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Environmental Protection
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September 1993

EPA

Water Quality Standards Handbook

Second Edition

"... to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

Section 101(a) of the Clean Water Act

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WATER QUALITY STANDARDS

HANDBOOK

SECOND EDITION

Water Quality Standards Branch
Office of Science and Technology
U.S. Environmental Protection Agency
Washington, DC 20460

September 1993

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FOREWORD

Dear Colleague:

The following document entitled *Water Quality Standards Handbook - Second Edition* provides guidance issued in support of the Water Quality Standards Regulation (40 CFR 131, as amended). This Handbook includes the operative provisions of the first volume of the Handbook issued in 1983 and incorporates subsequent guidance issued since 1983. The 1993 Handbook contains only final guidance previously issued by EPA—it contains no new guidance.

Since the 1983 Handbook has not been updated in ten years, we hope that this edition will prove valuable by pulling together current program guidance and providing a coherent document as a foundation for State and Tribal water quality standards programs. The Handbook also presents some of the evolving program concepts designed to reduce human and ecological risks, such as endangered species protection; criteria to protect wildlife, wetlands, and sediment quality; biological criteria to better define desired biological communities in aquatic ecosystems; and nutrient criteria.

This Handbook is intended to serve as a "living document," subject to future revisions as the water quality standards program moves forward, and to reflect the needs and experiences of EPA and the States. To this end, the Handbook is published in a loose leaf format designed to be placed in a three ring binder. EPA anticipates publishing changes to the Handbook periodically and providing them to Handbook recipients. To ensure that you will receive these updates, please copy the update request form in Appendix W and mail it to the address below.

The Handbook also contains a listing, by title and date, of the guidance issued since the Handbook was first published in 1983 that is incorporated in the Second Edition. Copies of these documents are available upon request.

The *Water Quality Standards Handbook - Second Edition* provides guidance on the national water quality standards program. EPA regional offices and States may have additional guidance that provides more detail on selected topics of regional interest. For information on regional or State guidance, contact the appropriate regional water quality standards coordinator listed in Appendix U.

EPA invites participation from interested parties in the water quality standards program, and appreciates questions on this guidance as well as suggestions and comments for improvement. Questions or comments may be directed to the EPA regional water quality standards coordinators or to:

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William R. Diamond, Director
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Note to the Reader

The Water Quality Standards Handbook, first issued in 1983, is a compilation of EPA's guidance on the water quality standards program and provides direction for States in reviewing, revising and implementing water quality standards. The *Water Quality Standards Handbook - Second Edition* retains all the guidance in the 1983 Handbook unless such guidance was specifically revised in subsequent years. An annotated list of the major guidance and policy documents on the water quality standards program issued since 1983 is included in the Introduction section. Material in the Handbook contains only guidance previously issued by EPA; it contains no new guidance.

The guidance contained in each of the documents listed in the Introduction is either: 1) incorporated in its entirety, or summarized, in the text of the appropriate section of this Handbook, or 2) attached as an appendix (see Table of Contents). If there is uncertainty or perceived inconsistency on any of the guidance incorporated into this Handbook, the reader is directed to review the original guidance documents or call the Water Quality Standards Branch at (202) 260-1315. Copies of all original guidance documents not attached as appendices may be obtained from the source listed for each document in the Reference section of this Handbook.

Copies of this Handbook may be obtained from:

Office of Water Resource Center, RC-4100
U. S. Environmental Protection Agency
401 M Street, S.W.
Washington, DC 20460
Telephone: (202) 260-7786 (voice mail publication request line)

Robert S. Shippen
Editor

NEW POLICY SIGNED

On October 1, 1993, the Acting Assistant Administrator for Water issued the *Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria.*

Since the policy document was signed to late for inclusion in the Handbook, the complete policy document is being sent to the recipients of this Handbook under separate cover. Later this fiscal year, you will receive an update, for insertion into the Handbook, reflecting this policy document and other new policy and guidance that may be produced in the interim.

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A - *Water Quality Standards Regulation* - 40 CFR 131.

B - *Chronological Summary of Federal Water Quality Standards Promulgation Actions.*

C - *Biological Criteria: National Program Guidance for Surface Waters*, April 1990.

D - *National Guidance: Water Quality Standards for Wetlands*, July 1990.

E - *An Approach for Evaluating Numeric Water Quality Criteria for Wetlands Protection*, July 1991.

F - *Coordination Between the Environmental Protection Agency, Fish and Wildlife Service and National Marine Fisheries Service Regarding Development of Water Quality Criteria and Water Quality Standards Under the Clean Water Act*, July 1992.

G - *Questions and Answers on: Antidegradation*, August 1985.

H - *Derivation of the 1985 Aquatic Life Criteria.*

I - List of EPA Water Quality Criteria Documents.

J - Reserved

K - *Procedures for the Initiation of Narrative Biological Criteria*, October 1992.

L - Reserved.

M - Reserved.

N - *IRIS [Integrated Risk Information System] Background Paper.*

O- Reserved.

P - List of 126 Section 307(a) Priority Toxic Pollutants.

Q - *Wetlands and 401 Certification: Opportunities and Guidelines for States and Eligible Indian Tribes* - April 1989.

R - *Policy on the Use of Biological Assessments and Criteria in the Water Quality Program*, May 1991.

S - Reserved.

T - Use Attainability Analysis Case Studies.

U - List of EPA Regional Water Quality Standards Coordinators.

V - Water Quality Standards Program Document Request Forms.

W - Update Request Form for *Water Quality Standards Handbook - Second Edition.*

GLOSSARY

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

GLOSSARY

The "Act" refers to the Clean Water Act (Public Law 92-500, as amended (33 USC 1251, et seq.) (40 CFR 131.3.)

"Acute" refers to a stimulus severe enough to rapidly induce an effect; in aquatic toxicity tests, an effect observed in 96- hours or less is typically considered acute. When referring to aquatic toxicology or human health, an acute affect is not always measured in terms of lethality (USEPA, 1991a.)

"Acute-chronic ratio" (ACR) is the ratio of the acute toxicity of an effluent or a toxicant to its chronic toxicity. It is used as a factor for estimating chronic toxicity on the basis of acute toxicity data, or for estimating acute toxicity on the basis of chronic toxicity data (USEPA, 1991a.)

"Acutely toxic conditions" are those acutely toxic to aquatic organisms following their short-term exposure within an affected area (USEPA, 1991a.)

"Additivity" is the characteristic property of a mixture of toxicants that exhibits a total toxic effect equal to the arithmetic sum of the effects of the individual toxicants (USEPA, 1991a.)

"Ambient toxicity" is measured by a toxicity test on a sample collected from a water body (USEPA, 1991a.)

"Antagonism" is the characteristic property of a mixture of toxicants that exhibits a less-than-additive total toxic effect (USEPA, 1991a.)

"Aquatic community" is an association of interacting populations of aquatic organisms in a given water body or habitat (USEPA, 1990; USEPA, 1991a.)

"Averaging period" is the period of time over which the receiving water concentration is averaged for comparison with criteria concentrations. This specification limits the duration of concentrations above the criteria (USEPA, 1991a.)

"Bioaccumulation" is the process by which a compound is taken up by an aquatic organism, both from water and through food (USEPA, 1991a.)

"Bioaccumulation factor" (BAF) is the ratio of a substance's concentration in tissue versus its concentration in ambient water, in situations where the organism and the food chain are exposed (USEPA, 1991a.)

"Bioassay" is a test used to evaluate the relative potency of a chemical or a mixture of chemicals by comparing its effect on a living organism with the effect of a standard preparation on the same type of organism. Bioassays are frequently used in the pharmaceutical industry to evaluate the potency of vitamins and drugs (USEPA, 1991a.)

"Bioavailability" is a measure of the physicochemical access that a toxicant has to the biological processes of an organism. The less the bioavailability of a toxicant, the less its toxic effect on an organism (USEPA, 1991a.)

"Bioconcentration" is the process by which a compound is absorbed from water through gills or epithelial tissues and is concentrated in the body (USEPA, 1991a.)

"Bioconcentration factor" (BCF) is the ratio of a substance's concentration in tissue versus its concentration in water, in situations where the food chain is not exposed or contaminated. For non-metabolized substances, it represents equilibrium partitioning between water and organisms (USEPA, 1991a.)

"Biological criteria" are narrative expressions or numeric values of the biological characteristics of aquatic communities based on appropriate reference conditions. As such, biological criteria serve as an index of aquatic community health. It is also known as **biocriteria** (USEPA, 1991a.)

"Biological integrity" is the condition of the aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by community structure and function (USEPA, 1991a.)

"Biological monitoring" describes the use of living organisms in water quality surveillance to indicate compliance with water quality standards or effluent limits and to document water quality trends. Methods of biological monitoring may include, but are not limited to, toxicity testing (such as ambient toxicity testing or whole-effluent toxicity testing) and biological surveys. It is also known as **biomonitoring** (USEPA, 1991a.)

"Biological survey or biosurvey" is collecting, processing, and analyzing a representative portion of the resident aquatic community to determine its structural and/or functional characteristics (USEPA. 1991a.)

"Biomagnification" is the process by which the concentration of a compound increases in species occupying successive trophic levels (USEPA, 1991a.)

