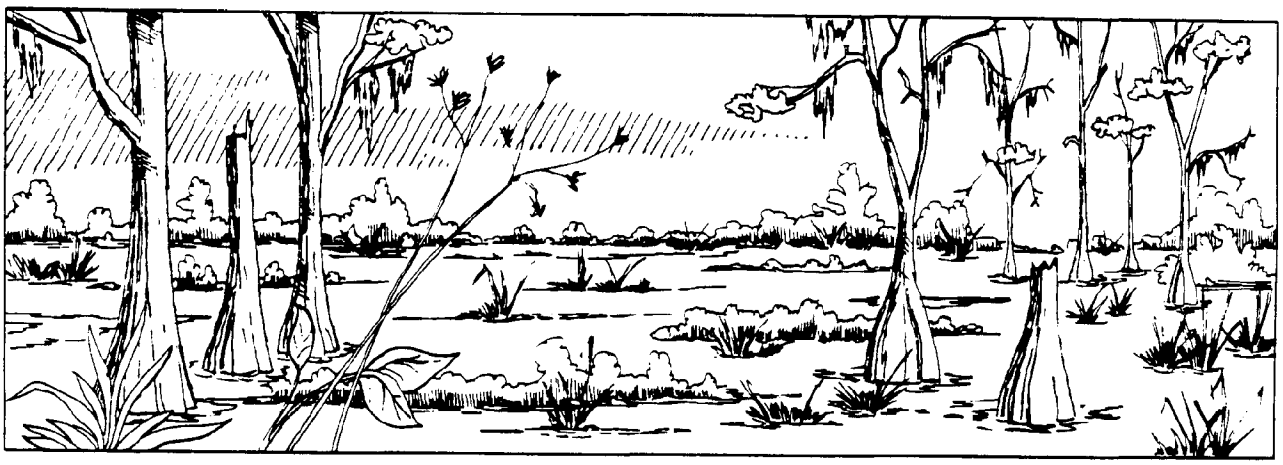
Created wastewater treatment wetlands[1] designed, built, and operated solely as wastewater treatment systems are generally not considered to be waters of the U.S. Water quality standards that apply to natural wetlands generally do not apply to such created wastewater treatment wetlands. Many created wetlands, however, are designed, built, and operated to provide, in addition to wastewater treatment, functions and values similar to those provided by natural wetlands. Under certain circumstances, such created multiple use wetlands may be considered waters of the U.S. and as such would require water quality standards. This determination must be made on a case-by-case basis, and may consider factors such as the size and degree of isolation of the created wetlands and other appropriate factors.



1 Different offices within EPA use different terminology (e.g., "create" or "constructed") to describe wastewater treatment wetlands. This terminology is evolving; for purposes of this guidance document, the terms are interchangeable in meaning.

Chapter 2.0

Inclusion of Wetlands in the Definition of State Waters



The first, and most important, step in applying water quality standards to wetlands is ensuring that wetlands are legally included in the scope of States' water quality standards programs. EPA expects States' water quality standards to include wetlands in the definition of "State waters" by the end of FY 1993. States may accomplish this by adopting a regulatory definition of "State waters" at least as inclusive as the Federal definition of "waters of the U.S." and by adopting an appropriate definition for "wetlands." For example, one State includes the following definitions in their water quality standards:

> *"Surface waters of the State"... means all streams,... lakes..., ponds, marshes, wetlands* or other waterways...
>
> *"Wetlands" means areas of land where the water table is at, near or above the land surface long enough each year to result in the formation of characteristically wet (hydric) soil types, and support the growth of water dependent (hydrophytic) vegetation. Wetlands include, but are not limited to, marshes, swamps, bogs, and other such low-lying areas.*

States may also need to remove or modify regulatory language that explicitly or implicitly limits the authority of water quality standards over wetlands. In certain instances, such as when water

quality standards are statutory or where a statute defines or limits regulatory authority over wetlands, statutory changes may be needed.

The CWA does not preclude States from adopting, under State law, a more expansive definition of "waters of the State" to meet the goals of the act. Additional areas that could be covered include riparian areas, floodplains, vegetated buffer areas, or any other critical areas identified by the State. Riparian areas and floodplains are important and severely threatened ecosystems, particularly in the arid and semiarid West. Often it is technically difficult to separate, jurisdictionally, wetlands subject to the provisions of the CWA from other areas within the riparian or floodplain complex.

States may choose to include riparian or floodplain ecosystems as a whole in the definition of "waters of the State" or designate these areas for special protection in their water quality standards through several mechanisms, including definitions, use classifications, and antidegradation. For example, the regulatory definition of "waters of the State" in one State includes:

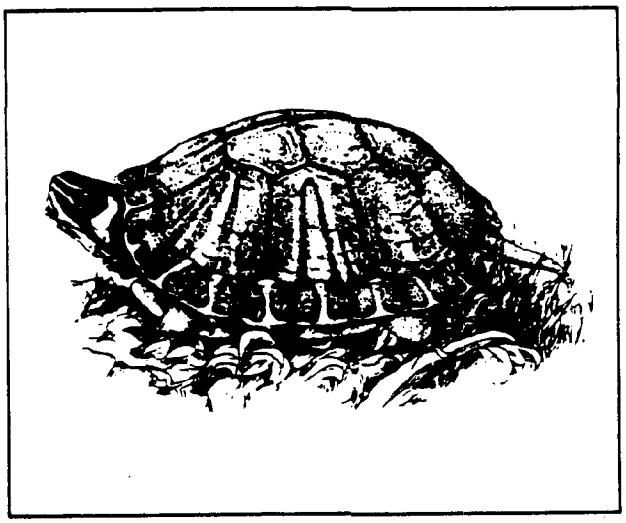
> *...The flood plain of free flowing waters determined by the Department...on the basis of the 100-year flood frequency.*

In another State, the definition of a use classification states:

> *This beneficial use is a combination of the characteristics of the watershed expressed in the water quality and the riparian area.*

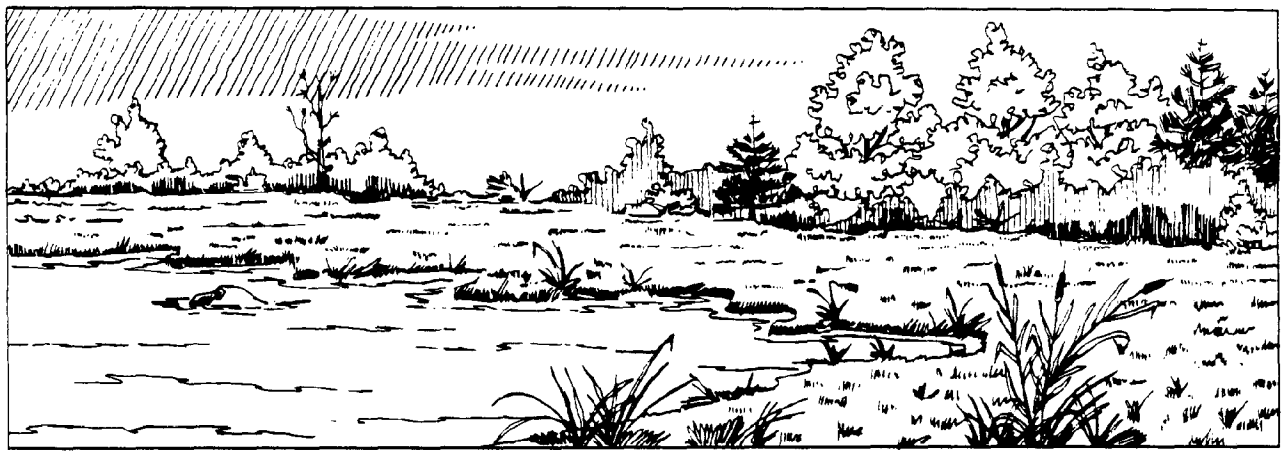
And in a third State, the antidegradation protection for high-quality waters provides that:

> These waters shall not be lowered in quality...unless it is determined by the commission that such lowering will not do any of the following:
>
> > *...[b]ecome injurious to the value or utility of riparian lands...*



Chapter 3.0

Use Classification



At a minimum, EPA expects States by the end of FY 1993 to designate uses for all wetlands, and to meet the same minimum requirements of the WQS regulation (40 CFR 131.10) that are applied to other waters. Uses for wetlands must meet the goals of Section 101(a)(2) of the CWA by providing for the protection and propagation of fish, shellfish, and wildlife and for recreation in and on the water, unless the results of a use attainability analysis (UAA) show that the CWA Section 101(a)(2) goals cannot be achieved. The Water Quality Standards Regulation (40 CFR 131.10(c)) allows for the designation of subcategories of a use, an activity that may be appropriate for wetlands. Pursuant to the WQS Regulation (40 CFR 131.10(i)), States must designate any uses that are presently being attained in the wetland. A technical support document is currently being developed by the Office of Water Regulations and Standards for conducting use attainability analyses for wetlands.

The propagation of aquatic life and wildlife is an attainable use in virtually all wetlands. Aquatic life protection need not refer only to year-round fish and aquatic life. Wetlands often provide valuable seasonal habitat for fish and other aquatic life, amphibians, and migratory bird reproduction and migration. States should ensure that aquatic life and wildlife uses are designated for wetlands even if a limited habitat is available or the use is attained only seasonally.

Recreation in and on the water, on the other hand, may not be attainable in certain wetlands that do not have sufficient water, at least seasonally. However, States are also encouraged to recognize and protect recreational uses that do not directly involve contact with water, e.g., hiking, camping, bird watching.

The WQS regulation requires a UAA wherever a State designates a use that does not include the uses specified in Section 101(a)(2) of the CWA; see 40 CFR Part 131.10(j). This need not be an onerous task for States when deciding whether certain recreational uses are attainable. States may conduct generic UAAs for entire classes or types of

wetlands based on the demonstrations in 40 CFR Part 131.10(g)(2). States must, however, designate CWA goal uses wherever these are attainable, even where attainment may be seasonal.

When designating uses for wetlands, States may choose to use their existing general and water-specific classification systems, or they may set up an entirely different system for wetlands. Each of these approaches has advantages and disadvantages, as discussed below.

Some States stipulate that wetlands are designated for the same uses as the adjacent waters. States may also apply their existing general classification system to designate uses for specific wetlands or groups of wetlands. The advantage of these approaches is that they do not require States to expend additional effort to develop specific wetland uses, or determine specific functions and values, and can be generally used to designate the CWA goal uses for wetlands. However, since wetland attributes may be significantly different than those of other waters, States with general wetland use designations will need to review the uses for individual wetlands in more detail when assessing activities that may impair the specific "existing uses" (e.g., functions and values). In addition, the "adjacent" approach does not produce uses for "isolated" wetlands.

Owing to these differences in attributes, States should strongly consider adopting a separate use classification system for wetlands based on wetland type and/or beneficial use (function and value). This approach initially requires more effort in developing use categories (and specific criteria that may be needed for them), as well as in determining what uses to assign to specific wetlands or groups of wetlands. The greater the specificity in designating uses, however, the easier it is for States to justify regulatory controls to protect those uses. States may wish to designate beneficial uses for individually named wetlands, including outstanding wetlands (see Section 6.3), although this approach may be practical only for a limited number of wetlands. For the majority of their wetlands, States may wish to designate generalized uses for groups of wetlands based on region or wetland type.

Two basic pieces of information are useful in classifying wetland uses: (1) the structural types of wetlands; and (2) the functions and values associated with such types of wetlands. The functions and values of wetlands are often defined based upon structural type and location within the landscape or watershed. The understanding of the various wetland types within the State and their functions and values provides the basis for a comprehensive classification system applicable to all wetlands and all wetland uses. As with other waters, both general and waterbody-specific classifications may be needed to ensure that uses are appropriately assigned to all wetlands in the State. Appropriate and definitive use designations allow water quality standards to more accurately reflect both the "existing" uses and the States' goals for their wetland resources, and to allow standards to be a more powerful tool in protecting State wetlands. Sections 3.1 through 3.3 provide further information on wetland types, functions, and values, and how these can be used to designate uses for wetlands.

3.1 Wetland Types

A detailed understanding of the various wetland types within the State provides the basis for a comprehensive classification system. The classification system most often cited and used by Federal and State wetland permit programs was developed by Cowardin et al. (1979) for the U.S. Fish and Wildlife Service (FWS); see Figure 1. This system provides the basis for wetland-related activities within the FWS. The Cowardin system is hierarchical and thus can provide several levels of detail in classifying wetlands. The "System" and "Subsystem" levels of detail appear to be the most promising for water quality standards. The "Class" level may be useful for designating uses for specific wetlands or wetland types. Section 3.3 gives an example of how one State uses the Cowardin system to generate designated uses for wetlands.

Under the Emergency Wetlands Resources Act of 1986, the FWS is required to complete the mapping of wetlands within the lower 48 States by 1998 through the National Wetlands Inventory (NWI) and to assess the status of the nation's wetland resources every 10 years. The maps and status and trend reports may help States understand the extent of their wetlands and wetland types and ensure that all wetlands are assigned appropriate uses. To date, over 30,000 detailed 1:24,000 scale maps have been completed, covering approximately 60 percent of

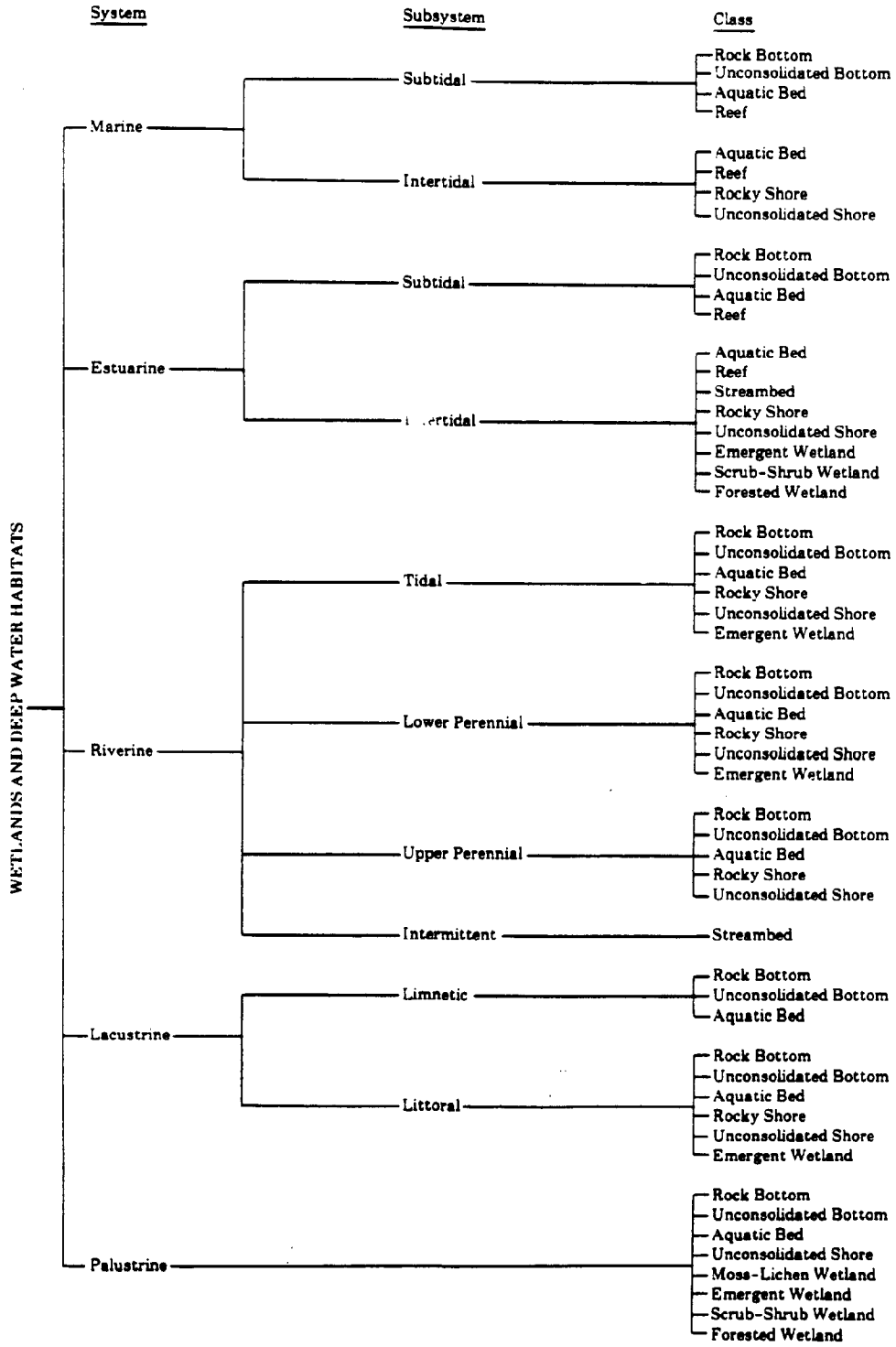


Figure 1. Classification hierarchy of wetlands and deepwater habitats, showing Systems, Subsystems, and Classes. The Palustrine System does not include deepwater habitats (from Cowardin et al., 1979).

the coterminous United States and 16 percent of Alaska[2].