"Cancer potency slope factor" (q_1*) is an indication of a chemical's human cancer-causing potential derived using animal studies or epidemiological data on human exposure; based on extrapolation of high-dose levels over short periods of time to low-dose levels and a lifetime exposure period through the use of a linear model (USEPA, 1991a.)

"Chronic" defines a stimulus that lingers or continues for a relatively long period of time, often one-tenth of the life span or more. Chronic should be considered a relative term depending on the life span of an organism. The measurement of a chronic effect can be reduced growth, reduced reproduction, etc., in addition to lethality (USEPA, 1991a.)

"Community component" is a general term that may pertain to the biotic guild (fish, invertebrates, algae), the taxonomic category (order, family, genus, species), the feeding strategy (herbivore, omnivore, predator), or the organizational level (individual, population, assemblage) of a biological entity within the aquatic community (USEPA, 1991a.)

"Completely mixed condition" is defined as no measurable difference in the concentration of a pollutant exists across a transect of the water body (e.g., does not vary by 5%) (USEPA, 1991a.)

"Criteria" are elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated use (40 CFR 131.3.)

"Criteria continuous concentration" (CCC) is the EPA national water quality criteria recommendation for the highest instream concentration of a toxicant or an effluent to which organisms can be exposed indefinitely without causing unacceptable effect (USEPA, 1991a.)

"Criteria maximum concentration" (CMC) is the EPA national water quality criteria recommendation for the highest instream concentration of a toxicant or an effluent to which organisms can be exposed for a brief period of time without causing an acute effect (USEPA, 1991a.)

"Critical life stage" is the period of time in an organism's lifespan in which it is the most susceptible to adverse effects caused by exposure to toxicants, usually during early development (egg, embryo, larvae). Chronic toxicity tests are often run on critical life stages to replace long duration, life cycle tests since the most toxic effect usually occurs during the critical life stage (USEPA, 1991a.)

"Design flow" is the flow used for steady-state waste load allocation modeling (USEPA, 1991a.)

"Designated uses" are those uses specified in water quality standards for each water body or segment whether or not they are being attained (40 CFR 131.3.)

"Discharge length scale" is the square root of the cross-sectional area of any discharge outlet (USEPA, 1991a.)

"Diversity" is the number and abundance of biological taxa in a specified location (USEPA, 1991a.)

"Effective concentration" (EC) is a point estimate of the toxicant concentration that would cause an observable adverse effect (such as death, immobilization, or serious incapacitation) in a given percentage of the test organisms (USEPA, 1991a.)

"Existing uses" are those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards (40 CFR 131.3.)

"Federal Indian Reservation," "Indian Reservation," or "Reservation" is defined as all land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, and including rights-of-way running through the reservation (40 CFR 131.3.)

"Final acute value" (FAV) is an estimate of the concentration of the toxicant corresponding to a cumulative probability of 0.05 in the acute toxicity values for all genera for which acceptable acute tests have been conducted on the toxicant (USEPA, 1991a.)

"Frequency" is how often criteria can be exceeded without unacceptably affecting the community (USEPA, 1991a.)

"Harmonic mean flow" is the number of daily flow measurements divided by the sum of the reciprocals of the flows. That is, it is the reciprocal of the mean of reciprocals (USEPA, 1991a.)

"Indian Tribe" or "Tribe" describes any Indian Tribe, band, group, or community recognized by the Secretary of the Interior and exercising governmental authority over a Federal Indian reservation (40 CFR 131.3.)

"Inhibition concentration" (IC) is a point estimate of the toxicant concentration that would cause a given percent reduction (e.g., IC25) in a non-lethal biological measurement of the test organisms, such as reproduction or growth (USEPA, 1991a.)

"Lethal concentration" is the point estimate of the toxicant concentration that would be lethal to a given percentage of the test organisms during a specified period (USEPA, 1991a.)

"Lipophilic" is a high affinity for lipids (fats) (USEPA, 1991a.)

"Load allocations" (LA) the portion of a receiving water TMDL that is attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources (USEPA, 1991a.)

"Lowest-observed-adverse-effect-level" (LOAEL) is the lowest concentration of an effluent or toxicant that results in statistically significant adverse health effects as observed in chronic or subchronic human epidemiology studies or animal exposure (USEPA, 1991a.)

"Magnitude" is how much of a pollutant (or pollutant parameter such as toxicity), expressed as a concentration or toxic unit is allowable (USEPA, 1991a.)

"Minimum level" (ML) refers to the level at which the entire analytical system gives recognizable mass spectra and acceptable calibration points when analyzing for pollutants of concern. This level corresponds to the lowest point at which the calibration curve is determined (USEPA, 1991a.)

"Mixing zone" is an area where an effluent discharge undergoes initial dilution and is extended to cover the secondary mixing in the ambient water body. A mixing zone is an allocated impact zone where water quality criteria can be exceeded as long as acutely toxic conditions are prevented (USEPA, 1991a.)

"Navigable waters" refer to the waters of the United States, including the territorial seas (33 USC 1362.)

"No-observed-adverse-effect-level" (NOAEL) is a tested dose of an effluent or a toxicant below which no adverse biological effects are observed, as identified from chronic or subchronic human epidemiology studies or animal exposure studies (USEPA, 1991a.)

"No-observed-effect-concentration" (NOEC) is the highest tested concentration of an effluent or a toxicant at which no adverse effects are observed on the aquatic test organisms at a specific time of observation. Determined using hypothesis testing (USEPA, 1991a.)

"Nonthreshold effects" are associated with exposure to chemicals that have no safe exposure levels. (i.e., cancer) (USEPA, 1991a.)

"Persistent pollutant" is not subject to decay, degradation, transformation, volatilization, hydrolysis, or photolysis (USEPA, 1991a.)

"Pollution" is defined as the man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of water (33 USC 1362.)

"Priority pollutants" are those pollutants listed by the Administrator under section 307(a) of the Act (USEPA, 1991a.)

"Reference ambient concentration" (RAC) is the concentration of a chemical in water which will not cause adverse impacts to human health; RAC is expressed in units of mg/l (USEPA, 1991a.)

"Reference conditions" describe the characteristics of water body segments least impaired by human activities. As such, reference conditions can be used to describe attainable biological or habitat conditions for water body segments with common watershed/catchment characteristics within defined geographical regions.

"Reference tissue concentration" (RTC) is the concentration of a chemical in edible fish or shellfish tissue which will not cause adverse impacts to human health when ingested. RTC is expressed in units of mg/kg (USEPA, 1991a.)

"Reference dose" (RfD) is an estimate of the daily exposure to human population that is likely to be without appreciable risk of deleterious effect during a lifetime; derived from NOAEL or LOAEL (USEPA, 1991a.)

"Section 304(a) criteria" are developed by EPA under authority of section 304(a) of the Act based on the latest scientific information on the relationship that the effect of a constituent concentration has on particular aquatic species and/or human health. This information is issued periodically to the States as guidance for use in developing criteria (40 CFR 131.3.)

"States" include: the 50 States, the District of Columbia, Guam, the Commonwealth of Puerto Rico, Virgin Islands, American Samoa, the Trust Territory of the Pacific Islands, and the Commonwealth of the Northern Mariana Islands, and Indian Tribes that EPA determines qualify for treatment as States for the purposes of water quality standards (40 CFR 131.3.)

"Steady-state model" is a fate and transport model that uses constant values of input variables to predict constant values of receiving water quality concentrations (USEPA, 1991a.)

"STORET" is EPA's computerized water quality database that includes physical, chemical, and biological data measured in water bodies throughout the United States (USEPA, 1991a.)

"Sublethal" refers to a stimulus below the level that causes death (USEPA, 1991a.)

"Synergism" is the characteristic property of a mixture of toxicants that exhibits a greater-than-additive total toxic effect (USEPA, 1991a.)

"Threshold effects" result from chemicals that have a safe level (i.e., acute, subacute, or chronic human health effects) (USEPA, 1991a.)

"Total maximum daily load" (TMDL) is the sum of the individual waste load allocations (WLAs) and load allocations (LAs); a margin of safety is included with the two types of allocations so that any additional loading, regardless of source, would not produce a violation of water quality standards (USEPA, 1991a.)

"Toxicity test" is a procedure to determine the toxicity of a chemical or an effluent using living organisms. A toxicity test measures the degree of effect on exposed test organisms of a specific chemical or effluent (USEPA, 1991a.)

"Toxic pollutant" refers to those pollutants, or combination of pollutants, including disease-causing agents, which after discharge and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will, or on the basis of information available to the administrator, cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring (33 USC section 1362.)

"Toxic units" (TUs) are a measure of toxicity in an effluent as determined by the acute toxicity units (TUa) or chronic toxicity units (TUc) measured (USEPA, 1991a.)

"Toxic unit acute" (TUa) is the reciprocal of the effluent concentration that causes 50 percent of the organisms to die by the end of the acute exposure period (i.e., $100/LC_{50}$) (USEPA, 1991a.)

"Toxic unit chronic" (TUc) is the reciprocal of the effluent concentration that causes no observable effect on the test organisms by the end of the chronic exposure period (i.e., 100/NOEC) (USEPA, 1991a.)

"Use attainability analysis" (UAA) is a structured scientific assessment of the factors affecting the attainment of the use which may include physical, chemical, biological, and economic factors as described in section 131.10(g) (40 CFR 131.3.)

"Waste load allocation" (WLA) is the portion of a receiving water's TMDL that is allocated to one of its existing or future point sources of pollution (USEPA, 1991a.)

"Water quality assessment" is an evaluation of the condition of a water body using biological surveys, chemical-specific analyses of pollutants in water bodies, and toxicity tests (USEPA, 1991a.)

"Water quality limited segment" refers to any segment where it is known that water quality does not meet applicable water quality standards and/or is not expected to meet applicable water quality

standards even after application of technology-based effluent limitations required by sections 301(b)(1)(A) and (B) and 306 of the Act (40 CFR 131.3.)

"Water quality standards" (WQS) are provisions of State or Federal law which consist of a designated use or uses for the waters of the United States, water quality criteria for such waters based upon such uses. Water quality standards are to protect public health or welfare, enhance the quality of the water and serve the purposes of the Act (40 CFR 131.3.)

"Waters of the United States" refer to:

(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 or degradation of which would affect 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;

(ii) from which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

(iii) which are 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 in paragraphs (1) through (4) of this definition;

(6) the territorial sea; and

(7) wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (1) through (6) of this definition. "Wetlands" are defined as 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.

Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of the Act (other than cooling ponds as defined in 40 CFR 423.11(m) which also meet the criteria for this definition) are not waters of the United States. (40 CFR 232.2.)

"Whole-effluent toxicity" is the total toxic effect of an effluent measured directly with a toxicity test (USEPA, 1991a.)

INTRODUCTION

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

INTRODUCTION

HISTORY OF THE WATER QUALITY STANDARDS PROGRAM

Statutory History

The first comprehensive legislation for water pollution control was the Water Pollution Control Act of 1948 (Public Law 845, 80th Congress). This law, passed after a half century of debate on the responsibility of the Federal Government for resolving water pollution problems, adopted principles of State-Federal cooperative program development, limited Federal enforcement authority, and provided limited financial assistance. These concepts were continued in the Federal Water Pollution Control Act (FWPCA) of 1956 (Public Law 660, 84th Congress) and in the Water Quality Act of 1965. Under the 1965 Act, States were directed to develop water quality standards for interstate waters. As a result of enforcement complexities and other problems, however, this approach was not sufficiently effective. In the FWPCA Amendments of 1972 (Public Law 92-500), Congress established a discharge permit system and provided a broader Federal role through more extensive Federal grants to finance local sewage treatment systems and through Federal (EPA) setting of technology-based effluent limitations. The 1972 Amendments extended the water quality standards program to intrastate waters and provided for implementation of water quality standards through discharge permits.

Section 303(c) of the 1972 FWPCA Amendments (33 USC 1313(c)) established the statutory basis for the current water quality standards program. It completed the transition from the previously established program of water quality standards for interstate waters to one requiring standards for all surface waters of the United States.

Although the major innovation of the 1972 FWPCA was technology-based controls, Congress maintained the concept of water quality standards both as a mechanism to establish goals for the Nation's waters and as a regulatory requirement when standardized technology controls for point source discharges and/or nonpoint source controls were inadequate. In recent years, Congress and EPA have given these water quality-based controls new emphasis in the continuing quest to enhance and maintain water quality to protect the public health and welfare.

Briefly stated, the key elements of section 303(c) are as follows:

(1) A water quality standard is defined as the designated beneficial uses of a water segment and the water quality criteria necessary to support those uses;

(2) The minimum beneficial uses to be considered by States in establishing water quality standards are specified as public water supplies, propagation of fish and wildlife, recreation, agricultural uses, industrial uses, and navigation;

(3) A requirement specifies that State standards must protect public health or welfare, enhance the quality of water, and serve the purposes of the Clean Water Act;

(4) A requirement specifies that States must review their standards at least once each 3-year period using a process that includes public participation;

(5) The process is described for EPA review of State standards that might ultimately result in the promulgation of a superseding Federal rule in cases where a State's standards are not consistent with the applicable requirements of the CWA, or in situations where the Agency determines that Federal standards are necessary to meet the requirements of the Act.

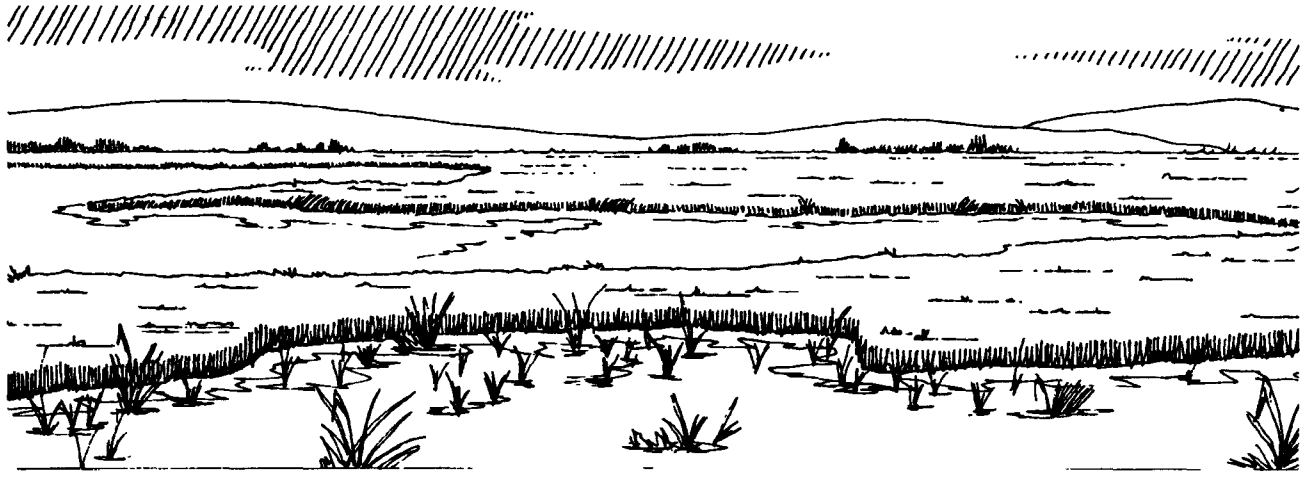
The Federal Water Pollution Control Act, including the major 1977, 1981, and 1987 Amendments are commonly referred to as the "Clean Water Act" (the Act or CWA).

On February 4, 1987, Congress enacted the Water Quality Act of 1987 (Public Law 100-4), making substantial additions to the Clean Water Act and directly affecting the standards program. Congress concluded that toxic pollutants in water constitute one of the most pressing water pollution problems. The Water Quality Act provided a new approach to controlling toxic pollutants by requiring ". . . States to identify waters that do not meet water quality standards due to the discharge of toxic substances, to adopt numerical criteria for the pollutants in such waters, and to establish effluent limitations for individual discharges to such water bodies" (from Senator Mitchell, 133 Congressional Record S733). As now amended, the Clean Water Act requires that States adopt numeric criteria for toxic pollutants listed under section 307(a) of the Clean Water Act for which section 304(a) criteria have been published, if the presence of these pollutants is likely to adversely affect the water body's use. Guidance on these changes is discussed in detail in section 3.4 of this Handbook. Additionally, for the first time, the Act explicitly recognizes antidegradation (see section 303(d)(4) of the Act).

Regulatory History

EPA first published a water quality standards regulation in 1975 (40 CFR 130.17, promulgated in 40 F.R. 55334, November 28, 1975) as part of EPA's water quality management regulations, mandated under section 303(e) of the Act. The first Water Quality Standards Regulation did not specifically address toxic pollutants or any other criteria. It simply required "appropriate" water quality criteria necessary to support designated uses.

In the late 1970s and early 1980s, the public and Congress raised concerns about toxic pollutant control. EPA realized that promulgating effluent guidelines or effluent standards under section 307 of the Act would not comprehensively address toxic pollutants. So, EPA decided to use the statutory connection between water quality standards and NPDES permits provided by section 301(b)(1)(C) to effectively control a range of toxic pollutants from point sources. To best accomplish this process, the Agency decided to amend the Water Quality Standards Regulation to explicitly address toxic criteria requirements in State



standards. Other legal and programmatic issues also necessitated a revision of the Standards Regulation. The culmination of this effort was the promulgation of the present Water Quality Standards Regulation on November 8, 1983 (54 F.R. 51400).

The present Water Quality Standards Regulation (40 CFR Part 131) is a much more comprehensive regulation than its predecessor. In subpart B, the Regulation addresses both the designated use component and the criteria component of a water quality standard. Section 131.11 of the Regulation requires States to review available information and ". . . to identify specific water bodies where toxic pollutants may be adversely affecting water quality . . . and must adopt criteria for such toxic pollutants applicable to the water body sufficient to protect the designated use." The Regulation provides that either or both numeric and narrative criteria may be appropriately used in water quality standards.

Since the middle of the 1980's, EPA's annual program guidance to the States reflected the increasing emphasis on controlling toxics. States were strongly encouraged to adopt criteria in their standards for the pollutants listed pursuant to section 307(a) of the Act, especially where EPA has published criteria guidance under section 304(a) of the Act.