In some States, wetland maps developed under the NWI program have been digitized and are available for use with geographic information systems (GIS). To date, more than 5,700 wetland maps representing 10.5 percent of the coterminous United States have been digitized. Statewide digital databases have been developed for New Jersey, Delaware, Illinois, Maryland, and Washington, and are in progress in Indiana and Virginia. NWI digital data files also are available for portions of 20 other States. NWI data files are sold at cost in 7.5-minute quadrangle units. The data are provided on magnetic tape in MOSS export, DLG3 optional, ELAS, and IGES formats[3]. Digital wetlands data may expedite assigning uses to wetlands for both general and wetland-specific FIC classifications.

The classification of wetlands may benefit from the use of salinity concentrations. The Cowardin classification system uses a salinity criterion of 0.5 ppt ocean-derived salinity to differentiate between estuarine and freshwater wetlands. Differences in salinity are reflected in the species composition of plants and animals. The use of salinity in the classification of wetlands may be useful in restricting activities that would alter the salinity of a wetland to such a degree that the wetland type would change. These activities include, for example, the construction of dikes to convert a saltwater marsh to a freshwater marsh or the dredging of channels that would deliver saltwater to freshwater wetlands.

3.2 Wetland Functions and Values

Many approaches have been developed for identifying wetland functions and values. Wetland evaluation techniques developed prior to 1983 have been summarized by Lonard and Clairain (1985), and EPA has summarized assessment methodologies developed since 1983 (see Appendix C). EPA has also developed guidance on the selection of a methodology for activities under the Section 404 program entitled *Draft Guidance to EPA Regional Offices on the Use of Advance Identification Authorities Under Section 404 of the Clean Water Act* (USEPA 1989a). States may develop their own techniques for assessing the functions and values of their wetlands.

General wetland functions that directly relate to the physical, chemical, and biological integrity of wetlands are listed below. The protection of these functions through water quality standards also may be needed to attain the uses of waters adjacent to, or downstream of, wetlands.

- Groundwater Recharge/Discharge
- Flood Flow Alteration
- Sediment Stabilization
- Sediment/Toxic Retention
- Nutrient Removal/Transformation
- Wildlife Diversity/Abundance
- Aquatic Diversity/Abundance
- Recreation

Methodologies that are flexible with regard to data requirements and include several levels of detail have the greatest potential for application to standards. One such methodology is the Wetland Evaluation Technique developed by Adamus, et al. (1987) for the U.S. Army Corps of Engineers and the

2 Information on the availability of draft and final maps may be obtained for the coterminous United States by calling 1-800-USA-MAPS or 703-860-6045 in Virginia. In Alaska, the number is 907-271-4159, and in Hawaii the number is 808-548-2861. Further information on the FWS National Wetlands Inventory (NWI) may be obtained from the FWS Regional Coordinators listed in Appendix D.

3 For additional information on digital wetland data contact: USFWS; National Wetlands Inventory Program, 9720 Executive Center Drive, Monroe Building, Suite 101, St. Petersburg, FL 33702; 813-893-3624, FTS 826-3624.

Department of Transportation. The Wetland Evaluation Technique was designed for conducting an initial rapid assessment of wetland functions and values in terms of social significance, effectiveness, and opportunity. Social significance assesses the value of a wetland to society in terms of its special designation, potential economic value, and strategic location. Effectiveness assesses the capability of a wetland to perform a function because of its physical, chemical, or biological characteristics. Opportunity assesses the [opportunity] of a wetland to perform a function to its level of capability. This assessment results in "high," "moderate," or "low" ratings for 11 wetland functions in the context of social significance, effectiveness, and opportunity. This technique also may be useful in identifying outstanding wetlands for protection under State antidegradation policies; see Section 5.3.

The FWS maintains a Wetlands Values Database that also may be useful in identifying wetland functions and in designating wetland uses. The data are keyed to the Cowardin-based wetland codes identified on the National Wetland Inventory maps. The database contains scientific literature on wetland functions and values. It is computerized and contains over 18,000 citations, of which 8,000 are annotated. For further information, contact the NWI Program (see Section 3.1) or the FWS National Ecology Research Center[4]. In addition, State wetland programs, EPA Regional wetland coordinators, and FWS Regional wetland coordinators can provide information on wetland functions and values on a State or regional basis; see Appendix D.

3.3 Designating Wetland Uses

The functions and values of specifically identified and named wetlands, including those identified within the State's water-specific classification system and outstanding national resource water (ONRW) category, may be defined using the Wetland Evaluation Technique or similar methodology. For the general classification of wetlands, however, States may choose to evaluate wetland function and values for all the wetlands within the State based on wetland type (using Cowardin (1979); see Figure 1). One State applies its general use classifications to different wetland types based on Cowardin's system level of detail as illustrated in Figure 2. Note that the State's uses are based on function, and the designation approach links specific wetland functions to a given wetland type. The State evaluates wetlands on a case-by-case basis as individual permit decisions arise to ensure that designated uses are being protected and have reflected existing uses.

4 USFWS; Wetlands Values Database, National Ecology Research Center, 4512 McMurray, Ft. Collins, CO 80522; 303-226-9407.

	WETLAND TYPE (Cowardin)				
BENEFICIAL USE	**MARINE**	**ESTUARINE**	**RIVERINE**	**LACUSTRINE**	**PALUSTRINE**
Municipal and Domestic Supply	-	-	x	x	x
Agricultural Supply	-	x	x	x	x
Industrial Process Supply	-	x	o	o	-
Groundwater Recharge	x	x	x	x	x
Freshwater Replenishment	-	-	x	x	x
Navigation	x	x	x	x	x
Water Contact Recreation	x	x	x	x	x
Non-Contact Water Recreation	x	x	x	x	x
Ocean Commercial and Sport Fishing	x	x	-	-	-
Warm Fresh Water Habitat	-	-	x	x	x
Cold Fresh Water Habitat	-	-	x	x	x
Preservation of Areas of Special Biological Significance	-	-	-	-	-
Wildlife Habitat	x	x	x	x	x
Preservation of Rare and Endangered Species	x	x	x	x	x
Marine Habitat	x	x	-	-	-
Fish Migration	x	x	x	x	-
Shellfish Harvesting	x	x	x	-	-
Estuarine Habitat	-	x	-	-	-

x = existing beneficial use
o = potential beneficial use

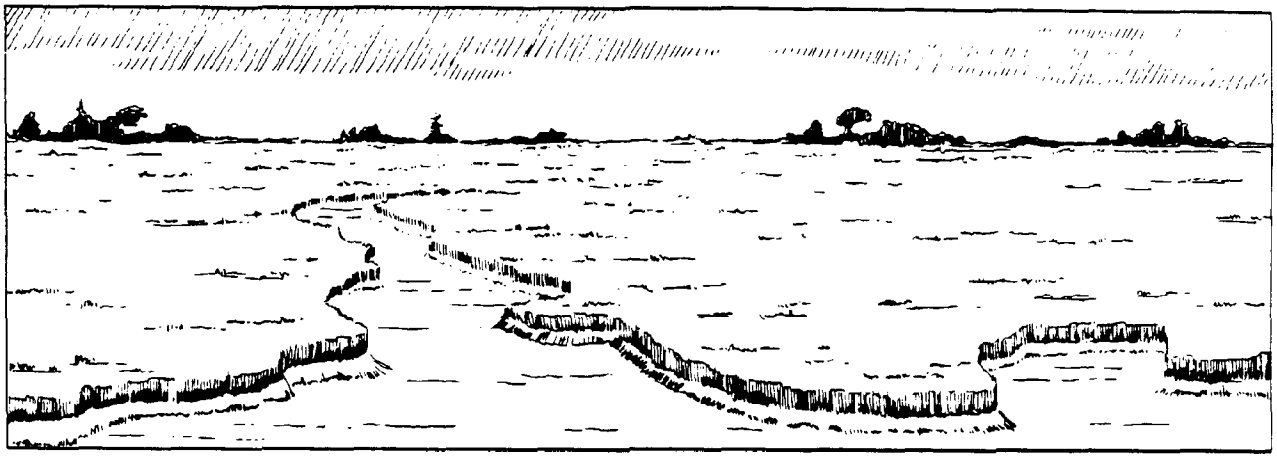
Figure 2. Example Existing and Potential Uses of Wetlands

Alternatively, a third method may use the location of wetlands within the landscape as the basis for establishing general functions and values applicable to all the wetlands within a defined region. EPA has developed a guidance entitled *Regionalization as a Tool for Managing Environmental Resources* (USEPA 1989c). The guidance illustrates how various regionalization techniques have been used in water quality management, including the use of the ecoregions developed by EPA's Office of Research and Development, to direct State water quality standards and monitoring programs. These approaches also may be useful in the classification of wetlands.

EPA's Office of Research and Development is currently refining a draft document that will provide useful information to States related to use classification methodologies (Adamus and Brandt - Draft). There are likely many other approaches for designating uses for wetlands, and the States are encouraged to develop comprehensive classification systems tailored to their wetland resources. As with other surface waters, many wetlands are currently degraded by natural and anthropogenic activities. The classification of wetlands should reflect the potential uses attainable for a particular wetland, wetland type, or class of wetland.

Chapter 4.0

Criteria



The Water Quality Standards Regulation (40 CFR 131.11(a)(1)) requires States to adopt criteria sufficient to protect designated uses. These criteria may include general statements (narrative) and specific numerical values (i.e., concentrations of contaminants and water quality characteristics). At a minimum, EPA expects States to apply aesthetic narrative criteria (the "free froms") and appropriate numeric criteria to wetlands and to adopt narrative biological criteria for wetlands by the end of FY 1993. Most State water quality standards already contain many criteria for various water types and designated use classes, including narrative criteria and numeric criteria to protect human health and freshwater and saltwater aquatic life, that may be applicable to wetlands.

In many cases, it may be necessary to use a combination of numeric and narrative criteria to ensure that wetland functions and values are adequately protected. Section 4.1 describes the application of narrative criteria to wetlands and Section 4.2 discusses application of numeric criteria for protection of human health and aquatic life.

4.1 Narrative Criteria

Narrative criteria are general statements designed to protect a specific designated use or set of uses. They can be statements prohibiting certain actions or conditions (e.g., "free from substances that produce undesirable or nuisance aquatic life") or positive statements about what is expected to occur in the water (e.g., "water quality and aquatic life shall be as it naturally occurs"). Narrative criteria are used to identify impacts on designated uses and as a regulatory basis for controlling a variety of impacts to State waters. Narrative criteria are particularly important in wetlands, since many wetland impacts cannot be fully addressed by numeric criteria. Such impacts may result from the discharge of chemicals for which there are no numeric criteria in State standards, from nonpoint sources, and from activities that may affect the physical and/or biological, rather than the chemical, aspects of water quality (e.g., discharge of dredged and fill material). The Water Quality Standards Regulation (40 CFR 131.11(b)) states that "States should...include narra-

tive criteria in their standards where numeric criteria cannot be established or to supplement numeric criteria."

4.1.1 General Narrative Criteria

Narrative criteria within the water quality standards program date back to at least 1968 when five "free froms" were included in *Water Quality Criteria* (the Green Book), (FWPCA 1968). These "free froms" have been included as "aesthetic criteria" in EPA's most recent Section 304(a) criteria summary document, *Quality Criteria for Water - 1986* (USEPA 1987a). The narrative criteria from these documents state:

All waters [shall be] free from substances attributable to wastewater or other discharge that:

(1) settle to form objectionable deposits;

(2) float as debris, scum, oil, or other matter to form nuisances;

(3) produce objectionable color, odor, taste, or turbidity;

(4) injure or are toxic or produce adverse physiological responses in humans, animals or plants; and

(5) produce undesirable or nuisance aquatic life.

The *Water Quality Standards Handbook* (USEPA 1983b) recommends that States apply narrative criteria to all waters of the United States. If these or similar criteria are already applied to all State waters in a State's standards, the inclusion of wetlands in the definition of "waters of the State" will apply these criteria to wetlands.

4.1.2 Narrative Biological Criteria

Narrative biological criteria are general statements of attainable or attained conditions of biological integrity and water quality for a given use designation. Narrative biological criteria can take a number of forms. As a sixth "free from," the criteria could read "free from activities that would substantially impair the biological community as it naturally occurs due to physical, chemical, and hydrologic changes," or the criteria may contain positive statements about the biological community existing or attainable in wetlands.

Narrative biological criteria should contain attributes that support the goals of the Clean Water Act, which provide for the protection and propagation of fish, shellfish, and wildlife. Therefore, narrative criteria should include specific language about community characteristics that (1) must exist in a wetland to meet a particular designated aquatic life/wildlife use, and (2) are quantifiable. Supporting statements for the criteria should promote water quality to protect the most natural community associated with the designated use. Mechanisms should be established in the standard to address potentially conflicting multiple uses. Narratives should be written to protect the most sensitive designated use and to support existing uses under State antidegradation policies.

In addition to other narrative criteria, narrative biological criteria provide a further basis for managing a broad range of activities that impact the biological integrity of wetlands and other surface waters, particularly physical and hydrologic modifications. For instance, hydrologic criteria are one particularly important but often overlooked component to include in water quality standards to help maintain wetlands quality. Hydrology is the primary factor influencing the type and location of wetlands. Maintaining appropriate hydrologic conditions in wetlands is critical to the maintenance of wetland functions and values. Hydrologic manipulations to wetlands have occurred nationwide in the form of flow alterations and diversions, disposal of dredged or fill material, dredging of canals through wetlands, and construction of levees or dikes. Changes in base flow or flow regime can severely alter the plant and animal species composition of a wetland, and destroy the entire wetland system if the change is great enough. States should consider the establishment of criteria to regulate hydrologic alterations to wetlands. One State has adopted the following language and criteria to maintain and protect the natural hydrologic conditions and values of wetlands:

Natural hydrological conditions necessary to support the biological and physical characteristics naturally present in wetlands shall be protected to prevent significant adverse impacts on:

(1) *Water currents, erosion or sedimentation patterns;*

(2) *Natural water temperature variations;*

(3) *The chemical, nutrient and dissolved oxygen regime of the wetland;*

(4) *The normal movement of aquatic fauna;*

(5) *The pH of the wetland; and*

(6) *Normal water levels or elevations.*

One source of information for developing more quantifiable hydrologic criteria is the Instream Flow Program of the U.S. Fish and Wildlife Service, which can provide technical guidance on the minimum flows necessary to attain various water uses.