State reaction to EPA's initiative was mixed. Several States proceeded to adopt large numbers of numeric toxic pollutant criteria, although primarily for the protection of aquatic life. Other States relied on a narrative "free from" toxicity criterion, using so-called "action levels" for toxic pollutants or for calculating site-specific criteria. Few States specifically addressed human health protection outside the National Primary Drinking Water Standards promulgated under the Safe Drinking Water Act.

In support of its 1983 regulation, EPA simultaneously issued program guidance entitled *Water Quality Standards Handbook* (December 1983). The foreword to the guidance noted that EPA's approach to controlling toxics included both chemical-specific numeric criteria and biological testing in whole-effluents or ambient waters. More detailed programmatic guidance on the application of biological testing was provided in the *Technical Support Document for Water Quality-based Toxics Control* (EPA 44/4-85-032, September 1985). This document provides the information needed to convert chemical-specific and biologically based criteria into permit limits for point source dischargers.

State water quality standards reviews submitted began to show the effects of EPA's efforts. More and more numeric criteria for toxics were being included in State standards as well as more aggressive use of the "free from toxics" narratives in setting protective NPDES permit limits. However, because of perceived problems in adopting numeric toxic pollutant criteria in State rulemaking proceedings, many States were reluctant to adopt numeric toxics criteria. Thus, in 1987, Congress responded to the lack of numeric criteria for toxic pollutants within State standards by mandating State adoption of such criteria.

In response to this new congressional mandate, EPA redoubled its efforts to promote and assist State adoption of water quality standards for priority toxic pollutants. EPA's efforts included the development and issuance of guidance to the States on December 12, 1988, which contained acceptable implementation procedures for several new sections of the Act, including sections 303(c)(2)(B).

EPA, in devising guidance for section 303(c)(2)(B), attempted to provide States with the maximum flexibility that complied with the express statutory language but also with the overriding congressional objective: prompt adoption and implementation of numeric toxics criteria. EPA believed that flexibility was important so that each State could comply with section 303(c)(2)(B) and to the extent possible, accommodate its existing water quality standards regulatory approach. The options EPA identified are described in section 3.4.1 of this Handbook.

EPA's December 1988 guidance also addressed the timing issue for State compliance with section 303(c)(2)(B). The statutory directive was clear: all State standards triennial reviews initiated after passage of the Act must include a consideration of numeric toxic criteria.

States significantly responded to the 1987 requirement for numeric criteria for toxic pollutants. For example, in 1986 on average, each State had 10 numeric criteria for freshwater aquatic life. By February 1990, the average number of freshwater aquatic life criteria was increased to 30. Also, States averaged 36 numeric criteria for human health in February 1990. However, by September 1990, many States had failed to fully satisfy the requirements of section 303(c)(2)(B).

The addition of section 303(c)(2)(B) to the Clean Water Act was an unequivocal signal to the States that Congress wanted toxics criteria in the State's water quality standards. EPA, consistent with this mandate, initiated Federal promulgation of toxic criteria for those States that had not complied with the Act. EPA proposed Federal criteria for toxic pollutants for 22 States and Territories, based on a preliminary assessment of compliance, on November 19, 1991 (56 F.R. 58420), and promulgated toxic criteria for 14 of those States on December 22, 1992 (57 F.R. 60848).

HANDBOOK CHANGES SINCE 1983

In December, 1983, EPA published its first *Water Quality Standards Handbook.* The 1983 Handbook was designed to help States implement the Water Quality Standards Regulation as revised in November 1983 (48 F.R. 51400). Since then, Congress enacted the Water Quality Act of 1987 (Public Law 100-4), making substantial additions to the Clean Water Act (CWA) directly affecting the standards program. In response to the Water Quality Act of 1987, and as a result of Federal promulgation actions, EPA amended the Water Quality Standards Regulation several times (see Appendices A and B). Since 1983 EPA also issued additional guidance to assist in the implementation of the WQS Regulation. *Water Quality Standards Handbook - Second Edition* incorporates all the WQS guidance issued since the 1983 Handbook was published. A summary of these guidance documents are as follows.

EPA Guidance on the Water Quality Act of 1987

On February 4, 1987, Congress enacted the Water Quality Act of 1987 (Public Law 100-4), making substantial additions to the Clean Water Act directly affecting the standards program. Section 303(c)(2)(B) of the Clean Water Act requires States to adopt numeric criteria for toxic pollutants listed under section 307(a) of the Clean Water Act for which section 304(a) criteria have been published, if the presence of these pollutants is likely to affect a water body's use. EPA published *Guidance for State Implementation of WQS for CWA section 303(c)(2)(B)* on December 12, 1988 (USEPA, 1988b). This guidance is incorporated into this Handbook at section 3.4.1.

The 1987 Act also added a new section 518, which requires EPA to promulgate a regulation specifying how the Agency will authorize qualified Indian Tribes to administer CWA programs including section 303 (water quality standards) and section 401 (certification) programs. Section 518 also requires EPA, in promulgating this regulation, to establish a mechanism to resolve unreasonable consequences that may result from an Indian Tribe and a State adopting differing water quality standards on common bodies of water. EPA promulgated a final regulation on December 12, 1991 (56 F.R. 64875). Guidance on water quality standards for Indian Tribes is contained in chapter 1.

Other EPA Guidance

Since 1983, EPA also developed additional policies and guidance on virtually all areas of the WQS Regulation. Following is a complete list of these guidance documents.

State Water Quality Standards Approvals: Use Attainability Analysis Submittals (USEPA, 1984d), clarifies EPA policy on several issues regarding approval of water body use designations less than the fishable/swimmable goal of the CWA. See section 6.2 for a discussion of this topic.

Interpretation of the Term "Existing Use" (USEPA, 1985e), expands on EPA's interpretation of when a use becomes an "existing use" as defined by the WQS Regulation. Discussion of "existing uses" is contained in section 4.4.

Selection of Water Quality Criteria in State Water Quality Standards (USEPA, 1985f), established EPA policy regarding the selection of appropriate water quality criteria for toxic pollutants in State water quality standards. This guidance preceded both the *Guidelines for Deriving Numerical National Water Quality Criteria for the for the Protection of Aquatic Organisms and Their Uses* (USEPA, 1985b), and the 1988 guidance on section 303(c)(2)(B) of the CWA, discussed above. Both of these later documents expand upon the February 1985 guidance, but the policy established therein

has not been substantively changed. Adoption of criteria for toxic pollutants is discussed in section 3.4.

Variances in Water Quality Standards (USEPA, 1985g), reinterprets the factors that could be considered when granting water quality standards variances. Variances are discussed in section 5.3.

Antidegradation, Waste loads, and Permits (USEPA, 1985h), clarifies that the antidegradation policy is an integral component of water quality standards and must be considered when developing waste load allocations and NPDES permits. Antidegradation is discussed in chapter 4.

Questions and Answers on Antidegradation (Appendix G), provides guidance on various aspects of the antidegradation policy where questions had arisen since the 1983 Regulation and Handbook were published.

Antidegradation Policy (USEPA, 1985i), reiterates the need for all States to have: (1) an antidegradation policy that fully complies with the Federal requirements, and (2) a procedure for consistently implementing that policy.

Answers to Questions on Nonpoint Sources and WQS (USEPA, 1986e), responded to two questions on nonpoint source pollution and water quality standards. The relationship between nonpoint source pollution and water quality standards is discussed in section 7.

Determination of "Existing Uses" for Purposes of Water Quality Standards Implementation (USEPA, 1986f), responds to concerns expressed to EPA on the interpretation of when a recreational use becomes an "existing use" as defined by the Regulation. Discussion of "existing uses" is contained in section 4.4.

Nonpoint Source Controls and Water Quality Standards (USEPA, 1987d), provides further guidance on nonpoint sources pollution and water quality standards reflecting the requirements of section 319 of the CWA as added by the 1987 CWA amendments.

EPA Designation of Outstanding National Resource Waters (USEPA, 1989f), restates the basis for EPA's practice of not designating State waters as Outstanding National Resource Waters (ONRW) where a State does not do so. ONRWs are discussed in section 4.6.

Guidance for the Use of Conditional Approvals for State WQS (USEPA, 1989g), provides guidelines for regional offices to use in granting State water quality standards approvals conditioned on the performance of specified actions by the State. Conditional approvals are discussed in section 6.2.3.

Application of Antidegradation Policy to the Niagara River (USEPA, 1989c), provides guidance on acceptable interpretations of the antidegradation policy to help attain the CWA objective to "restore and maintain" the integrity of the Nation's waters.

Designation of Recreation Uses (USEPA, 1989h), summarizes previously issued guidance, and outlines a number of acceptable State options for designating recreational uses. The use designation process is discussed in chapter 2.

Biological Criteria: National Program Guidance for Surface Waters (Appendix C), provides guidance on the effective development and application of biological criteria in the water quality standards program. Biological criteria are discussed in section 3.5.3.

National Guidance: Water Quality Standards for Wetlands (Appendix D), provides guidance for meeting the EPA priority to develop water quality standards for wetlands.

Section 401 certification and FERC licenses (USEPA, 1991h), clarifies the range of water quality standards elements that States need to apply when making CWA section 401 certification decisions. Section 401 of the CWA is discussed in section 7.6.3.

Technical Support Document for Water Quality-based Toxics Control, (USEPA, 1991a), provides technical guidance for assessing and regulating the discharge of toxic substances to the waters of the United States.

Policy on the Use of Biological Assessments and Criteria in the Water Quality Program (USEPA, 1991i), provides the basis for EPA's policy that biological surveys shall be fully integrated with toxicity and chemical-specific assessment methods in State water quality programs. Further discussion of this policy is contained in section 3.3.

Numeric Water Quality Criteria for Wetlands (Appendix E), evaluates EPA's numeric aquatic life criteria to determine how they can be applied to wetlands. Wetland aquatic life criteria are discussed in section 3.5.6.

Endangered Species Act Joint Guidance (Appendix F), establishes a procedure by which EPA, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service will consult on the development of water quality criteria and standards.

The guidance contained in each of the above documents is either incorporated into the text of the appropriate section of this Handbook or attached as appendices (see Table of Contents). The reader is directed to the original guidance documents for the explicit guidance on the topics discussed. Copies of all original guidance documents not attached as appendices may be obtained from the source listed for each document in the Reference section of this Handbook.

The *Water Quality Standards Handbook - Second Edition* is reorganized from the 1983 Handbook. An overview to Water Quality Standards and Water Quality Management programs has been added, and chapters 1 through 6 are organized to parallel the provisions of the Water Quality Standards Regulation. Chapter 7 briefly introduces the role of water quality standards in the water quality-based approach to pollution control.

The *Water Quality Standards Handbook - Second Edition* retains all the guidance in the 1983 Handbook unless such guidance was specifically revised in subsequent years.

OVERVIEW OF THE WATER QUALITY STANDARDS PROGRAM

A water quality standard defines the water quality goals of a water body, or portion thereof, by designating the use or uses to be made of the water, by setting criteria necessary to protect the uses, and by preventing degradation of water quality through antidegradation provisions. States adopt water quality standards to protect public health or welfare, enhance the quality of water, and serve the purposes of the Clean Water Act.

"Serve the purposes of the Act" (as defined in sections 101(a), 101(a)(2), and 303(c) of the Act) means that water quality standards:

- include provisions for restoring and maintaining chemical, physical, and biological integrity of State waters;
- wherever attainable, achieve a level of water quality that provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water ("fishable/swimmable"); and
- consider the use and value of State waters for public water supplies, propagation of fish and wildlife, recreation, agriculture and industrial purposes, and navigation.

Section 303(c) of the Clean Water Act provides the statutory basis for the water quality standards program. The regulatory requirements governing the program, the *Water Quality Standards Regulation*, are published at 40 CFR 131. The Regulation is divided into four subparts (A through D), which are summarized below.

General Provisions (40 CFR 131 - Subpart A)

Subpart A includes the scope (section 131.1) and purpose (section 131.2) of the Regulation, definitions of terms used in the Regulation (section 131.3), State (section 131.4) and EPA (section 131.5) authority for water quality standards, and the minimum requirements for a State water quality standards submission (section 131.6).

On December 12, 1991, the EPA promulgated amendments to Subpart A of the Water Quality Standards Regulation in response to the CWA section 518 requirements (see 56 F.R. 64875). The Amendments:

- establish a mechanism to resolve unreasonable consequences that may result from an Indian Tribe and a State adopting differing water quality standards on common bodies of water (section 131.7); and
- add procedures by which an Indian Tribe can qualify for the section 303 water quality standards and section 401 certification programs of the Clean Water Act (section 131.8).

The sections of Subpart A are discussed in chapter 1.

Establishment of Water Quality Standards - (Subpart B)

Subpart B contains regulatory requirements that must be included in State water quality standards: designated uses (section 131.10), criteria that protect the designated uses (section 131.11), and an antidegradation policy that protects existing uses and high water quality (section 131.12). Subpart B also provides for State discretionary policies, such as mixing zones and water quality standards variances (section 131.13).

Each of these sections is summarized below and discussed in detail in chapters 2 through 5 respectively.

Designation of Uses

The Water Quality Standards Regulation requires that States specify appropriate water uses to be

achieved and protected by taking into consideration the use and value of the water body for public water supply, for propagation of fish, shellfish, and wildlife, and for recreational, agricultural, industrial, and navigational purposes. In designating uses for a water body, States examine the suitability of a water body for the uses based on the physical, chemical, and biological characteristics of the water body, its geographical setting and scenic qualities, and the social-economic and cultural characteristics of the surrounding area. Each water body does not necessarily require a unique set of uses. Instead, the characteristics necessary to support a use can be identified so that water bodies having those characteristics might be grouped together as supporting particular uses.

Any water body with standards not consistent with the section 101(a)(2) goals of the Act must be reexamined every 3 years to determine if new information has become available that would warrant a revision of the standard. In addition, the Regulation requires that where existing water quality standards specify designated uses less than those which are presently being attained, the State shall revise its standards to reflect the uses actually being attained.

When reviewing uses, States must perform and submit to EPA a use attainability analysis if:

- either the State designates or has designated uses that do not include the uses specified in section 101(a)(2) of the Act;
- the State wishes to remove a designated use that is specified in section 101(a)(2); or
- the State wishes to adopt subcategories of uses specified in section 101(a)(2) that require less stringent criteria than are currently adopted.

States may adopt seasonal uses as an alternative to reclassifying a water body or segment thereof to uses requiring less stringent criteria. In no case may a State remove an existing use. No use attainability analysis is required when designating uses that include those specified in section 101(a)(2) of the Act.

Criteria Development and Review

States adopt water quality criteria with sufficient coverage of parameters and of adequate stringency to protect designated uses. In adopting criteria to protect the designated uses, States may:

- adopt the criteria that EPA publishes under section 304(a) of the Act;
- modify the section 304(a) guidance to reflect site-specific conditions; or
- use other scientifically defensible methods.

Section 131.11 encourages States to adopt both numeric and narrative criteria. Numeric criteria are important where the cause of toxicity is known or for protection against pollutants with potential human health impacts or potential for bioaccumulation. Narrative toxic criteria, based on whole-effluent toxicity (WET) testing, can be the basis for limiting toxicity in waste discharges where a specific pollutant can be identified as causing or contributing to the toxicity but there are no numeric criteria in the State standards or where toxicity cannot be traced to a particular pollutant. Whole-effluent toxicity testing is also appropriate for discharges containing multiple pollutants because WET testing provides a method for evaluating synergistic and antagonistic effects on aquatic life.

Section 303(c)(2)(B) requires States to adopt criteria for all section 307(a) toxic pollutants for which the Agency has published criteria under section 304(a) of the Act, if the discharge or presence of the pollutant could reasonably be expected to interfere with the designated uses of the water body. The section 307(a) list contains 65 compounds and families of compounds, which the Agency has interpreted to include 126 "priority" toxic pollutants for regulatory purposes. If data indicate that it is reasonable to expect that

one or more of the section 307(a) toxic pollutants will interfere with the attainment of the designated use, or is actually interfering with the designated use, then the State must adopt a numeric limit for the specific pollutant. Section 303(c)(2)(B) also provides that where EPA-recommended numeric criteria are not available, States shall adopt criteria based on biological monitoring or assessment methods.

Antidegradation Policy and Implementation Methods

Water quality standards include an antidegradation policy and methods through which the State implements the antidegradation policy. Section 131.12 sets out a three-tiered approach for the protection of water quality.

"Tier 1" (40 CFR 131.12(a)(1)) of antidegradation maintains and protects existing uses and the water quality necessary to protect these uses. An existing use can be established by demonstrating that fishing, swimming, or other uses have actually occurred since November 28, 1975, or that the water quality is suitable to allow such uses to occur, whether or not such uses are designated uses for the water body in question.

"Tier 2" (section 131.12(a)(2)) protects the water quality in waters whose quality is better than that necessary to protect "fishable/ swimmable" uses of the water body. 40 CFR 131.12(a)(2) requires that certain procedures be followed and certain showings be made (an "antidegradation review") before lowering water quality in high-quality waters. In no case may water quality on a Tier II water body be lowered to the level at which existing uses are impaired.

"Tier 3" (section 131.12 (a)(3)) protects outstanding national resource waters (ONRWs), which are provided the highest level of protection under the antidegradation policy. ONRWs generally include the highest quality waters of the United States. However, the ONRW antidegradation classification also offers special protection for waters of "exceptional ecological significance," i.e., those water bodies which are important, unique, or sensitive ecologically, but whose water quality, as measured by the traditional parameters such as dissolved oxygen or pH, may not be particularly high. Waters of exceptional ecological significance also include waters whose characteristics cannot adequately be described by traditional parameters (such as wetlands and estuaries).

Antidegradation implementation procedures address how States will ensure that the permits and control programs meet water quality standards and antidegradation policy requirements.

General Policies

The Water Quality Standards Regulation allows States to include in their standards State policies and provisions regarding water quality standards implementation, such as mixing zones, variances, and low-flow exemptions subject to EPA review and approval. These policies and provisions should be specified in the State's water quality standards document. The State's rationale and supporting documentation should be submitted to EPA for review during the water quality standards review and approval process.