Narrative criteria, in conjunction with antidegradation policies, can provide the basis for determining the impacts of activities (such as hydrologic modifications) on designated and existing uses. EPA has published national guidance on developing biological criteria for all surface waters (USEPA 1990b). EPA's Office of Research and Development also has produced a literature synthesis of wetland biomonitoring data on a State-by-State basis, which is intended to support the development of narrative biological criteria (Adamus and Brandt - Draft).

4.2 Numeric Criteria

Numeric criteria are specific numeric values for chemical constituents, physical parameters, or biological conditions that are adopted in State standards. These may be values not to be exceeded (e.g., toxics), values that must be exceeded (e.g., dissolved oxygen), or a combination of the two (e.g., pH). As with all criteria, numeric criteria are adopted to protect one or more designated uses. Under Section 304(a) of the Clean Water Act, EPA publishes numeric national criteria recommendations designed to protect aquatic organisms and human health. These criteria are summarized in *Quality Criteria for Water* - 1986 (USEPA 1987a). These criteria serve as guidelines from which States can develop their own numeric criteria, taking into account the particular uses designated by the State.

4.2.1 Numeric Criteria - Human Health

Human health water quality criteria are based on the toxicity of a contaminant and the amount of the contaminant consumed through ingestion of water and fish regardless of the type of water. Therefore, EPA's chemical-specific human health criteria are directly applicable to wetlands. A summary of EPA human health criteria recommendations is contained in *Quality Criteria for Water - 1986.*

Few wetlands are used directly for drinking water supplies. Where drinking water is a designated or existing use for a wetland or for adjacent waters affected by the wetland, however, States must provide criteria sufficient to protect human health based on water consumption (as well as aquatic life consumption if appropriate). When assessing the potential for water consumption, States should also evaluate the wetland's groundwater recharge function to assure protection of drinking water supplies from that source as well.

The application of human health criteria, based on consumption of aquatic life, to wetlands is a function of the level of detail in the States' designated uses. If all wetlands are designated under the State's general "aquatic life/wildlife" designation, consumption of that aquatic life is assumed to be an included use and the State's human health criteria based on consumption of aquatic life will apply throughout. However, States that adopt a more detailed use classification system for wetlands (or wish to derive site-specific human health criteria for wetlands) may wish to selectively apply human health criteria to those wetlands where consumption of aquatic life is designated or likely to occur (note that a UAA will be required where CWA goal uses are not designated). States may also wish to adjust the exposure assumptions used in deriving human health criteria. Where it is known that exposure to individuals at a certain site, or within a certain category of wetland, is likely to be different from the assumed exposure underlying the States' criteria, States may wish to consider a reasonable estimate of the actual exposure and take this estimate into account when calculating the criteria for the site.

4.2.2 Numeric Criteria - Aquatic Life

EPA develops chemical-specific numeric criteria recommendations for the protection of freshwater

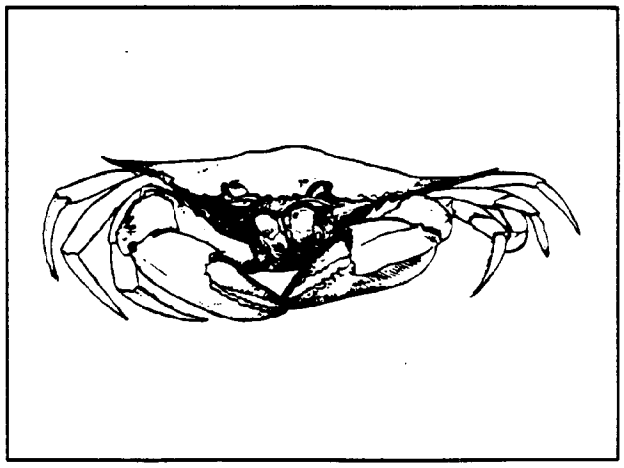
and saltwater aquatic life. These criteria may be divided into two basic categories: (1) chemicals that cause toxicity to aquatic life such as metals, ammonia, chlorine, and organics; and (2) other water quality characteristics such as dissolved oxygen, alkalinity, salinity, pH, and temperature. These criteria are currently applied directly to a broad range of surface waters in State standards, including lakes, impoundments, ephemeral and perennial rivers and streams, estuaries, the oceans, and in some instances, wetlands. A summary of EPA's aquatic life criteria recommendations is published in *Quality Criteria for Water - 1986*. The numeric aquatic life criteria, although not designed specifically for wetlands, were designed to be protective of aquatic life and are generally applicable to most wetland types.

EPA's aquatic life criteria are most often based upon toxicological testing under controlled conditions in the laboratory. The EPA guidelines for the development of such criteria (Stephan et al., 1985) require the testing of plant, invertebrate, and fish species. Generally, these criteria are supported by toxicity tests on invertebrate and early life stage fish commonly found in many wetlands. Adjustments based on natural conditions, water chemistry, and biological community conditions may be appropriate for certain criteria as discussed below. EPA's Office of Research and Development is currently finalizing a draft document that provides additional technical guidance on this topic, including site-specific adjustments of criteria (Hagley and Taylor - Draft).

As in other waters, natural water quality characteristics in some wetlands may be outside the range established for uses designated in State standards. These water quality characteristics may require the development of criteria that reflect the natural background conditions in a specific wetland or wetland type. States routinely set criteria for specific waters based on natural conditions. Examples of some of the wetland characteristics that may fall into this category are dissolved oxygen, pH, turbidity, color, and hydrogen sulfide.

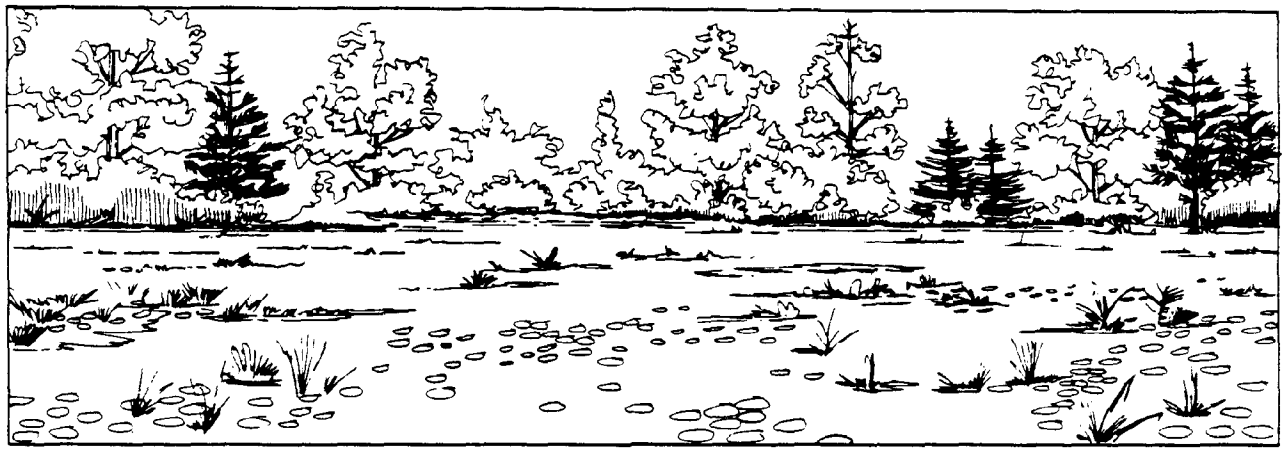
Many of EPA's aquatic life criteria are based on equations that take into account salinity, pH, temperature and/or hardness. These may be directly applied to wetlands in the same way as other water types with adjustments in the criteria to reflect these water quality characteristics. However, two national criteria that are pH dependent, ammonia and pentachlorophenol, present a different situation. The pH in some wetlands may be outside the pH range of 6.5-9.0 units for which these criteria were derived It is recommended that States conduct additional toxicity testing if they wish to derive criteria for ammonia and pentachlorophenol outside the 6.5-9.0 pH range, unless data are already available.

States may also develop scientifically defensible site-specific criteria for parameters whose Statewide values may be inappropriate. Site-specific adjustments may be made based on the water quality and biological conditions in a specific water, or in waters within a particular region or ecoregion. EPA has developed guidance on the site-specific adjustment of the national criteria (USEPA 1983b). These methods are applicable to wetlands and should be used in the same manner as States use them for other waters. As defined in the Handbook, three procedures may be used to develop site-specific criteria: (1) the recalculation procedures, (2) the indicator species procedures, and (3) the resident species procedures. These procedures may be used to develop site-specific numeric criteria for specific wetlands or wetland types. The recalculation procedure is used to make adjustments based upon differences between the toxicity to resident organisms and those used to derive national criteria. The indicator species procedure is used to account for differences in the bioavailability and/or toxicity of a contaminant based upon the physical and chemical characteristics of site water. The resident species procedure accounts for differences in both species sensitivity and water quality characteristics.



Chapter 5.0

Antidegradation



The antidegradation policies contained in all State standards provide a powerful tool for the protection of wetlands and can be used by States to regulate point and nonpoint source discharges to wetlands in the same way as other surface waters. In conjunction with beneficial uses and narrative criteria, antidegradation can be used to address impacts to wetlands that cannot be fully addressed by chemical criteria, such as physical and hydrologic modifications. The implications of antidegradation to the disposal of dredged and fill material are discussed in Section 5.1 below. At a minimum, EPA expects States to fully apply their antidegradation policies and implementation methods to wetlands by the end of FY 1993. No changes to State policies are required if they are fully consistent with the Federal policy. With the inclusion of wetlands as "waters of the State," State antidegradation policies and their implementation methods will apply to wetlands in the same way as other surface waters. The WQS regulation describes the requirements for State antidegradation policies, which include full protection of existing uses (functions and values), maintenance of water quality in high-quality waters, and a prohibition against lowering water quality in outstanding national resource waters. EPA guidance on the implementation of antidegradation policies is contained in the *Water Quality Standards Handbook* (USEPA 1983b) and *Questions and Answers on: Antidegradation* (USEPA 1985a).

5.1 Protection of Existing Uses

State antidegradation policies should provide for the protection of existing uses in wetlands and the level of water quality necessary to protect those uses in the same manner as for other surface waters; see Section 131.12(a)(1) of the WQS regulation. The existing use can be determined by demonstrating that the use or uses have actually occurred since November 28, 1975, or that the water quality is suitable to allow the use to be attained. This is the basis of EPA's antidegradation policy and is important in the wetland protection effort. States, especially those that adopt less detailed use classifications for wetlands, will need to use the existing use protection in their antidegradation policies to ensure protection of wetland values and functions.

Determination of an existing aquatic life and wildlife use may require physical, chemical, and biological evaluations through a waterbody survey and assessment. Waterbody survey and assessment guidance may be found in three volumes entitled *Technical Support Manual for Conducting Use Attainability Analyses* (USEPA 1983b, 1984a, 1984b). A technical support manual for conducting use attainability analyses for wetlands is currently under development by the Office of Water Regulations and Standards.

In the case of wetland fills, EPA allows a slightly different interpretation of existing uses under the antidegradation policy. This interpretation has been addressed in the answer to question no. 13 in *Questions and Answers on: Antidegradation* (USEPA 1985a), and is presented below:

> *Since a literal interpretation of the antidegradation policy could result in preventing the issuance of any wetland fill permit under Section 404 of the Clean Water Act, and it is logical to assume that Congress intended some such permits to be granted within the framework of the Act, EPA interprets 40 CFR 131.12(a)(I) of the antidegradation policy to be satisfied with regard to fills in wetlands if the discharge did not result in "significant degradation" to the aquatic ecosystem as defined under Section 230.10(c) of the Section 404(b)(I) guidelines. If any wetlands were found to have better water quality than "fishable/swimmable," the State would be allowed to lower water quality to the no significant degradation level as long as the requirements of Section 131.12(a)(2) were followed. As for the ONRW provision of antidegradation (131.12(a)(3)), there is no difference in the way it applies to wetlands and other waterbodies.*

The Section 404(b)(1) Guidelines state that the following effects contribute to significant degradation, either individually or collectively:

> *...significant adverse effects on (1) human health or welfare, including effects on municipal water supplies, plankton, fish, shellfish, wildlife, and special aquatic sites (e.g., wetlands); (2) on the life stages of aquatic life and other wildlife dependent on aquatic ecosystems, including the transfer, concentration or spread of pollutants or their byproducts beyond the site through biological, physical, or chemical process; (3) on ecosystem diversity, productivity and stability, including loss of fish and wildlife habitat or loss of the capacity of a wetland to assimilate nutrients, purify water or reduce wave energy; or (4) on recreational, aesthetic, and economic values.*

These Guidelines may be used by States to determine "significant degradation" for wetland fills. Of course, the States are free to adopt stricter requirements for wetland fills in their own antidegradation policies, just as they may adopt any other requirements more stringent than Federal law requires. For additional information on the linkage between water quality standards and the Section 404 program, see Section 6.2 of this guidance.

5.2 Protection of High-Quality Wetlands

State antidegradation policies should provide for water quality in "high quality wetlands" to be maintained and protected, as prescribed in Section 131.12(a)(2) of the WQS regulation. State implementation methods requiring alternatives analyses, social and economic justifications, point and nonpoint source control, and public participation are to be applied to wetlands in the same manner they are applied to other surface waters.

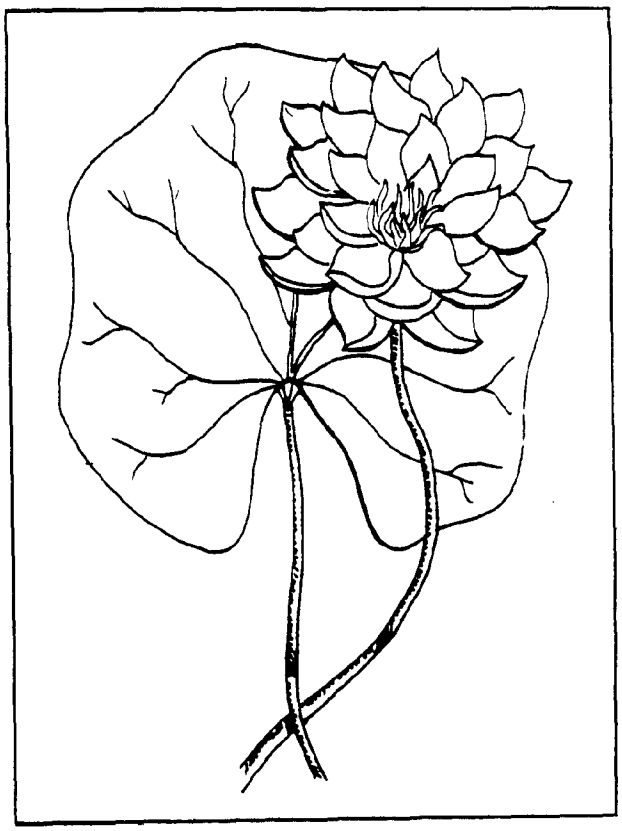
5.3 Protection of Outstanding Wetlands

Outstanding national resource waters (ONRW) designations offer special protection (i.e., no degradation) for designated waters, including wetlands. These are areas of exceptional water quality or recreational/ecological significance. State antidegradation policies should provide special protection to wetlands designated as outstanding national resource waters in the same manner as other surface waters; see Section 131.12(a)(3) of the WQS regulation and EPA guidance *Water Quality Standards Handbook* (USEPA 1983b), and *Questions and Answers on: Antidegradation* (USEPA 1985a). Activities that might trigger a State analysis of a wetland for possible designation as an ONRW are no different for wetlands than for other waters.

The following list provides general information on wetlands that are likely candidates for protection as ONRWs. It also may be used to identify specific wetlands for use designation under the State's wetland classification system; see Chapter 4.0. Some of these information sources are discussed in greater detail in EPA's guidance entitled *Wetlands and Section 401 Certification: Opportunities and Guidelines for States and Eligible Indian Tribes* (USEPA 1989f); see Section 6.1.

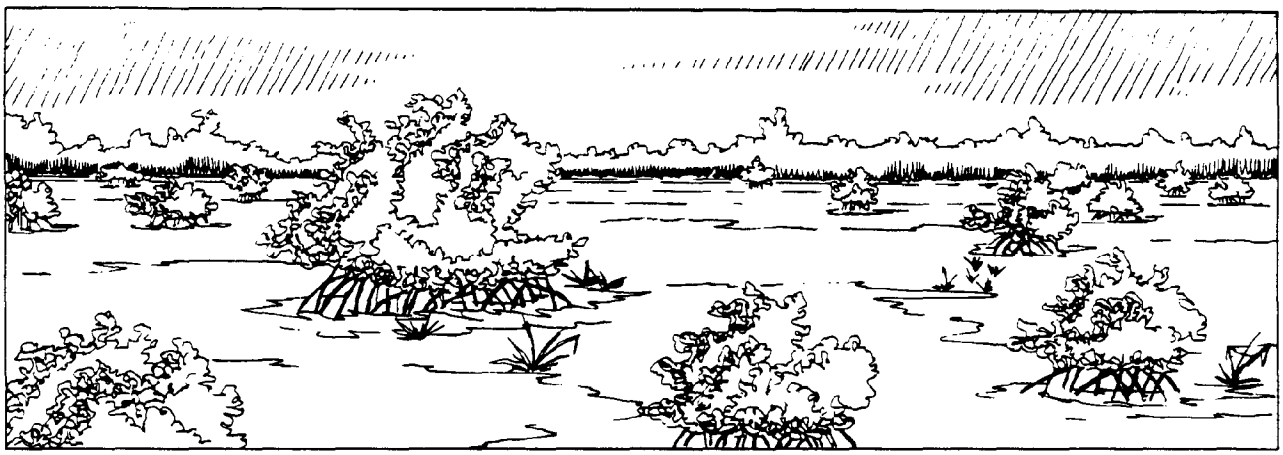
- Parks, wildlife management areas, refuges, wild and scenic rivers, and estuarine sanctuaries;
- Wetlands adjacent to ONRWs or other high-quality waters (e.g., lakes, estuaries shellfish beds);
- Priority wetlands identified under the Emergency Wetlands Resources Act of 1986 through Statewide Outdoor Recreation Plans (SORP) and Wetland Priority Conservation Plans;
- Sites within joint venture project areas under the North American Waterfowl Management Plan;
- Sites under the Ramsar (Iran) Treaty on Wetlands of International Importance;
- Biosphere reserve sites identified as part of the "Man and the Biosphere" Program sponsored by the United Nations;
- Natural heritage areas and other similar designations established by the State or private organizations (e.g., Nature Conservancy); and
- Priority wetlands identified as part of comprehensive planning efforts conducted at the local, State, Regional, or Federal levels of government; e.g., Advance Identification (ADID) program under Section 404 and Special Area Management Plans (SAMPs) under the 1980 Coastal Zone Management Act.

The Wetland Evaluation Technique; Volume II: Methodology (Adamus et al., 1987) provides additional guidance on the identification of wetlands with high ecological and social value; see Section 3.2.



Chapter 6.0

Implementation



Implementing water quality standards for wetlands will require a coordinated effort between related Federal and State agencies and programs. In addition to the Section 401 certification for Federal permits and licenses, standards have other potential applications for State programs, including landfill siting, fish and wildlife management and aquisition decisions, and best management practices to control nonpoint source pollution. Many coastal States have wetland permit programs, coastal zone management programs, and National Estuary Programs; and the development of water quality standards should utilize data, information and expertise from these programs. For all States, information and expertise is available nationwide from EPA and the Corps of Engineers as part of the Federal 404 permit program. State wildlife and fisheries departments can also provide data, advice, and expertise related to wetlands. Finally, the FWS can provide information on wetlands as part of the National Wetlands Inventory program, the Fish and Wildlife Enhancement Program, the Endangered Species and Habitat Conservation Program, the North American Waterfowl Management Program and the National Wildlife Refuge program. EPA and FWS wetland program contacts are included in Appendix D.

This section provides information on certain elements of standards (e.g., mixing zones) and the relationship between wetland standards and other water-related activities and programs (e.g., monitoring and CWA Sections 401, 402, 404, and 319). As information is developed by EPA and the States, EPA will periodically transfer it nationwide through workshops and program summaries. EPA's Office of Water Regulations and Standards has developed an outreach program for providing this information.

6.1 Section 401 Certification

Many States have begun to make more use of CWA Section 401 certification to manage certain activities that impact their wetland resources. Section 401 gives the States the authority to grant, deny, or condition certification of Federal permits or licenses (e.g., CWA Section 404 permits issued by the U.S. Army Corps of Engineers, Federal Energy

Regulatory Commission licenses, some Rivers and Harbors Act Sections 9 and 10 permits, and CWA Section 402 permits where issued by EPA) that may result in a discharge to "waters of the U.S." Such action is taken by the State to ensure compliance with various provisions of the CWA. Violation of water quality standards is often the basis for denials or conditioning through Section 401 certification. In the absence of wetland-specific standards, States have based decisions on their general narrative criteria and antidegradation policies. The Office of Wetlands Protection has developed a handbook for States entitled *Wetlands and 401 Certification: Opportunities and Guidelines for States and Eligible Indian Tribes* (USEPA 1989g) on the use of Section 401 certification to protect wetlands. This document provides several examples wherein States have applied their water quality standards to wetlands; one example is included in Appendix E.

The development of explicit water quality standards for wetlands, including wetlands in the definition of "State waters," uses, criteria, and antidegradation policies, can provide a strong and consistent basis for State 401 certifications.

6.2 Discharges to Wetlands

The Water Quality Standards Regulation (40 CFR 131.10(a)) states that, "in no case shall a State adopt waste transport or waste assimilation as a designated use for any 'waters of the U.S.'." This prohibition extends to wetlands, since they are included in the definition of "waters of the U.S." Certain activities involving the discharge of pollutants to wetlands may be permitted, as with other water types, providing a determination is made that the designated and existing uses of the wetlands and downstream waters will be maintained and protected. As with other surface waters, the State must ensure, through ambient monitoring, that permitted discharges to wetlands preserve and protect wetland functions and values as defined in State water quality standards; see Section 6.4.

Created wastewater treatment wetlands that are not impounded from waters of the United States and are designed, built, and operated solely as wastewater treatment systems, are a special case, and are not generally considered "waters of the U.S." Some such created wetlands, however, also provide other functions and values similar to those provided by natural wetlands. Under certain circumstances, such created, multiple use wetlands may be considered "waters of the U.S.," and as such, would be subject to the same protection and restrictions on use as natural wetlands (see *Report on the Use of Wetlands for Municipal Wastewater Treatment and Disposal* (USEPA 1987b)). This determination must be made on a case-by-case basis, and may consider factors such as the size and degree of isolation of the created wetland.

6.2.1 Municipal Wastewater Treatment

State standards should be consistent with the document developed by the Office of Municipal Pollution Control entitled *Report on the Use of Wetlands for Municipal Wastewater Treatment and Disposal* (USEPA 1987b), on the use of wetlands for municipal wastewater treatment. This document outlines minimum treatment and other requirements under the CWA for discharges to natural wetlands and those specifically created and used for the purpose of wastewater treatment.

The following is a brief summary of the above-referenced document. For municipal discharges to natural wetlands, a minimum of secondary treatment is required, and applicable water quality standards for the wetland and adjacent waters must be met. Natural wetlands are nearly always "waters of the U.S." and are afforded the same level of protection as other surface waters with regard to standards and minimum treatment requirements. There are no minimum treatment requirements for wetlands created solely for the purpose of wastewater treatment that do not qualify as "waters of the U.S." The discharge from the created wetlands that do not qualify as "waters of the U.S." must meet applicable standards for the receiving water. EPA encourages the expansion of wetland resources through the creation of engineered wetlands while allowing the use of natural wetlands for wastewater treatment only under limited conditions. Water quality standards for wetlands can prevent the misuse and overuse of natural wetlands for treatment through adoption of proper uses and criteria and application of State antidegradation policies.

6.2.2 Stormwater Treatment

Stormwater discharges to wetlands can provide an important component of the freshwater supply to wetlands. However, stormwater discharges from

various land use activities can also contain a significant amount of pollutants. Section 402(p)(2) of the Clean Water Act requires that EPA, or States with authorized National Pollutant Discharge Elimination System (NPDES) programs, issue NPDES permits for certain types of stormwater discharges. EPA is in the process of developing regulations defining the scope of this program as well as developing permits for these discharges. Stormwater permits can be used to require controls that reduce the pollutants discharged to wetlands as well as other waters of the United States. In addition, some of the stormwater management controls anticipated in permits will require creation of wetlands or structures with some of the attributes of wetlands for the single purpose of water treatment.

EPA anticipates that the policy for stormwater discharges to wetlands will have some similarities to the policies for municipal wastewater discharges to wetlands. Natural wetlands are "waters of the United States" and are afforded a level of protection with regard to water quality standards and technology-based treatment requirements. The discharge from created wetlands must meet applicable water quality standards for the receiving waters. EPA will issue technical guidance on permitting stormwater discharges, including permitting stormwater discharges to wetlands, over the next few years.

6.2.3 Fills

Section 404 of the CWA regulates the discharge of dredged and fill material into "waters of the U.S." The Corps of Engineers' regulations for the 404 program are contained in 33 CFR Parts 320-330, while EPA's regulations for the 404 program are contained in 40 CFR Part 230-33.

One State uses the following guidelines for fills in their internal Section 401 review guidelines:

(a) *if the project is not water dependent, certification is denied;*

(b) *if the project is water dependent, certification is denied if there is a viable alternative (e.g., available upland nearby is a viable alternative);*

(c) *if no viable alternatives exist and impacts to wetland cannot be made acceptable through conditions on certification (e.g., fish movement criteria, creation of floodways to bypass oxbows, flow through criteria), certification is denied.*

Some modification of this may be incorporated into States' water quality standards. The States are encouraged to provide a linkage in their water quality standards to the determination of "significant degradation" as required under EPA guidelines (40 CFR 230.10(c)) and other applicable State laws affecting the disposal of dredged or fill materials in wetlands; see Section 5.1.

6.2.4 Nonpoint Source Assessment and Control

Wetlands, as with other waters, are impacted by nonpoint sources of pollution. Many wetlands, through their assimilative capacity for nutrients and sediment, also can serve an important water quality control function for nonpoint source pollution effects on waters adjacent to, or downstream of, the wetlands. Water quality standards play a pivotal role in both of the above. First, Section 319 of the CWA requires the States to complete assessments of nonpoint source (NPS) impacts to State waters, including wetlands, and to prepare management programs to control NPS impacts. Water quality standards for wetlands can form the basis for these assessments and management programs for wetlands. Second, water quality standards requirements for other surface waters such as rivers, lakes, and estuaries can provide an impetus for States to protect, enhance, and restore wetlands to help achieve nonpoint source control and water quality standards objectives for adjacent and downstream waters. The Office of Water Regulations and Standards and the Office of Wetlands Protection have developed guidance on the coordination of wetland and NPS control programs entitled *National Guidance - Wetlands and Nonpoint Source Control Programs* (USEPA 1990c).

6.3 Monitoring

Water quality management activities, including the permitting of wastewater and stormwater discharges, the assessment and control of NPS pollution, and waste disposal activities (sewage sludge, CERCLA, RCRA) require sufficient monitoring to ensure that the designated and existing uses of "waters of the U.S." are maintained and protected. In addition, Section 305(b) of the CWA requires

States to report on the overall status of their waters in attaining water quality standards. The inclusion of wetlands in water quality standards provides the basis for conducting both wetland-specific and status and trend monitoring of State wetland resources. Information gathered from the 305(b) reports may also be used to update and refine the designated wetland uses. The monitoring of wetlands is made difficult by limitations in State resources. Where regulated activities impact wetlands or other surface waters, States should provide regulatory incentives and negotiate monitoring responsibilities of the party conducting the regulated activity.

Monitoring of activities impacting specific wetlands may include several approaches. Monitoring methods involving biological measurements, such as plant, macroinvertebrate, and fish (e.g., biomass and diversity indices), have shown promise for monitoring stream quality (Plafkin et al., 1989). These types of indicators have not been widely tested for wetlands; see Section 7.1. However, the State of Florida has developed biological criteria as part of their regulations governing the discharge of municipal wastewater to wetlands[5]. The States are encouraged to develop and test the use of biological indicators. Other more traditional methods currently applied to other surface waters, including but not limited to the use of water quality criteria, sediment quality criteria, and whole effluent toxicity, are also available for conducting monitoring of specific wetlands.

Discharges involving persistent or bioaccumulative contaminants may necessitate the monitoring of the fate of such contaminants through wetlands and their impacts on aquatic life and wildlife. The exposure of birds and mammals to these contaminants is accentuated by the frequent use of wetlands by wildlife and the concentration of contaminants in wetlands through sedimentation and other processes. States should conduct monitoring of these contaminants in wetlands, and may require such monitoring as part of regulatory activities involving these contaminants.

Status and trend monitoring of the wetland resources overall may require additional approaches; see Section 3.1. Given current gaps in scientific knowledge concerning indicators of wetland quality, monitoring of wetlands over the next few years may focus on the spatial extent (i.e., quantity) and physical structure (e.g., plant types, diversity, and distribution) of wetland resources. The tracking of wetland acreage and plant communities using aerial photography can provide information that can augment the data collected on specific activities impacting wetlands, as discussed above.