Mixing Zones

States may, at their discretion, allow mixing zones for dischargers. The States' water quality standards should describe the methodology for determining the location, size, shape, outfall design, and in-zone quality of mixing zones. Careful consideration must be given to the

appropriateness of a mixing zone where a substance discharged is bioaccumulative, persistent, carcinogenic, mutagenic, or teratogenic.

Low-Flow Provisions

State water quality standards should protect water quality for the designated and existing uses in critical low-flow situations. States may, however, designate a critical low-flow below which numerical water quality criteria do not apply. When reviewing standards, States should review their low-flow provisions for conformance with EPA guidance.

Water Quality Standards Variances

As an alternative to removing a designated use, a State may wish to include a variance as part of a water quality standard, rather than change the standard across the board, because the State believes that the standard ultimately can be attained. By maintaining the standard rather than changing it, the State will assure that further progress is made in improving water quality and attaining the standard. EPA has approved State-adopted variances in the past and will continue to do so if:

- the variance is included as part of the water quality standard;
- the variance is subjected to the same public review as other changes in water quality standards;
- the variance is granted based on a demonstration that meeting the standard is not feasible due to the presence of any of the same conditions as if the State were removing a designated use (these conditions are listed in section 131.10(g) of the Regulation); and
- existing uses will be fully protected.

Water Quality Standards Review and Revision Process - (Subpart C)

The Clean Water Act requires States to hold a public hearing(s) to review their water quality standards at least once every 3 years and revise them if appropriate. After State water quality standards are officially adopted, a Governor or designee submits the standards to the appropriate EPA Regional Administrator for review. EPA reviews the State standards to determine whether the analyses performed are adequate. The Agency also evaluates whether the designated uses and criteria are compatible throughout the water body and whether the downstream water quality standards are protected. After reviewing the standards, EPA makes a determination whether the standards meet the requirements of the law and EPA's water quality standards regulations. If EPA disapproves a standard, the Agency indicates what changes must be made for the standard to be approved. If a State fails to make the required changes, EPA promulgates a Federal standard, setting forth a new or revised water quality standard applicable to the State.

State Review and Revision

States identify additions or revisions necessary to existing standards based on their 305(b) reports, other available water quality monitoring data, previous water quality standards reviews, or requests from industry, environmental groups, or the public. Water quality standards reviews and revisions may take many forms, including additions to and modifications in uses, in criteria, in the antidegradation policy, in the antidegradation implementation procedures, or in other general policies.

Some States review parts of their water quality standards every year. Other States perform a comprehensive review every 3 years. Such reviews are necessary because new scientific and technical data may become available. Environmental changes over time may also necessitate the need for the review.

EPA Review

When States adopt new or revised WQS, the State is required under CWA section 303(c) to submit such standards to EPA for review and approval/disapproval. EPA reviews and approves/disapproves the standards based on whether the standards meet the requirements of the CWA. As a result of the EPA review process, three actions are possible:

- EPA approval (in whole or in part) of the submitted State water quality standards; or
- EPA disapproval (in whole or in part) of the submitted State water quality standards; or
- EPA conditional approval (in whole or in part) of the submitted State water quality standards.

Revisions to State water quality standards that meet the requirements of the Act and the WQS Regulation are approved by the appropriate EPA Regional Administrator. If only a partial approval is made, the Region, in notifying the State, identifies the portions which should be revised (e.g., segment-specific requirements).

If the Regional Administrator determines that the revisions submitted are not consistent with or do not meet the requirements of the Act or the WQS Regulation, the Regional Administrator disapproves the standards within 90 days with a written notification to the State. The letter notifies the State that the Administrator will initiate promulgation proceedings if the State fails to adopt and submit the necessary revisions within 90 days after notification. The State water quality standard remains in effect, even though disapproved by EPA, until the State revises it or EPA promulgates a rule that supersedes the State water quality standard.

Federally Promulgated Water Quality Standards - (Subpart D)

As discussed above, EPA may promulgate Federal Water Quality Standards. Section 303 of the Clean Water Act permits the Administrator to promulgate Federal standards:

- if a revised or new water quality standards submitted by the State is determined by the Administrator not to be consistent with the applicable requirements of the Act; or
- in any case where the Administrator determines that a new or revised standard is necessary to meet the requirements of the Act.

Federal promulgations are codified under Subpart D of the Regulation.

THE ROLE OF WQS IN THE WATER QUALITY MANAGEMENT PROGRAM

State water quality standards play a central role in a State's water quality management program, which identifies the overall mechanism States use to integrate the various Clean Water Act quality control requirements into a coherent management framework. This framework includes, for example:

- setting and revising standards for water bodies;
- Water Quality Assessments to determine attainment of designated uses;
- CWA section 305(b) water quality monitoring to provide information upon which water quality-based decisions will be made, progress evaluated, and success measured;
- calculating total maximum daily loads (TMDLs), waste load allocations (WLAs) for point sources of pollution, and load allocations (LAs) for nonpoint sources of pollution;
- developing a water quality management plan, certified by the Governor and approved by EPA, which lists the standards and prescribes the regulatory and construction activities necessary to meet the standards;
- preparing section 305(b) reports and lists that document the condition of the State's water quality;
- developing, revising, and implementing an effective CWA section 319 program and CZARA section 6217 program to control NPS pollution;
- making decisions involving CWA section 401 certification of Federal permits or licenses; and
- issuing NPDES permits for all point source discharges. Permits are written to meet applicable water quality standards.

The Act provides the basis for two different kinds of pollution control programs. Water quality standards are the basis of the water quality-based control program. The Act also provides for technology-based limits known as best available treatment technology economically achievable for industry and secondary treatment for publicly owned treatment works. In some cases, application of these technologically based controls will result in attaining water quality standards. Where such is not the case, the Act requires the development of more stringent limitations to meet the water quality standards.

Regulations, policy, and guidance have been issued on all the activities mentioned in this section. Chapter 7 contains a brief discussion of how water quality standards relate to many of these activities in the water quality-based approach to pollution control, but additional details on these other programs is beyond the scope of this Handbook. For further information, see the EPA guidance documents referenced in chapter 7.

FUTURE PROGRAM DIRECTIONS

Since the 1960's, the water science program has moved from solving a limited set of problems in a limited set of waters to one that is solving a broad range of complex problems in categories of U.S. waters and addressing cross-media aspects of water quality decisions. Initial efforts focused on the more visible sources of pollution such as organic loadings, solids, oil, and grease, and then shifted to toxics and more complex mixtures of pollutants.

Developments in two areas have significantly affected the scientific underpinnings of the water program. First is the science of risk assessment used to estimate risk to human health and the environment from exposure to contaminants. Second is our ability to measure pollutants in the environment at an increasing level of precision. The evolution of methods and capabilities within these two scientific disciplines has significantly advanced the sophistication of scientific analyses used to manage the water program.

As the water science program moves toward the 21st Century, we must provide technical information and tools that allow States, the regulated community, and the public to understand and apply the methods, criteria, and standards to environmental systems. This includes updating science and adapting technologies as appropriate to keep the foundation of our program solid as well as employing or modifying these approaches when appropriate for new problems.

The CWA provides broad authority through its goals and policy, such as:

> . . . to restore and maintain the chemical, physical, and biological integrity of the Nation's waters (section 101(a)); and
>
> . . . wherever attainable . . . water quality which provides for the protection and propagation of fish, shellfish, and wildlife . . . to protect the water of the United States (section 101(a)(2)).

The breadth of this authority is also reflected in specific EPA mandates such as those in section 304(a):

> [EPA] shall develop and publish . . . criteria for water accurately reflecting the latest scientific knowledge (A) on the kind and extent of all identifiable effects on health and welfare . . . (B) on the concentration and dispersion of pollutants . . . through biological, physical, and chemical processes; and (C) the effects of pollutants on biological community diversity, productivity, stability . . . including eutrophication and rates of . . . sedimentation . . . (CWA section 304(a)(1)); and
>
> [EPA] shall develop and publish . . . information (A) on the factors necessary to restore and maintain the chemical, physical, and biological integrity . . . (B) on the factors necessary for the protection and propagation of shellfish, fish, and wildlife . . . and to allow recreational activities in and on the water . . .".) (304(a)(2))(CWA section 304(a)(2))

EPA has traditionally focused on criteria for chemical pollutants, but has also developed criteria for a limited number of physical (e.g., color, turbidity, dissolves solids) and biological (bacteria, "free from" nuisance aquatic life) parameters (NAS/NAE, 1973; USEPA, 1976). However, as EPA's water quality protection program has evolved, it has become apparent that chemical criteria alone, without the criteria for the biological and physical/habitat components of

water bodies, are insufficient to fully achieve the goals of the CWA.

Future directions in the criteria and standards program will focus on providing scientific and technical tools to aid regional, State, and local environmental managers in (1) implementating the standards program, and (2) developing new science and technology that will reduce human and ecological risks resulting from exposure to unaddressed contaminants and prevent pollution from point and nonpoint sources.

Setting future national program priorities will be based on the consideration of risk assessment; statutory and court-mandated obligations; the expressed needs of regional, State, and local environmental managers and the regulated community; and the potential effectiveness of a program to influence real environmental improvement.

EPA will be developing methodologies and criteria in areas beyond the traditional chemical-specific type criteria of the past. Areas of scientific examination and potential regulatory controls include criteria to protect wildlife, wetlands, and sediment quality; biological criteria to better define desired biological communities in aquatic ecosystems; and nutrient criteria. EPA has also moved in the direction of the physical and habitat components of water quality protection in other water quality programs. For example, the CWA section 404(b)(1) Guidelines (40 CFR 230) evaluate physical characteristics (such as suspended particulates, flow, and hydroperiod), and habitat components (such as food web organisms, breeding/nesting areas, and cover). Implementation of these various types of criteria will be influenced by the environmental concerns in specific watersheds.

To protect human health, program emphasis will shift to focus on the human health impacts of pathogenic microorganisms in ambient waters that cause illness in humans, and will address concerns about the risk that contaminated fish may pose to sensitive populations whose daily diet includes large quantities of fish.

In an expanded effort to protect ecology, there will be increasing emphasis on the watershed approach by assessing all potential and actual threats to a watershed's integrity. Risk assessment of the watershed and setting priorities based on those risks will become increasingly important in future program efforts in criteria and standards as supporting elements to the watershed approach.

Over the next few years, there will be more emphasis on developing effective risk reduction strategies that include both traditional and non-traditional controls and approaches.

Future program directions in criteria development and then adoption and implementation of water quality standards will be based on the principle of ecological and human health risk reduction through sound and implementable science.

Endangered Species Act

An important consideration in future criteria and standards development will be the conduct of the consultation provisions of the Endangered Species Act (ESA) and the implementation of any revisions to standards resulting from those consultations. Section 7 of the Endangered Species Act requires all Federal agencies, in consultation with the Fish and Wildlife Service and the National Marine Fisheries Service (the Services) to assure that any action authorized, funded, or implemented by a Federal agency does not jeopardize the existence of endangered or threatened species or result in the destruction or adverse modification of their critical habitat. The definition of a Federal action is very broad and encompasses virtually every water program administered by EPA.

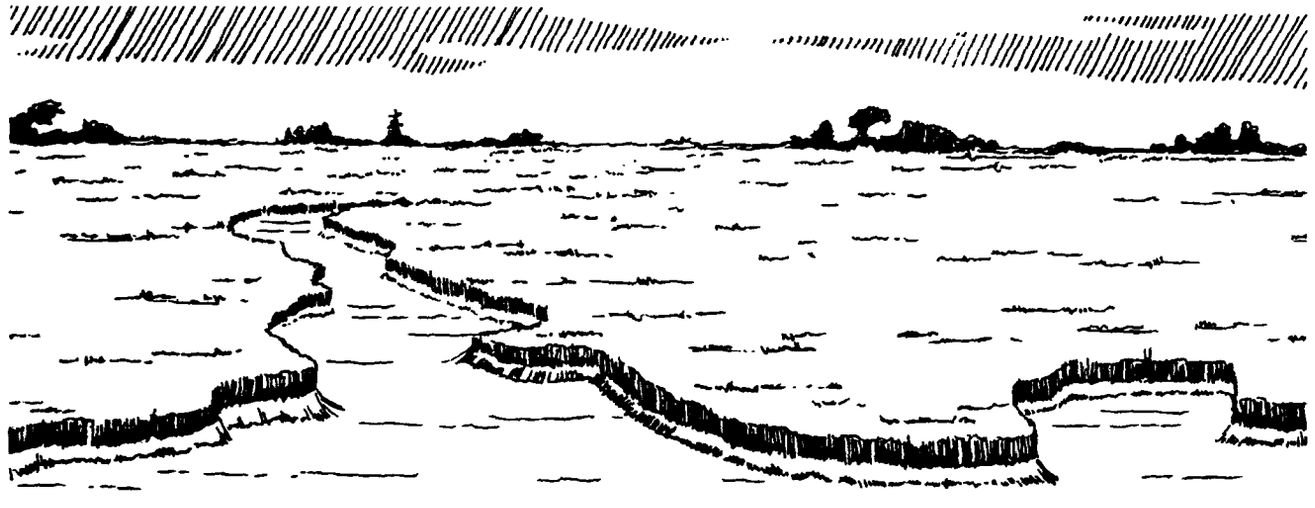
The responsibility for ensuring that consultation occurs with the Services lies with EPA, although in fulfilling the requirements a non-Federal representative may be designated for informal

consultation. (Note: Consultation may be formal or informal; the latter form is the most prevalent.) Protection of threatened and endangered species and their habitat is a critical national priority, and the criteria and standards programs can be effective tools to meet this national priority. All aspects of standards, including aquatic life criteria, uses, antidegradation, and implementation actions related to the standards are subject to consultation. All future revised aquatic life criteria, sediment, wildlife, and biological criteria will be subject to the consultation requirements as will their adoption into enforceable standards.

To form an effective partnership between the Services and EPA in creating a framework for meeting the responsibilities under section 7 of the Endangered Species Act and applicable EPA regulations, the Services and EPA entered into a joint guidance agreement in July 1992 (see Appendix F). This agreement sets forth the procedures to be followed by the Services and EPA to assure compliance with section 7 of the ESA in the development of water quality criteria published pursuant to section 304(a) of the CWA and the adoption of water quality standards under section 303(c). This agreement also indicated that the regional and field offices of EPA and the Services could establish sub-agreements specifying how they would implement the joint national guidance.

During the preparation of this second edition Handbook, the Services and EPA initiated a work group to develop a more extensive joint agreement. This group was charged with the responsibility of reviewing the July 1992 agreement, making appropriate revisions to the water quality criteria and standards sections, and adding a new section discussing the consultation procedures to be followed for the NPDES permit program. When the revised agreement is approved by the Agencies, it will replace the agreement included in this Handbook as Appendix F.

Both the current agreement and the proposed revision seek to ensure a nationally consistent consultation process that allows flexibility to deal with site-specific issues and to streamline the process to minimize the regulatory burden. The overriding goal is to provide for the protection and support of the recovery of threatened and endangered species and the ecosystems on which they depend.



CHAPTER 1

GENERAL PROVISIONS

(40 CFR 131 - Subpart A)

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CHAPTER 1
GENERAL PROVISIONS

1.1 Scope - 40 CFR 131.1

The Water Quality Standards Regulation (40 CFR 131) describes State requirements and procedures for developing, reviewing, revising, and adopting water quality standards (WQS), and EPA requirements and procedures for reviewing, approving, disapproving, and promulgating water quality standards as authorized by section 303(c) of the Clean Water Act. This Handbook serves as guidance for implementing the Water Quality Standards Regulation and its provisions.

1.2 Purpose - 40 CFR 131.2

A water quality standard defines the water quality goals for a water body, or portion thereof, by designating the use or uses to be made of the water, by setting criteria necessary to protect the uses, and by protecting water quality through antidegradation provisions. States adopt water quality standards to protect public health or welfare, enhance the quality of water, and serve the purposes of the Clean Water Act (the Act). "Serve the purposes of the Act" means that water quality standards should:

- wherever attainable, achieve a level of water quality that provides for the protection and propagation of fish, shellfish, and wildlife, and for recreation in and on the water, and take into consideration the use and value of public water supplies, and agricultural, industrial, and other purposes, including navigation (sections 101(a)(2) and 303(c) of the Act); and

- restore and maintain the chemical, physical, and biological integrity of the Nation's waters (section 101(a)).

CLEAN WATER ACT GOALS

- Achieve a level of water quality that provides for the protection and propagation of fish, shellfish, and wildlife, and for recreation in and on the water, where attainable.

- Restore and maintain the chemical, physical, and biological integrity of the Nation's waters.

These standards serve dual purposes: They establish the water quality goals for a specific water body, and they serve as the regulatory basis for establishing water quality-based treatment controls and strategies beyond the technology-based levels of treatment required by sections 301(b) and 306 of the Act.

1.3 Definitions - 40 CFR 131.3

Terms used in the Water Quality Standards Regulation are defined in section 131.3 of the regulation. These definitions, as well as others appropriate to the water quality standards program, are contained in the glossary of this Handbook. No additional guidance is necessary to explain the definitions; however, some background information on the definitions of "States" and "waters of the United States" may be helpful.

1.3.1 States

Indian Tribes may now qualify for the water quality standards and 401 certification programs. The February 4, 1987, Amendments to the Act

added a new section 518 requiring EPA to promulgate regulations specifying how the Agency will treat qualified Indian Tribes as States for the purposes of, the section 303 (water quality standards) programs, the section 401 (certification) programs, and other programs. On December 12, 1991, the EPA promulgated amendments to Subpart A of the Water Quality Standards Regulation in response to the CWA section 518 requirements (see 56 F.R. 64893). These amendments modified the definition of States by adding the phrase ". . . and Indian Tribes that EPA determines qualify for treatment as States for purposes of water quality standards."