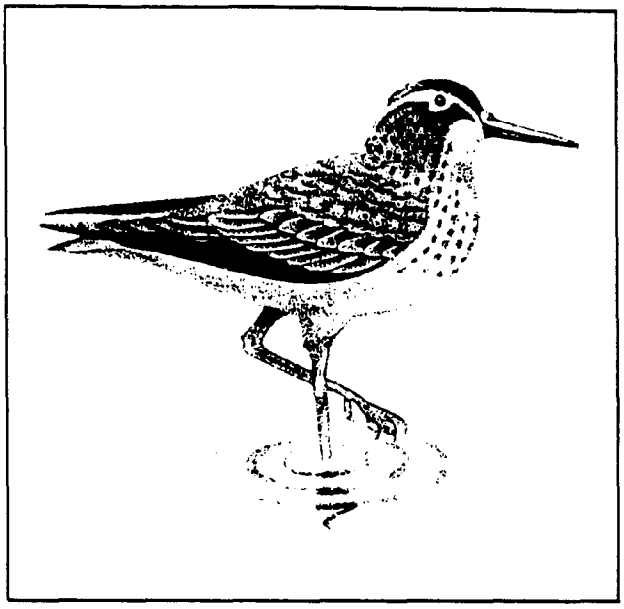
EPA has developed guidance on the reporting of wetland conditions for the Section 305(b) program entitled *Guidelines for the Preparation of the 1990 State Water Quality Assessment 305(b) Report* (USEPA 1989b). When assessing individual specific wetlands, assessment information should be managed in an automated data system compatible with the Section 305(b) Waterbody System. In addition, the NWI program provides technical procedures and protocols for tracking the spatial extent of wetlands for the United States and subregions of the United States. These sources provide the framework for reporting on the status and trends of State wetland resources.

6.4 Mixing Zones and Variances

The guidance on mixing zones in the *Water Quality Standards Handbook* (USEPA 1983b) and the *Technical Support Document for Water Quality-Based Toxics Control* (TSD) (USEPA 1985b) apply to all surface waters, including wetlands. This includes the point of application of acute and chronic criteria. As with other surface waters, mixing zones may be granted only when water is present, and may be developed specifically for different water types. Just as mixing zone procedures are often different for different water types and flow regimes (e.g., free flowing streams versus lakes and estuaries), separate procedures also may be developed specifically for wetlands. Such procedures should meet the requirements contained in the TSD.

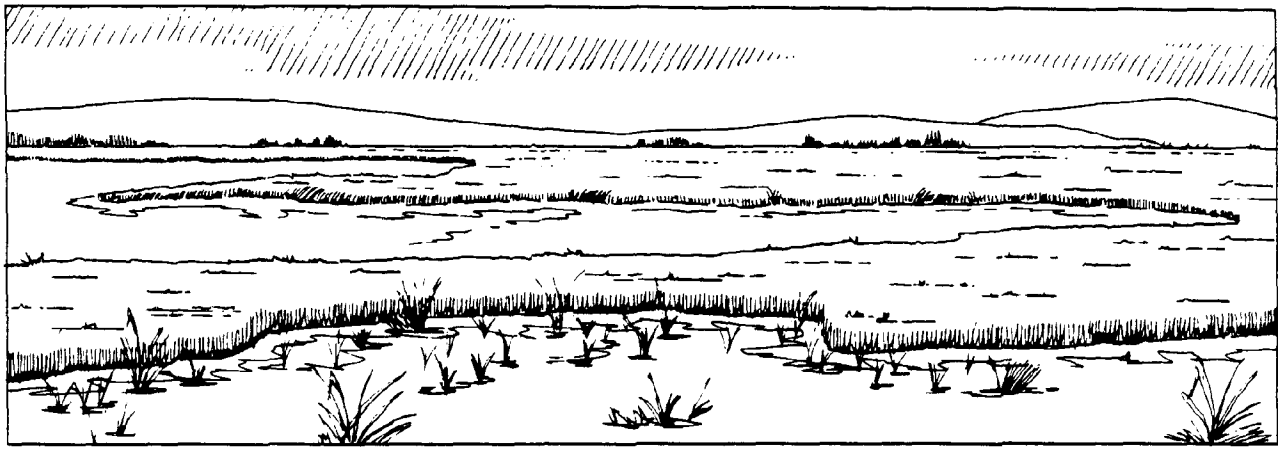
5 Florida Department of Environmental Regulations; State Regulations Part I, "Domestic Wastewater Facilities," Subpart C, "Design/Performance Considerations," 17-6.055, "Wetlands Applications."

As in other State waters, variances may be granted to discharges to wetlands. Variances must meet one or more of the six requirements for the removal of a designated use (40 CFR Part 131.10(g)) and must fully protect any existing uses of the wetland.



Chapter 7.0

Future Directions



EPA's Office of Water Regulations and Standards' planning document *Water Quality Standards Framework* (USEPA - Draft 1989e), identifies the major objectives for the program and the activities necessary to meet these objectives. Activities related to the development of water quality standards for wetlands are separated into two phases: (1) Phase 1 activities to be developed by the States by the end of FY 1993, discussed above; and (2) Phase 2 activities that will require additional research and program development, which are discussed below.

7.1 Numeric Biological Criteria for Wetlands

Development of narrative biological criteria is included in the first phase of the development of water quality standards for wetlands; see Section 5.1.2. The second phase involves the implementation of numeric biological criteria. This effort requires the detailed evaluation of the components of wetland communities to determine the structure and function of unimpaired wetlands. These measures serve as reference conditions for evaluating the integrity of other wetlands. Regulatory activities involving discharges to wetlands (e.g., CWA Sections 402 and 404) can provide monitoring data to augment data collected by the States for the development of numeric biological criteria; see Section 7.4. The development of numeric biological criteria for wetlands will require additional research and field testing over the next several years.

Biological criteria are based on local and regional biotic characteristics. This is in contrast to the nationally based chemical-specific aquatic life criteria developed by EPA under controlled laboratory conditions. The States will have primary responsibility for developing and implementing biological criteria for their surface waters, including wetlands, to reflect local and regional differences in resident biological communities. EPA will work closely with the States and the EPA Office of Research and Development to develop and test numeric biological criteria for wetlands. Updates on this work will be provided through the Office of Water Regulations

and Standards, Criteria and Standards Division's regular newsletter.

7.2 Wildlife Criteria

Wetlands are important habitats for wildlife species. It is therefore important to consider wildlife in developing criteria that protect the functions and values of wetlands. Existing chemical-specific aquatic life criteria are derived by testing selected aquatic organisms by exposing them to contaminants in water. Although considered to be protective of aquatic life, these criteria often do not account for the bioaccumulation of these contaminants, which may cause a major impact on wildlife using wetland resources. Except for criteria for PCB, DDT, selenium, and mercury, wildlife have not been included during the development of the national aquatic life criteria.

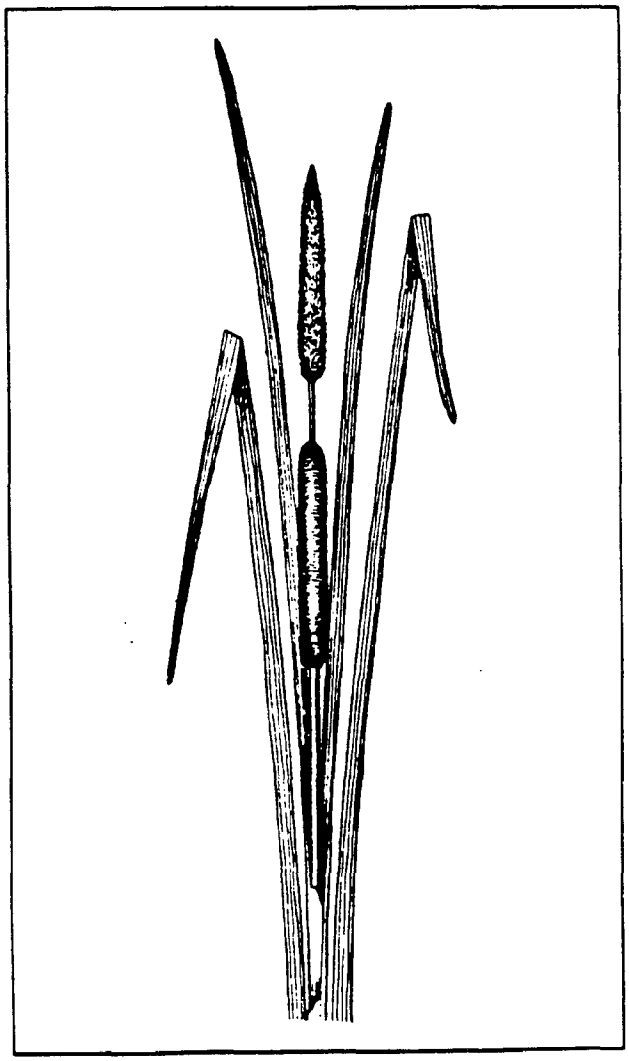
During the next 3 years, the Office of Water Regulations and Standards is reviewing aquatic life water quality criteria to determine whether adjustments in the criteria and/or alternative forms of criteria (e.g., tissue concentration criteria) are needed to adequately protect wildlife species using wetland resources. Since wetlands may not have open surface waters during all or parts of the year, alternative tissue based criteria based on contaminant concentrations in wildlife species and their food sources may become important criteria for evaluating contaminant impacts in wetlands, particularly those that bioaccumulate. Based on evaluations of current criteria and wildlife at risk in wetlands, national criteria may be developed.

7.3 Wetlands Monitoring

EPA's Office of Water Regulations and Standards is developing guidance for EPA and State surface water monitoring programs that will be issued by the end of FY 1990. This guidance will (1) encourage States to use monitoring data in a variety of program areas to support water quality management decisions; and (2) provide examples of innovative monitoring techniques through the use of case studies. The uses of data pertinent to wetlands that will be discussed include the following:

- refining use classification systems by developing physical, chemical, and biological water quality criteria, goals, and standards that account for regional variation in attainable conditions;
- identifying high-quality waters deserving special protection;
- using remote-sensing data;
- using integrated assessments to detect subtle ecological impacts; and
- identifying significant nonpoint sources of pollution that will prevent attainment of uses.

One or more case studies will address efforts to quantify the extent of a State's wetlands and to identify sensitive wetlands through their advance identification (USEPA 1989a).



References

Adamus, P.R., E.J. Clairain Jr., R.D. Smith, and R.E. Young. 1987. Wetland Evaluation Technique (WET); Volume II: Methodology. Operational Draft Technical Report Y-87; U.S. Army Engineers Waterways Experiment Station, Vicksburg, MS. (Source #11)

Adamus, P.R. and K. Brandt. Draft. Impacts on Quality of Inland Wetlands of the United States: A Survey of Techniques, Indicators, and Applications of Community-level Biomonitoring Data. USEPA Environmental Research Laboratory, Corvallis, OR. (Source #8)

The Conservation Foundation. 1988. Protecting America's Wetlands: An Action Agenda, The Final Report of the National Wetlands Policy Forum. Washington, DC. (Source #10)

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States, U.S. Fish and Wildlife Service, Washington, DC. FWS/OBS-79/31. (Source #6a)

Federal Water Pollution Control Administration. 1968. Water Quality Criteria (the Green Book), Report of the National Technical Advisory Committee to the Secretary of the Interior. U.S. Department of the Interior, Washington, DC. (out of print).

Hagley, C.A. and D.L. Taylor. Draft. An Approach for Evaluating Numeric Water Quality Criteria for Wetlands Protection. USEPA Environmental Research Laboratory, Duluth, MN. (Source #12)

Lonard, R.I. and E.J. Clairain. 1986. Identification of Methodologies for the Assessment of Wetland Functions and Values, Proceeding of the National Wetland Assessment Symposium, Association of Wetland Managers, Berne, NY. pp. 66-72. (Source #1)

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers, USEPA, Office of Water Regulations and Standards. EPA/444/4-89/001. (Source #2)

Stephan, C.E., D.I. Mount, D.J. Hansen, J.H. Gentile, G.A. Chapman, and W.A. Brungs. 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses. USEPA, Office of Research and Development, Duluth, MN. NTIS# PB-85-227049. (Source #3)

U.S. Environmental Protection Agency. 1983a. Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses. Office of Water Regulations and Standards, Washington, DC. (Source #4)

_____. 1983b. Water Quality Standards Handbook. Office of Water Regulations and Standards, Washington, DC. (Source #4)

_____. 1984a. Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses. Vol II. Estuarine Systems. Office of Water Regulations and Standards, Washington, DC. (Source #4)

_____. 1984b. Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses. Vol III. Lake Systems. Office of Water Regulations and Standards, Washington, DC. (Source #4)

_____. 1985a. Questions and Answers on: Antidegradation. Office of Water Regulations and Standards, Washington, DC. (Source #4)

_____. 1985b. Technical Support Document for Water Quality-based Toxics Control. Office of Water Enforcement and Permits, Washington, DC. (Source #5)

_____. 1987a. Quality Criteria for Water - 1986. Office of Water Regulations and Standards, Washington, DC. EPA 440/5-86-001. (Source #6b)

_____. 1987b. Report on the Use of Wetlands for Municipal Wastewater Treatment and Disposal. Office of Municipal Pollution Control, Washington, DC. (with Attachment D, September 20, 1988). EPA 430/09-88-005. (Source #9)

_____. 1989a. Guidance to EPA Regional Offices on the Use of Advanced Identification Authorities Under Section 404 of the Clean Water Act. Office of Wetlands Protection, Washington, DC. (Source #1)

_____. 1989b. Guidelines for the Preparation of the 1990 State Water Quality Assessment (305(b) Report). Office of Water Regulations and Standards, Washington, DC. (Source #2)

_____. 1989c. Regionalization as a Tool for Managing Environmental Resources. Office of Research and Development, Corvallis, OR. EPA/600/3-89/060. (Source #8)

_____. 1989d. Survey of State Water Quality Standards for Wetlands. Office of Wetlands Protection, Washington, D.C. (Source #1)

_____. 1989e. Water Quality Standards Framework (draft). Office of Water Regulations and Standards, Washington, DC. (Source #4)

_____. 1989f. Wetland Creation and Restoration: The Status of the Science. Office of Research and Development, Corvallis, OR. EPA 600/3-89/038a and EPA 600/3-89/038b. (Source #8)

_____. 1989g. Wetlands and 401 Certification: Opportunities and Guidelines for States and Eligible Indian Tribes. Office of Wetlands Protection, Washington, DC. (Source #1)

_____. 1990a. Agency Operating Guidance, FY 1991: Office of Water. Office of the Administrator, Washington, DC. (Source #7)

_____. 1990b. Biological Criteria, National Program Guidance for Surface Waters. Office of Water Regulations and Standards, Washington, DC. EPA 440/5-90-004. (Source #4)

_____. 1990c. National Guidance, Wetlands and Nonpoint Source Control Programs. Office of Water Regulations and Standards, Washington, DC. (Source #2)

Sources of Documents

1 USEPA, Office of Wetlands Protection
Wetlands Strategies and State Programs Division
401 M St., S.W. (A-104F)
Washington, DC 20460
(202) 382-5048

2 USEPA, Office of Water Regulations and Standards
Assessment and Watershed Protection Division
401 M St., S.W. (WH-553)
Washington, DC 20460
(202) 382-7040

3 National Technical Information Service (NTIS)
5285 Front Royal Road
Springfield, VA 22116
(703) 487-4650

4 USEPA, Office of Water Regulations and Standards
Criteria and Standards Division
401 M St., S.W. (WH-585)
Washington, DC 20460
(202) 475-7315

5 Out of print. A revised Technical Support Document for Water Quality-based Toxics Control will be available October 1990 from:
Office of Water Enforcement and Permits
Permits Division
401 M St., S.W. (EN-336)
Washington, DC 20460

6 U.S. Government Printing Office
North Capitol St., N.W.
Washington, DC 20401
(202) 783-3238
a Order No. 024-010-00524-6
b Order No. 955-002-0000-8

7 USEPA, Water Policy Office
401 M St., S.W. (WH-556)
Washington, DC 20460
(202) 382-5818

8 USEPA, Office of Research and Development
Environmental Research Laboratory
200 SW 35th St.
Corvallis, OR 97333
(503) 420-4666

9 USEPA, Office of Municipal Pollution Control
401 M St., S.W. (WH-546)
Washington, DC 20460
(202) 382-5850

10 The Conservation Foundation
1250 Twenty-Fourth St., N.W.
Washington, DC 20037
(202) 293-4800

11 U.S. Army, Corps of Engineers
Wetlands Research Program
(601) 634-3774

12 USEPA, Office of Research and Development
Environmental Research Laboratory
Duluth, MN 55804
(218) 780-5549

Appendix A

Glossary

Ambient Monitoring - Monitoring within natural systems (e.g., lakes, rivers, estuaries, wetlands) to determine existing conditions.

Created Wetland - A wetland at a site where it did not formerly occur. Created wetlands are designed to meet a variety of human benefits including, but not limited to, the treatment of water pollution discharges (e.g., municipal wastewater, stormwater) and the mitigation of wetland losses permitted under Section 404 of the Clean Water Act. This term encompasses the term "constructed wetland" as used in other EPA guidance and documents.

Enhancement - An activity increasing one or more natural or artificial wetland functions. For example, the removal of a point source discharge impacting a wetland.

Functions - The roles that wetlands serve, which are of value to society or the environment.

Habitat - The environment occupied by individuals of a particular species, population, or community.

Hydrology - The science dealing with the properties, distribution, and circulation of water both on the surface and under the earth.

Restoration - An activity returning a wetland from a disturbed or altered condition with lesser acreage or functions to a previous condition with greater wetland acreage or functions. For example, restoration might involve the plugging of a drainage ditch to restore the hydrology to an area that was a wetland before the installation of the drainage ditch.

Riparian - Areas next to or substantially influenced by water. These may include areas adjacent to rivers, lakes, or estuaries. These areas often include wetlands.

Upland - Any area that does not qualify as wetland because the associated hydrologic regime is not sufficiently wet to elicit development of vegetation, soils and/or hydrologic characteristics associated with wetlands, or is defined as open waters.

Waters of the U.S. - See Appendix B for Federal definition; 40 CFR Parts 122.2, 230.3, and 232.2.

Wetlands - Those areas that are inundated or saturated by surface or groundwater 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. See Federal definition contained in Federal regulations: 40 CFR Parts 122.2, 230.3, and 232.2.

Appendix B

The Federal definition of "waters of the United States" (40 CFR Section 232.2(q)) is:

(1) All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;

(2) All interstate waters including interstate wetlands;

(3) All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which would or could affect interstate or foreign commerce including any such waters:

(i) Which are or could be used by interstate or foreign travelers for recreational or other purposes; or
(ii) From which fish or shellfish could be taken and sold in interstate or foreign commerce;
(iii) Which are used or could be used for industrial purposes by industries in interstate commerce;*

(4) All impoundments of waters otherwise defined as waters of the United States under this definition;

(5) Tributaries of waters identified in paragraphs 1-4;

(6) The territorial sea; and

(7) Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in 1-6; waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of CWA (other than cooling ponds as defined in 40 CFR 423.11(m) which also meet criteria in this definition) are not waters of the United States.

(*Note: EPA has clarified that waters of the U.S. under the commerce connection in (3) above also include, for example, waters:

Which are or would be used as habitat by birds protected by Migratory Bird Treaties or migratory birds which cross State lines;
Which are or would be used as habitat for endangered species;
Used to irrigate crops sold in interstate commerce.)

Appendix C

Information on the Assessment of Wetland Functions and Values

Summary of Methodologies Prior to 1983 (Lonard and Clairain 1986)

Introduction

Since 1972, a wide variety of wetlands evaluation methodologies have been developed by Federal or State agencies, private consulting firms, and the academic community. These evaluation methods have been developed to ascertain all or selected wetland functions and values that include habitat; hydrology, including water quality recreation; agriculture/silviculture; and heritage functions.

Publications by the U.S. Water Resources Council (Lonard et al., 1981) and the U.S. Army Engineer Waterways Experiment Station (Lonard et al., 1984) documented and summarized pre-1981 wetland evaluation methods. The two documents include a critical review of the literature, identification of research needs, and recommendations for the improvement of wetlands evaluation methodologies. Methodology analyses include an examination of wetlands functions; geographic features; personnel requirements for implementation, data requirements, and products; field testing; flexibility; and administrative uses. Recently, the U.S. Environmental Protection Agency, with technical assistance from WAPORA, Inc. (1984) summarized freshwater wetland evaluation methodologies related to primary and cumulative impacts published prior to 1981. The specific objective of this paper is to present a summary of wetlands evaluation methodologies identified from the pre-1981 literature, and to present an update of methodologies published since 1981.

Methods

In 1981, a U.S. Army Engineer Waterways Experiment Station (WES) study team evaluated 40 wetlands evaluation methodologies according to several screening criteria, and examined 20 of the methodologies in detail using a series of descriptive parameters (Lonard et al., 1981). The criteria and parameters were developed to ensure consistency during review and analysis of methodologies. Five additional methodologies proposed since 1981 have been analyzed and summarized for this paper using the same criteria. This does not suggest, however, that only five methodologies have been developed since 1981.

Available Wetlands Evaluation Methodologies

Abstracts of 25 wetlands evaluation methodologies that met the WES study team's criteria include the following:

1. Adamus, P.R., and Stockwell, L.T. 1983. "A Method for Wetland Functional Assessment. Volume I. Critical Review and Evaluation Concepts," U.S. Department of Transporta-

tion. Federal Highway Administration. Office of Research, Environmental Division. Washington, D.C. 20590; and Adamus, P.R. 1983. "A Method for Wetland Functional Assessment. Volume II. The Method," U.S. Department of Transportation. Federal Highway Administration. Office of Research, Environmental Division. Washington, D.C. 20590.

Volume I of the method provides a detailed literature review and discussion of the rationale of the method. The wetland functional assessment or evaluation methodology presented in Volume II consists of three separate procedures. Procedure I, referred to as a "Threshold Analysis," provides a methodology for estimating the probability that a single wetland is of high, moderate, or low value for each of 11 wetland functions discussed in detail in Volume I. This procedure is based on assessment of 75 bio-physical wetland features obtained from office, field, and quantitative studies. It also incorporates consideration of the social significance of the wetland as indicated by public priorities. The priorities are determined based on results of a series of questions that the evaluator must consider. Procedure II, designed as a "Comparative Analysis," provides parameters for estimating whether one wetland is likely to be more important than another for each wetland function, and Procedure II, referred to as "Mitigation Analysis," provides an outline for comparing mitigation alternatives and their reasonableness." The evaluation methodology is qualitative in its approach.

2. Brown, A., Kittle, P., Dale, E.E., and Huffman, R.T. 1974. "Rare and Endangered Species, Unique Ecosystems, and Wetlands," Department of Zoology and Department of Botany and Bacteriology. The University of Arkansas, Fayetteville, Arkansas.

The Arkansas Wetlands Classification System contains a two-part, multivariate approach for evaluating freshwater wetlands for maximum wildlife production and diversity. Initially, Arkansas wetlands were qualitatively classified as prime or nonprime wetlands habitats according to use by man. A numerical value for a wetland was determined by calculating a subscore, which was based on the multiplication of a significance coefficient by a determined weighted value. The values for each variable were summed, and a total wetland qualitative value was obtained for use by decision makers.

3. Dee, N., Baker, J., Drobney, N., Duke, K., Whitman, I., and Fahringer, D. 1973. "Environmental Evaluation System for Water Resources Planning," *Water Resources Research*, Vol 9, No. 3, pp 523-534.

The Environmental Evaluation System (EES) is a methodology for conducting environmental impact analysis. It was developed by an interdisciplinary research team, and is based on a hierarchical arrangement of environmental quality indicators, an arrangement that classifies the major areas of environmental concern into major categories, components, and ultimately into parameters and measurements of environmental quality. The EES provides for environmental impact evaluation in four major categories: ecology, environmental pollution, aesthetics, and human interest. These four categories are further broken down into 18 components, and finally into 78 parameters. The EES provides a means for measuring or estimating selected environmental impacts of large-scale water resource development projects in commensurate units termed environmental impact units (EIU). Results of using the EES include a total score in EIU "with" and "without" the proposed project; the difference between the two scores in one measure of environmental impact. Environmental impact scores developed in the EES are based on the magnitude of specific environmental impacts and their relative importance. Another major output from the EES is an indication of major adverse impacts called "red flags," which are of concern of and by themselves. These red flags indicate "fragile" elements of the environment that must be studied in more detail. (Authors' abstract.)

4. Euler, D.L., Carreiro, F.T., McCullough, G.B., Snell, E.A., Glooschenko, V., and Spurr, R.H. 1983. "An Evaluation System for Wetlands of Ontario South of the Precambrian Shield," First Edition. Ontario Ministry of Natural Resources and Canadian Wildlife Service, Ontario Region. Variously paged.

The methodology was developed to evaluate a wide variety of wetland functions that include biological, social, hydrological, and special fea-

tures. The procedures includes a rationale of scientific and technical literature for wetlands values, the evaluation methodology, a step-by-step procedure manual, a wetland data record, and a wetland evaluation record. The procedure was developed to evaluate and rank a wide variety of inland wetlands located in Ontario, Canada, south of the Precambrian Shield.

5. Fried, E. 1974. "Priority Rating of Wetlands for Acquisition," *Transaction of the Northeast Fish and Wildlife Conference*, Vol 31, pp 15-30.

New York State's Environmental Quality Bond Act of 1972 provides $5 million for inland wetland acquisition, $18 million for tidal wetlands acquisition, and $4 million for wetlands restoration. A priority rating system, with particular emphasis on inland wetlands, was developed to guide these programs. The governing equation was: priority rating = (P + V + A) x 5, where the priority rating is per acre desirability for acquisition, P is biological productivity, V is vulnerability, and A is additional factors. Both actual and potential conditions could be rated. The rating system was successfully applied to some 130 inland wetlands. Using a separate equation, wetland values were related to costs. (Authors's abstract.)

6. Galloway, G.E. 1978. "Assessing Man's Impact on Wetlands," Sea Grant Publications Nos. UNC-SG-78-17 or UNC-WRRI-78-136, University of North Carolina, Raleigh, North Carolina.

The Wetland Evaluation System (WES) proposed by Galloway emphasizes a system approach to evaluate man's impact on a wetland ecosystem. Impacts are determined and compared for "with" and "without" project conditions. The advice of an interdisciplinary team, as well as the input of local elected officials and laymen, are included as part of the WES model. Parameters that make up a wetland are assessed at the macro-level, and the results of the evaluation are displayed numerically and graphically with computer assisted techniques.

7. Golet, F.C. 1973. "Classification Evaluation of Freshwater Wetlands as Wildlife Habitat in the Glaciated Northeast," *Transactions of the Northeast Fish and Wildlife Conference*, Vol 30, pp 257-279.

A detailed classification system for freshwater wetlands is presented along with 10 criteria for the evaluation of wetlands as wildlife habitat. The results are based on a 2-year field study of over 150 wetlands located throughout the state of Massachusetts. The major components of the classification system include wetland classes and subclasses, based on the dominant life form of vegetation and surface water depth and permanence; size categories; topographic and hydrologic location; surrounding habitat types; proportions and interspersion of cover and water; and vegetative interspersion. These components are combined with wetland juxtaposition and water chemistry to produce criteria for a wetland evaluation. Using a system of specification and ranks, wetlands can be arranged according to their wildlife value for decision-making. (Author's abstract.) "At this point, the system has been used in numerous states on thousands of wetlands; recent revisions have resulted in such use." (F.C. Golet)

8. Gupta, T.R., and Foster, J.H. 1973. "Valuation of Visual-Cultural Benefits from Freshwater Wetlands in Massachusetts," *Journal of the Northeastern Agricultural Council*, Vol 2, No 1, pp 262-273.

The authors suggested an alternative to the "willingness to pay" approaches for measuring the social values of natural open space and recreational resources. The method combines an identification and measurement of the physical qualities of the resource by landscape architects. Measurement values were expressed in the context of the political system and current public views. The procedure is demonstrated by its application to freshwater wetlands in Massachusetts.

9. Kibby, H.V. 1978. "Effects of Wetlands on Water Quality," *Proceedings of the Symposium on Strategies for Protection and Management of Floodplain Wetlands and other Riparian Ecosystems*, General Technical Report No. GTR-WO-12, U.S. Department of Agriculture, Forest Service. Washington, D.C.

Wetlands potentially have significant effects on water quality. Significant amounts of nitrogen are assimilated during the growing season and then released in the fall and early spring. Phosphorus, while assimilated by wetlands, is also released throughout the year. Some potential management tools for evaluating the effect of wetlands on water quality are discussed. (Author's abstract.)

10. Larson, J.S. (ed.) 1976. "Models for Assessment of Freshwater Wetlands," Publication No. 32. Water Resources Research Center, University of Massachusetts, Amherst, Massachusetts.

Four submodels for relative and economic evaluation of freshwater wetlands are presented within a single, 3-phase elimination model. The submodels treat wildlife, visual-cultural, groundwater, and economic values.

The wildlife and visual-cultural models are based on physical characteristics that, for the most part, can be measured on existing maps and aerial photographs. Each characteristic is given values by rank and coefficient. A relative numerical score is calculated for the total wetland characteristics and used to compare it with a broad range of northeastern wetlands or with wetlands selected by the user. The groundwater model places wetlands in classes of probable groundwater yield, based on surficial geologic deposits under the wetland.

The economic submodel suggests values for wildlife, visual-cultural aspects, groundwater, and flood control. Wildlife values are derived from the records of state agency purchases of wetlands with sportsmen's dollars for wildlife management purposes. Visual-cultural economic values are based on the record of wetland purposes for open space values by municipal conservation commissions. Groundwater values stem from savings realized by selection of a drilled public water supply over a surface water source. Flood control values are based on U.S. Army Corps of Engineers data on flood control values of the Charles River, Massachusetts, mainstream wetlands.

The submodels are presented within the framework of an overall 3-phase eliminative model. Phase I identifies outstanding wetlands that should be protected at all costs. Phase II applies the wildlife, visual-cultural, and groundwater submodels to those wetlands that do not meet criteria for outstanding wetlands. Phase III develops the economic values of the wetlands evaluated in Phase II.

The models are intended to be used by local, regional, and state resource planners and wetlands regulation agencies. (Author's abstract.)

11. Marble, A.D., and Gross, M. 1984. "A Method for Assessing Wetland Characteristics and Values," *Landscape Planning*, Vol 11, pp 1-17.

The method presented for assessing wetland values identified the relative importance of wetlands in providing wildlife habitat, flood control, and improvement of surface water quality. All wetlands in the study area were categorized on the basis of their landscape position of hilltop, hillside, or valley. Each of the wetland values measured were then related to the corresponding landscape position categories. Valley wetlands were found to be most valuable in all instances. The method provides information on wetland values that can be simply gathered and easily assessed, requiring only available data and a minimum of resources. Implementation of this method on a regional or municipality-wide basis can provide decision makers with readily accessible and comparative information on wetland values. (Authors' abstract.)

12. Michigan Department of Natural Resources. 1980. "Manual for Wetland Evaluation Techniques: Operation Draft," Division of Land Resource Programs, Lansing, Michigan. 29 pp.

The Michigan Department of Natural Resources (MDNR) Wetland Evaluation Technique is designed to assist decision makers on permit applications involving projects where significant impacts are anticipated. The manual describes the criteria to be used in evaluating any particular wetland. The technique provides a means of evaluating the status of existing wetlands as well as potential project-related impacts on wetland structure and aerial extent. One part of the technique requires examination of six basic features of wetlands, including: (1) hydrologic functions; (2) soil characteristics; (3) wildlife habitat/use evaluation; (4) fisheries habitat/use; (5)

nutrient removal/recycling functions; (6) removal of suspended sediments. A second part of the analysis includes consideration of public interest concerns. This method also includes brief consideration of cumulative, cultural/historic, and economic impacts.

13. Reppert, R.T., Sigleo, W., Stakhiv, E., Messman, L., and Meyers, C. 1979. "Wetland Values: Concepts and Methods for Wetlands Evaluation," IWR Research Report 79-R-1, U.S. Army Engineer Institute for Water Resources, Fort Belvoir, Virginia.

The evaluation of wetlands is based on the analysis of their physical, biological, and human use characteristics. The report discusses these functional characteristics and identifies specific criteria for determining the efficiency with which the respective functions are performed.

Two potential wetlands evaluation methods are described. One is a non-quantitative method in which individual wetland areas are evaluated based on the deductive analysis of their individual functional characteristics. The other is a semi-quantitative method in which the relative values of two or more site alternatives are established through the mathematical rating and summation of their functional relationships.

The specific functions and values of wetlands that are covered in this report are (1) natural biological functions, including food chain productivity and habitat; (2) their use as sanctuaries, refuges, or scientific study areas; (3) shoreline protection; (4) groundwater recharge; (5) storage for flood and stormwater; (6) water quality improvement; (7) hydrologic support; and (8) various cultural values. (Authors' abstract.)

14. Shuldiner, P.W., Cope, D.F., and Newton, R.B. 1979. "Ecological Effects on Highway Fills of Wetlands," Research Report. National Cooperative Highway Research Program Report No. 218A, Transportation Research Board, National Research Council, Washington, D.C.; and Shuldiner, P.W., Cope, D.F., and Newton, R.B. 1979. "Ecological Effects of Highway Fills on Wetlands," User's Manual. National Cooperative Highway Research Program Report No. 218B, Transportation Research Board, National Research Council, Washington, D.C.

The two reports include a Research Report and a User's Manual to provide, in concise format, guidelines and information needed for the determination of the ecological effects that may result from the placement of highway fills on wetlands and associated floodplains, and to suggest procedures by which deleterious impacts can be minimized or avoided. The practices that can be used to enhance the positive benefits are also discussed. Both reports cover the most common physical, chemical, and biological effects that the highway engineer is likely to encounter when placing fills in wetlands, and displays the effects and their interactions in a series of flowcharts and matrices.

15. SCS Engineers. 1979. "Analysis of Selected Functional Characteristics of Wetlands," Contract No. DACW73-78-R-0017, Reston, Virginia.

The investigation focused on identifying factors and criteria for assessing the wetland functions of water quality improvement, groundwater recharge, storm and floodwater storage, and shoreline protection. Factors and criteria were identified that could be used to develop procedures to assist Corps personnel in wetlands assessing the values of general wetland types and of specific wetlands in performing the functions indicated. To the extent possible, procedures were then outlined that allow the application of these criteria in specific sites.

16. Smardon, R.D. 1972. "Assessing Visual-Cultural Values on Inland Wetlands in Massachusetts," Master of Science Thesis. University of Massachusetts. Amherst, Massachusetts.

This study deals with the incorporation of visual-cultural values of inland wetlands into the decision making process of land use allocation of inland wetlands in Massachusetts. Visual-cultural values of inland wetlands may be defined as visual, recreational, and educational values of inland wetlands to society. The multivariate model is an eliminative and comparative model that has three levels of evaluation. The first level identifies those wetlands that are outstanding natural areas, have regional landscape value, or are large wetland systems.

These wetlands have top priority for preservation. The second level is a rating and ranking system. At this stage, the combined natural resource values of the wetland are evaluated. Wetlands with high ratings or rank from this level are eliminated and have the next highest priority for preservation or some sort of protection. The third level evaluation considers the cultural values (e.g., accessibility, location near schools) of wetlands. The model is designed to be utilized at many different levels of decision making. For example, it can be used by state agencies, town conservation commissions, and conceivably could be used by other states in northeastern United States. (Author's abstract.)

17. Solomon, R.D., Colbert, B.K., Hansen, W.J., Richardson, S.E., Ganter, L.W., and Vlachos, E.C. 1977. "Water Resources Assessment Methodology (WRAM)--Impact Assessment and Alternative Evaluation," Technical Report Y-77-1, Environmental Effects Laboratory, U.S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Mississippi.

This study presented a review of 54 impact assessment methodologies and found that none entirely satisfied the needs or requirements for the Corps' water resources project and programs. However, salient features contained in several of the methodologies were considered pertinent and were utilized to develop a water resources assessment methodology (WRAM). One of the features consisted of weighting impacted variables and scaling the impacts of alternatives. The weighted rankings technique is the basic weighting and scaling tool used in this methodology. Principal components of WRAM include assembling an interdisciplinary team; selecting and ensuring assessment variables; identifying, predicting, and evaluating impacts and alternatives; and documenting the analysis. Although developed primarily for use by the Corps in water resources management, WRAM is applicable to other resources agencies.

18. State of Maryland Department of Natural Resources. Undated. "Environmental Evaluation of Coastal Wetlands (Draft)," Tidal Wetlands Study, pp 181-208.

The Maryland scheme for the evaluation of coastal wetlands is based on the recognition of 32 distinct types of vegetation in the marshes and swamps of tidewater areas of the state. Rankings of vegetation types were developed and parameters for the evaluation of specific areas of wetlands were described. The application of the scheme is explained and demonstrated. Guidance is provided for the interpretation of results. The application of the Maryland scheme requires a detailed inventory of the types of vegetation in the area selected for evaluation.

19. U.S. Army Engineer District, Rock Island. 1983. "Wetland Evaluation Methodology," Wisconsin Department of Natural Resources, Bureau of Water Regulation and Zoning.

The Wetland Evaluation Methodology is a shortened and revised version of a technique developed for the Federal Highway Administration (FHWA) (see Adamus, 1983; Number 1). The FHWA technique was designed to assess all wetland types whereas the Wetland Evaluation Methodology assesses those wetlands in Wisconsin (e.g., assessment procedures in the FHWA technique for estuarine marshes have been omitted from the Wetland Evaluation Methodology). Other changes have also been incorporated into the Wetland Evaluation Methodology to more closely reflect other regional conditions.

20. U.S. Army Engineer Division, Lower Mississippi Valley. 1980. "A Habitat Evaluation System for Water Resources Planning," U.S. Army Corps of Engineers, Lower Mississippi Valley Division, Vicksburg, Mississippi.

A methodology is presented for determining the quality of major habitat types based on the description and quantification of habitat characteristics. Values are compared for existing baseline conditions, future conditions without the project, and with alternative project conditions. Curves, parameter characteristics, and descriptive information are included in the appendices. The Habitat Evaluation System (HES) procedure includes the following steps for evaluating impacts of a water resource development project. The steps include: (1) obtaining habitat type or land use acreage; (2) deriving Habitat Quality Index scores; (3) deriving Habitat Unit Values; (4) projecting Habitat Unit Values for the future "with" and "without" project conditions; (5)

using Habitat Unit Values to assess impacts of project conditions; and (6) determining mitigation requirements.

21. U.S. Army Engineer Division, New England. 1972. "Charles River: Main Report and Attachments," Waltham, Massachusetts.

The study was a long-term project directed by the U.S. Army Corps of Engineers to study the resources of the Charles River Watershed in eastern Massachusetts. It had an emphasis on how to control flood damage in the urbanized lower watershed, and how to prevent any significant flood damage in the middle and upper watershed. Seventeen crucial wetlands were identified for acquisition to maintain flood storage capacity in the watershed as a nonstructural alternative for flood protection in the lower Charles River basin. Various aspects of the watershed were studied in an interdisciplinary fashion.

22. U.S. Department of Agriculture. 1978. "Wetlands Evaluation Criteria--Water and Related Land Resources of the Coastal Region, Massachusetts," Soil Conservation Service, Amherst, Massachusetts.

A portion of the document contains criteria used to evaluate major wetlands in the coastal region of Massachusetts. Each of the 85 wetlands evaluated was subjected to map study and field examination. Ratings were assigned based on point values obtained for various attributes. A rationale for each evaluation item was developed to explain the development of the criteria.

23. U.S. Fish and Wildlife Service. 1980. "Habitat Evaluation Procedures (HEP) Manual (102ESM)," Washington, D.C.

HEP is a method that can be used to document the quality and quantity of available habitat for selected wildlife species. HEP provides information for two general types of wildlife habitat comparisons: (1) the relative value of different areas at the same point in time; and (2) the relative value of the same area at future points in time. By combining the two types of comparisons, the impact of proposed or anticipated land and water changes on wildlife habitat can be quantified. This document described HEP, discusses some probable applications, and provides guidance in applying HEP in the field.

24. Virginia Institute of Marine Science. Undated. "Evaluation of Virginia Wetlands," (mimeographed). Glouchester Point, Virginia.

The authors presented a procedure to evaluate the wetlands of Virginia. The objective of the wetland evaluation program was to recognize wetlands that possess great ecological significance as well as those of lesser significance. Two broad categories of criteria were utilized in evaluating the ecological significance of wetlands: (1) the interaction of wetlands with the marine environment; and (2) the interaction of the wetland with the terrestrial environment. A formula was developed to incorporate various factors into "relative ecological significance values."

25. Winchester, B.H., and Harris, L.D. 1979. "An Approach to Valuation of Florida Freshwater Wetlands," *Proceedings of the Sixth Annual Conference on the Restoration and Creation of Wetlands*, Tampa, Florida.

A procedure was presented for estimating the relative ecological and functional value of Florida freshwater wetlands. Wetland functions evaluated by this procedure include water quality enhancement, water detention, vegetation diversity and productivity, and wildlife habitat value. The field parameters used in the assessment were wetland size, contiguity, structural vegetative diversity, and an edge-to-area ration. The procedure was field tested and was time- and cost-effective. Allowing flexibility in both the evaluative criteria used and the relative weight assigned to each criterion, the methodology is applicable in any Florida region for which basic ecological data are available.

Literature Cited

Adamus, P. and Stockwell, L.R. 1983. A method for wetland functional assessment. Volume 1. Critical review and evaluation concepts. U.S. Department of Transportation. Federal Highway Administration. Office Research, Environmental Division. Washington, D.C. 20590 (No. FHWA-IP-82-23).

Adamus, P.R. 1983. A method for wetland functional assessment. Volume II. The method. U.S. Department of Transportation, Federal Highway Administration. Office of Research, Environmental Division. Washington, D.C. 20590. (No. FHWA-IP-82-24).

Brown, A., Kittle, P., Dale, E.E., and Huffman, R.T. 1974. Rare and endangered species, unique ecosystems, and wetlands. Department of Zoology and Department of Botany and Bacteriology. University of Arkansas, Fayetteville, Arkansas.

Dee, N., Baker, J., Drobney, N., Duke, K., Whitman, I., and Fahringer, D. 1973. Environmental evaluation system for water resources planning. Water Resources Research, Vol 9, No. 3, pp 523-534.

Euler, D.L., Carreiro, F.T., McCullough, G.B., Snell, E.A., Glooschenko, V., and Spurr, R.H. 1983. An evaluation system for wetlands of Ontario south of the Precambrian Shield. First Edition. Ontario Ministry of Natural Resources and Canadian Wildlife Service, Ontario Region. Variously paged.

Fried, E. 1974. Priority rating of wetlands for acquisition. Transaction of the Northeast Fish and Wildlife Conference, Vol 31, pp 15-30.

Galloway, G.E. 1978. Assessing man's impact on wetlands, Sea Grant Publication Nos. UNC-SG-78-17 or UNC-WRRI-78-136, University of North Carolina, Raleigh, North Carolina.

Golet, F.C. 1973. Classification and evaluation of freshwater wetlands as wildlife habitat in the glaciated Northeast. Transactions of the Northeast Fish and Wildlife Conference, Vol 30, pp 257-279.

Gupta, T.R., and Foster, J.H. 1973. Evaluation of visual-cultural benefits from freshwater wetlands in Massachusetts, Journal of the Northeastern Agricultural Council, Vol 2, No. 2, pp 262-273.

Kibby, H.V. 1978. Effects of wetlands on water quality. Proceedings of the symposium on strategies for protection and management of floodplain wetlands and other riparian ecosystems, General Technical Report No. GRW-WO-12, U.S. Department of Agriculture, Forest Service, Washington, D.C.

Larson, J.S. (ed.) 1976. Models for assessment of freshwater wetlands. Publication No. 32, Water Resources Center, University of Massachusetts, Amherst, Massachusetts.

Lonard, R.I., Clairain, E.J., Jr., Huffman, R.T., Hardy, J.W., Brown, L.D., Ballard, P.E., and Watts, J.W. 1981. Analysis of methodologies used for the assessment of wetlands values. U.S. Water Resources Council, Washington, D.C.

Lonard, R.I., Clairain, E.J., Jr., Huffman, R.T., Hardy, J.W., Brown, L.D., Ballard, P.E., and Watts, J.W. 1984. Wetlands function and values study plan; Appendix A: Analysis of methodologies for assessing wetlands values. Technical Report Y-83-2, U.S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Mississippi.

Marble, A.D., and Gross, M. 1984. A method for assessing wetland characteristics and values. Landscape Planning II, pp 1-17.

Michigan Department of Natural Resources. 1980. Manual for wetland evaluation techniques: operation draft. Division of Land Resources Programs, Lansing, Michigan. 22 pp.

Reppert, R.T., Sigleo, W., Stakhiv, E., Messman, L., and Meyer, C. 1979. Wetlands values: concepts and methods for wetlands evaluation. IWR Research Report 79-R-1, U.S. Army Engineer Institute for Water Resources, Fort Belvoir, Virginia.

Shuldiner, P.W., Cope, D.F., and Newton, R.B. 1979a. Ecological effects of highway fills on wetlands. Research Report No. 218B, Transportation Research Board, National Research Council. Washington, D.C.

Smardon, R.C. 1972. Assessing visual-cultural values on inland wetlands in Massachusetts. Master of Science Thesis, University of Massachusetts, Amherst, Massachusetts. Solomon, R.D., Colbert, B.K., Hansen, W.J., Richardson, S.E., Canter, L.W., and Vlachos, E.C. 1977. Water resources assessment methodology (WRAM)--impact assessment and alternative evaluation. Technical Report Y-77-1, U.S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Mississippi.

State of Maryland Department of Natural Resources. Undated. Environmental evaluation of coastal wetlands (Draft). Tidal Wetlands Study, pp 181-208.

Stearns, Conrad and Schmidt Consulting Engineers, Inc. 1979. Analysis of selected functional characteristics of wetlands. Contract No. DACW72-78-0017, Draft Report, prepared for U.S. Army Engineers Research Center by the authors, Reston, Virginia.

U.S. Army Engineer Division, Lower Mississippi Valley. 1980. A habitat evaluation system (HES) for water resources planning. U.S. Army Engineer Division, Lower Mississippi Valley. Vicksburg, Mississippi.

U.S. Army Engineer Division, New England. 1972. Charles River; main report and attachments. U.S. Army Engineer Division, New England. Waltham, Massachusetts.

U.S. Department of Agriculture. 1978. Wetland evaluation criteria--water and related land resources of the coastal region of Massachusetts. Soil Conservation Service, Amherst, Massachusetts.

U.S. Environmental Protection Agency. 1984. Technical report: literature review of wetland evaluation methodologies. U.S. Environmental Protection Agency, Region 5, Chicago, Illinois.

U.S. Fish and Wildlife Service. 1980. Habitat evaluation procedures (HEP) manual. 102 ESM, Washington, D.C.

Virginia Institute of Marine Science. Undated. Evaluation of Virginia wetlands. Mimeographed Paper, Glouchester Point, Virginia.

Winchester, B.H., and Harris, L.D. 1979. An approach to valuation of Florida freshwater wetlands. Proceedings of the Sixth Annual Conference on the Restoration and Creation of Wetlands, Hillsborough Community College, Tampa, Florida.

Wetland Assessment Techniques Developed Since 1983 (USEPA 1989a)

- Wetlands Evaluation Technique (Adamus, et al. 1987). This nationally applicable procedure has been used in at least six ADIDs to date, mostly in its original form (known popularly as the "FHWA" or "Adamus" method). It has since been extensively revised and is available at no cost (with simple software) from the Corps of Engineers Wetlands Research Program (contact: Buddy Clairain, 601-634-3774). Future revisions are anticipated.

- Bottomland Hardwoods WET (Adamus 1987). This is a simplified, regionalized version of WET, applicable to EPA Regions 4 and 6. It is available from OWP (contact: Joe DaVia at 202-475-8795). Supporting software is being developed, and future revisions are anticipated.

- Southeastern Alaska WET (Adamus Resource Assessment 1987). This is also a simplified, regionalized version of WET.

- Minnesota Method (U.S. Army Corps of Engineers-St.Paul, 1988). This was a joint State-Federal effort that involved considerable adaptation of WET. A similar effort is underway in Wisconsin.

- Onondaga County Method (SUNY-Syracuse 1987). This was adapted from WET by Smardon and others at the State University of New York.

- Hollands-Magee Method. This is a scoring technique developed by two consultants and has been applied to hundreds of wetlands in New England and part of Wisconsin (contact: Dennis Magee at 603-472-5191). Supporting software is available.

- Ontario Method (Euler et al. 1983). This is also a scoring technique, and was extensively peer-reviewed in Canada. (Contact: Valanne Glooschenko, 416-965-7641).

- Connecticut Method (Amman et al. 1986). This is a scoring technique developed for inland municipal wetland agencies.

- Marble-Gross Method (Marble and Gross 1984) This was developed for a local application in Connecticut.

- Habitat Evaluation System (HES) (Tennessee Dept. of Conservation 1987). This is a revised version of a Corps-sponsored method used to evaluate Lower Mississippi wildlife habitat.

References

Adamus, P.R. (ed.) 1987. Atlas of breeding birds in Maine 1978-1983. Maine Department of Inland Fisheries and Wildlife, Augusta. 366 pp.

Adamus Resource Assessment, Inc. 1987. Juneau wetlands: functions and values. City and Borough of Juneau Department of Community Development, Juneau, Alaska. 3 vols.

Amman, A.P., R.W. Franzen, and J.L. Johnson. 1986.

Method for the evaluation of inland wetlands in Connecticut. Bull. No. 9. Connecticut Dept. Envir. Prot. and USDA Soil Conservation Service, Hartford, Connecticut.

Euler, D.L., F.T. Carreiro, G.B. McCullough, G.B. Snell, V.

Glooschenko, and R.H. Spurr. 1983. An evaluation system for wetlands of Ontario south of the Precambrian Shield. Ontario Ministry of Natural Resources and Canadian Wildlife Service, Ontario Region.

Marble, A.D. and M. Gross. 1984. A method for assessing wetland characteristics and values. Landscape Planning 2:1-17.

State University of New York at Syracuse (SUNY). 1987. Wetlands evaluation system for Onondaga County, New York State. Draft. 93 pp.

Tennessee Dept. of Conservation. 1987. Habitat Evaluation

System: Bottomland Forest Community Model. Tennessee Dept. of Conservation, Ecological Services Division, Nashville. 92 pp.

U.S. Army Corps of Engineers-St. Paul. 1988. The Minnesota wetland evaluation methodology for the North Central United States. Minnesota Wetland Evaluation Methodology Task Force and Corps of Engineers-St. Paul District. 97 pp. + appendices.

Appendix D

REGIONAL COORDINATORS

Regional Water Quality Standards Coordinators
U.S. Environmental Protection Agency (USEPA)

Eric Hall, WQS Coordinator
USEPA, **Region 1**
Water Management Division
JFK Federal Building
Boston, MA 02203
(FTS) 835-3533
(617) 565-3533

Rick Balla, WQS Coordinator
USEPA, **Region 2**
Water Management Division
26 Federal Plaza
New York, NY 10278
(FTS) 264-1559
(212) 264-1559

Linda Holst, WQS Coordinator
USEPA, **Region 3**
Water Management Division
841 Chestnut Street
Philadelphia, PA 19107
(FTS) 597-0133
(215) 597-3425

Fritz Wagener, WQS Coordinator
USEPA, **Region 4**
Water Management Division
345 Courtland Street, N.E.
Atlanta, GA 30365
(FTS) 257-2126
(404) 347-2126

Larry Shepard, WQS Coordinator
USEPA, **Region 5** (TUD-8)
Water Management Division
230 South Dearborn Street
Chicago, IL 60604
(FTS) 886-0135
(312) 886-0135

David Neleigh, WQS Coordinator
USEPA, **Region 6**
Water Management Division
1445 Ross Avenue
First Interstate Bank Tower
Dallas, TX 75202
(FTS) 255-7145
(214) 655-7145

John Houlihan, WQS Coordinator
USEPA, **Region 7**
Water Compliance Branch
726 Minnesota Avenue
Kansas City, KS 66101
(FTS) 276-7432
(913) 551-7432

Bill Wuerthele, WQS Coordinator
USEPA, **Region 8** (8WM-SP)
Water Management Division
999 18th Street
Denver, CO 80202-2405
(FTS) 330-1586
(303) 293-1586

Phil Woods, WQS Coordinator
USEPA, **Region 9**
Water Management Division (W-3-1)
75 Hawthorne Street
San Francisco, CA 94105
(FTS) 484-1994
(415) 744-1994

Sally Marquis, WQS Coordinator
USEPA, **Region 10**
Water Management Division (WD-139)
1200 Sixth Avenue
Seattle, WA 98101
(FTS) 399-2116
(206) 442-2116

Regional Wetland Program Coordinators
U.S. Environmental Protection Agency (USEPA)

Doug Thompson, Wetlands Coordinator
USEPA, **Region 1**
Water Management Division
Water Quality Branch
John F. Kennedy Federal Building
Boston, Massachusetts 02203-2211
(FTS) 835-4422
(617) 565-4422

Dan Montella, Wetlands Coordinator
USEPA, **Region 2**
Water Management Division
Marine & Wetlands Protection Branch
26 Federal Plaza
New York, New York 10278
(FTS) 264-5170
(212) 264-5170

Barbara D'Angelo, Wetlands Coordinator
USEPA, **Region 3**
Environmental Service Division
Wetlands and Marine Policy Section
841 Chestnut Street
Philadelphia, Pennsylvania 19107
(FTS) 597-9301
(215) 597-9301

Tom Welborn, Wetlands Coordinator
(Regulatory Unit)
Gail Vanderhoogt, Wetlands Coordinator
(Planning Unit)
USEPA, **Region 4**
Water Management Division
Water Quality Branch
345 Courtland Street, N.E.
Atlanta, Georgia 30365
(FTS) 257-2126
(404) 347-2126

Doug Ehorn, Wetland Coordinator
USEPA, **Region 5**
Water Management Division
Water Quality Branch
230 South Dearborn Street
Chicago, Illinois 60604
(FTS) 886-0243
(312) 886-0243

Jerry Saunders, Wetlands Coordinator
USEPA, **Region 6**
Environmental Services Division
Federal Activities Branch
12th Floor, Suite 1200
1445 Ross Avenue
Dallas, Texas 75202
(FTS) 255-2263
(214) 655-2263

Diane Hershberger, Wetlands Coordinator
Assistant Regional Administrator for
Policy and Management
USEPA, **Region 7**
Environmental Review Branch
726 Minnesota Avenue
Kansas City, Kansas 66101
(FTS) 276-7573
(913) 551-7573

Gene Reetz, Wetlands Coordinator
USEPA, **Region 8**
Water Management Division
State Program Management Branch
One Denver Place, Suite 500
999 18th Street
Denver, Colorado 80202-2405
(FTS) 330-1565
(303) 293-1565

Phil Oshida, Wetlands Coordinator
USEPA, **Region 9**
Water Management Division
Wetlands, Oceans and Estuarine Branch
1235 Mission Street
San Francisco, California 94103
(FTS) 464-2187
(415) 744-2180

Bill Riley, Wetlands Coordinator
USEPA, **Region 10**
Water Management Division
Environmental Evaluation Branch
1200 Sixth Avenue
Seattle, Washington 98101
(FTS) 399-1412
(206) 422-1412

Regional Wetland Program Coordinators
U.S. Fish and Wildlife Service (USFWS)

Region 1	California, Hawaii, Idaho, Nevada, Oregon, Washington RWC: Dennis Peters ASST: Howard Browers	Regional Wetland Coordinator USFWS, Region 1 Fish and Wildlife Enhancement 1002 N.E. Holladay Street Portland, Oregon 97232-4181 COM: 503/231-6154 FTS: 429-6154
Region 2	Arizona, New Mexico Oklahoma, Texas RWC: Warren Hagenbuck ASST: Curtis Carley	Regional Wetland Coordinator USFWS, Region 2 Room 4012 500 Gold Avenue, SW Albuquerque, New Mexico 87103 COM: 505/766-2914 FTS: 474-2914
Region 3	Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, Wisconsin RWC: Ron Erickson ASST: John Anderson	Regional Wetland Coordinator USFWS, Region 3 Fish and Wildlife Enhancement Federal Building, Ft Snelling Twin Cities, Minnesota 55111 COM: 612/725-3536 FTS: 725-3536
Region 4	Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, Virgin Islands RWC: John Hefner ASST: Charlie Storrs	Regional Wetland Coordinator USFWS, Region 4 R.B. Russell Federal Building 75 Spring Street, S.W. Suite 1276 Atlanta, Georgia 30303 COM: 404/331-6343 FTS: 841-6343

Region 5	Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, New Jersey, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia RWC: Ralph Tiner ASST: Glenn Smith	Regional Wetland Coordinator USFWS, Region 5 One Gateway Center, Suite 700 Newton Corner, MA 02158 COM: 617/965-5100 FTS: 829-9379
Region 6	Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, Utah, Wyoming RWC: Chuck Elliott ASST: Bill Pearson	Regional Wetland Coordinator USFWS, Region 6 Fish and Wildlife Enhancement P.O. Box 25486 Denver Federal Center Denver, Colorado 80225 COM: 303/236-8180 FTS: 776-8180
Region 7	Alaska RWC: Jon Hall ASST: David Dall	Regional Wetland Coordinator USFWS, Region 7 1011 East Tudor Road Anchorage, Alaska 99503 COM: 907/786-3403 or 3471 FTS: (8) 907/786-3403

Appendix E

EXAMPLE OF STATE CERTIFICATION ACTION INVOLVING WETLANDS UNDER CWA SECTION 401

The dam proposed by the City of Harrisburg was to be 3,000 feet long and 17 feet high. The dam was to consist of 32 bottom-hinged flap gates. The dam would have created an impoundment with a surface area of 3,800 acres, a total storage capacity of 35,000 acre-feet, and a pool elevation of 306.5 feet. The backwater would have extended approximately 8 miles upstream on the Susquehanna River and approximately 3 miles upstream on the Conodoguinet Creek.

The project was to be a run-of-the-river facility, using the head difference created by the dam to create electricity. Maximum turbine flow would have been 10,000 cfs (at a nethead of 12.5), and minimum flow would have been 2,000 cfs. Under normal conditions, all flows up to 40,000 cfs would have passed through the turbines.

The public notice denying 401 certification for this project stated as follows:

1. The construction and operation of the project will result in the significant loss of wetlands and related aquatic habitat and acreage. More specifically:

    a. The destruction of the wetlands will have an adverse impact on the local river ecosystem because of the integral role wetlands play in maintaining that ecosystem.

    b. The destruction of the wetlands will cause the loss of beds of emergent aquatic vegetation that serve as habitat for juvenile fish. Loss of this habitat will adversely affect the relative abundance of juvenile and adult fish (especially smallmouth bass).

    c. The wetlands which will be lost are critical habitat for, among other species, the yellow crowned night heron, black crowned night heron, marsh wren and great egret. In addition, the yellow crowned night heron is a proposed State threatened species, and the marsh wren and great egret are candidate species of special concern.

    d. All affected wetlands areas are important and, to the extent that the loss of these wetlands can be mitigated, the applicant has failed to demonstrate that the mitigation proposed is adequate. To the extent that adequate mitigation is possible, mitigation must include replacement in the river system.

    e. Proposed riprapping of the shoreline could further reduce wetland acreage. The applicant has failed to demonstrate that there will not be an

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adverse water quality and related habitat impact resulting from riprapping.

f. Based upon information received by the Department, the applicant has underestimated the total wetland acreage affected.

2. The applicant has failed to demonstrate that there will be no adverse water quality impacts from increased groundwater levels resulting from the project. The ground water model used by the applicant is not acceptable due to erroneous assumptions and the lack of a sensitivity analysis. The applicant has not provided sufficient information concerning the impact of increased groundwater levels on existing sites of subsurface contamination, adequacy of subsurface sewage system replacement areas and the impact of potential increased surface flooding. Additionally, information was not provided to adequately assess the effect of raised groundwater on sewer system laterals, effectiveness of sewer rehabilitation measures and potential for increased flows at the Harrisburg wastewater plant.

3. The applicant has failed to demonstrate that there will not be a dissolved oxygen problem as a result of the impoundment. Present information indicates the existing river system in the area is sensitive to diurnal, dissolved oxygen fluctuation. Sufficient information was not provided to allow the Department to conclude that dissolved oxygen standards will be met in the pool area. Additionally, the applicant failed to adequately address the issue of anticipated dissolved oxygen levels below the dam.

4. The proposed impoundment will create a backwater on the lower three miles of the Conodoguinet Creek. Water quality in the Creek is currently adversely affected by nutrient problems. The applicant has failed to demonstrate that there will not be water quality degradation as a result of the impoundment.

5. The applicant has failed to demonstrate that there will not be an adverse water quality impact resulting from combined sewer overflows.

6. The applicant has failed to demonstrate that there will not be an adverse water quality impact to the 150-acre area downstream of the proposed dam and upstream from the existing Dock Street dam.

7. The applicant has failed to demonstrate that the construction and operation of the proposed dam will not have an adverse impact on the aquatic resources upstream from the proposed impoundment. For example, the suitability of the impoundment for smallmouth bass spawning relative to the frequency of turbid conditions during spawning was not adequately addressed and construction of the dam and impoundment will result in a decrease in the diversity and density of the macroinvertebrate community in the impoundment area.

8. Construction of the dam will have an adverse impact on upstream and downstream migration of migratory fish (especially shad). Even with the construction of fish passageways for upstream and downstream migration, significant declines in the numbers of fish successfully negotiating the obstruction are anticipated.

9. The applicant has failed to demonstrate that there will not be an adverse water quality impact related to sedimentation within the pool area.