1.3.2 Waters of the United States

Section 303(c) of the CWA requires States to adopt water quality standards for "navigable waters," which are defined at section 502(7) of the Act as "waters of the United States." The Water Quality Standards Regulation contains no definition of "waters of the United States," although this term is used in the definition of "water quality standards." The phrase "waters of the United States" has been defined elsewhere in Federal regulations (e.g., in regulations governing the National Pollutant Discharge Elimination System (NPDES) and section 404 programs (40 CFR sections 122.2, 230.3, and 232.3, respectively). This definition appears in the glossary of this Handbook and is used in interpreting the phrase "water quality standards."

The definition of "waters of the United States" emphasizes protection of a broad range of waters, including interstate and intrastate lakes, streams, wetlands, other surface waters, impoundments, tributaries of waters, and the territorial seas.

EPA believes that some States may not be providing the same protection to wetlands that they provide to other surface waters. Therefore, EPA wishes to emphasize that wetlands deserve the same protection under water quality standards. For more information on the application of water quality standards to wetlands, see Appendix D of this Handbook.

WATERS OF THE UNITED STATES

- Interstate/intrastate lakes
- Streams
- Wetlands
- Other surface waters
- Impoundments
- Tributaries of waters
- Territorial seas

Concerns have been raised regarding applicability of water quality standards to riparian areas other than riparian wetlands. "Riparian areas" are areas in a stream's floodplain with life characteristic of a floodplain. Wetlands are often found in portions of riparian areas. The Clean Water Act requires States to adopt water quality standards only for "waters of the United States," such as wetland portions of riparian areas that meet the regulatory definition. Of course, States may, at their discretion, choose to adopt water quality standards or other mechanisms to protect other riparian areas.

1.4 State Authority - 40 CFR 131.4

States (including Indian Tribes qualified for the purposes of water quality standards) are responsible for reviewing, establishing, and revising water quality standards. Under section 510 of the Act, States may develop water quality standards more stringent than required by the Water Quality Standards Regulation.

Under section 401 of the Act, States also have authority to issue water quality certifications for federally permitted or licensed activities. This authority is granted because States have jurisdiction over their waters and can influence the design and operation of projects affecting those waters. Section 401 is intended to ensure that Federal permits and licenses comply with applicable water quality requirements, including State water quality standards, and applies to all

Federal agencies that grant a license or permit. (For example, EPA-issued permits for point source discharges under section 402 and discharges of dredged and fill material under section 404 of the Clean Water Act; permits for activities in navigable waters that may affect navigation under sections 9 and 10 of the Rivers and Harbors Act (RHA); and licenses required for hydroelectric projects issued under the Federal Power Act). Section 401 certifications are normally issued by the State in which the discharge originates.

States may deny certification, approve certification, or approve certification with conditions. If the State denies certification, the Federal permitting or licensing agency is prohibited from issuing the permit or license. Certifications are subject to objection by downstream States where the downstream State determines that the proposed activity would violate its water quality standards. [For more information on the 401 certification process, refer to *Wetlands and 401 Certification: Opportunities for States and Eligible Indian Tribes* (USEPA, 1989a).]

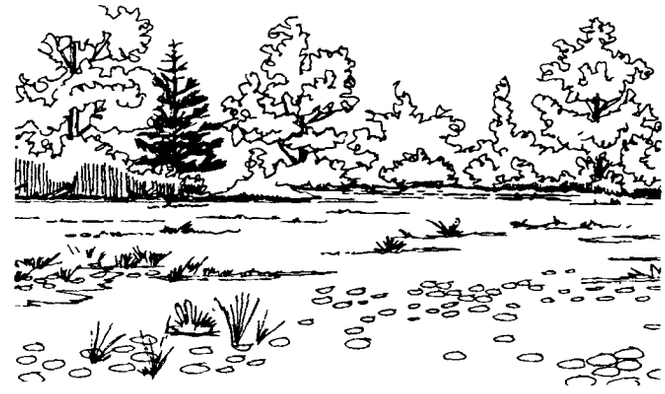
1.5 EPA Authority - 40 CFR 131.5

Under section 303(c) of the Act, EPA is to review and to approve or disapprove State-adopted water quality standards. This review involves a determination of whether:

- the State has adopted water uses consistent with the requirements of the Clean Water Act;
- the State has adopted criteria that protect the designated water uses;
- the State has followed its legal procedures for revising or adopting standards;
- the State standards that do not include the uses specified in section 101(a)(2) of the Act are based upon appropriate technical and scientific data and analyses; and
- the State submission meets the requirements included in section 131.6 of the Water Quality Standards Regulation.

EPA reviews State water quality standards to ensure that the standards meet the requirements of the Clean Water Act. If EPA determines that State water quality standards are consistent with the five factors listed above, EPA approves the standards. EPA disapproves the State water quality standards and may promulgate Federal standards under section 303(c)(4) of the Act if State-adopted standards are not consistent with the factors listed above. Section 510 of the Act provides that the States are not precluded from adopting requirements regarding control or abatement of pollution as long as such requirements are not less stringent than the requirements of the Clean Water Act. The Agency is not authorized to disapprove a State water quality standard on the basis that EPA considers the standard to be too stringent. EPA may also promulgate a new or revised standard where necessary to meet the requirements of the Act. In certain cases, EPA may conditionally approve a State's standards. A conditional approval is appropriate only:

- to correct minor deficiencies in a State's standards; and
- when a State agrees to a specific time schedule to make the corrections in as short a time as possible. Section 6.2 provides guidance on conditional approvals.



EPA also has the authority to issue section 401 certification where a State or interstate agency has no authority to do so.

1.6 Requirements for Water Quality Standards Submission - 40 CFR 131.6

The following elements must be included in each State's water quality standards submittal to EPA for review:

- use designations consistent with the provisions of sections 101(a)(2) and 303(c)(2) of the Act;
- methods used and analyses conducted to support water quality standards revisions;
- water quality criteria sufficient to protect the designated uses, including criteria for priority toxic pollutants and biological criteria;
- an antidegradation policy and implementation methods consistent with section 131.12 of the Water Quality Standards Regulation;
- certification by the State Attorney General or other appropriate legal authority within the State that the water quality standards were duly adopted pursuant to State law; and
- general information to aid the Agency in determining the adequacy of the scientific bases of the standards that do not include the uses specified in section 101(a)(2) of the Act as well as information on general policies applicable to State standards that may affect their application and implementation.

EPA may also request additional information from the State to aid in determining the adequacy of the standards.

1.7 Dispute Resolution Mechanism - 40 CFR 131.7

Section 518 of the Act requires EPA to establish a "mechanism for the resolution of any unreasonable consequences that may arise as a result of differing water quality standards that may be set by States and Indian Tribes located on common bodies of water." EPA's primary responsibility in response to this requirement is to establish a practical procedure to address and, where possible, resolve such disputes as they arise. However, the Agency's authority is limited.

For example, EPA does not believe that section 518 grants EPA authority to override section 510 of the Act. EPA believes that the provisions of section 510 would apply to Indian Tribes that qualify for treatment as States. Section 518(e) and its accompanying legislative history suggest that Congress intended for section 510 to apply to Tribes as well as States. Were Tribes prohibited from establishing standards more stringent than minimally approvable by EPA, there would be little need for the dispute resolution mechanism required by section 518(e)(2). Therefore, EPA does not believe that section 518 authorizes the Agency to disapprove a State or Tribe water quality standard and promulgate a less stringent standard as a means of resolving a State/Tribe dispute.

EPA also believes there are strong policy reasons to allow Tribes to set any water quality standards consistent with the Water Quality Standards Regulation. First, it puts Tribes and States on equal footing with respect to standards setting. There is no indication that Congress intended to treat Tribes as "second class" States under the Act. Second, treating Tribes as essentially equivalent to States is consistent with EPA's 1984 Indian Policy. Third, EPA believes it would be unfeasible to require Tribes to adopt "minimum" standards allowed under Federal law. EPA has no procedures in place for defining a "minimum" level of standards for Indian Tribes. EPA evaluates only whether the standards are stringent enough, not how much more stringent than any Federal minimum.

1.7.1 Responsibility Is With Lead EPA Regional Administrator

EPA's role in dispute resolution is to work with all parties to the dispute in an effort to reach an agreement that resolves the dispute. The Agency does not automatically support the Indian position in all disputes over water quality standards. Rather, EPA employees serving as mediators or arbitrators will serve outside the normal Agency chain of command and are expected to act in a neutral fashion.

The lead EPA Regional Administrator will be determined using OMB Circular A-95. The lead Region is expected to enlist the aid of other affected Regions in routine dispute resolution. EPA Headquarters will also oversee the process to ensure that the interests of all affected Regions are represented. Designation as the lead Region for resolving a dispute or programmatic issues within EPA does not mean that the lead Region has a license to act unilaterally. Rather, designation as lead Region assigns the responsibility to ensure that the process leading to a decision is fair to all parties.

The Regional Administrator may include other parties besides Tribes and States in the dispute resolution process. In some cases, the inclusion of permittees or landowners subject to nonpoint source restrictions may be needed to arrive at a meaningful resolution of the dispute. However, only the Tribe and State are in a position to implement a change in water quality standards and are, thus, the only "necessary" parties in the dispute resolution.

1.7.2 When Dispute Resolution May Be Initiated

The regulation establishes conditions under which the Regional Administrator would be responsible for initiating a dispute resolution action. Such actions would be initiated where, in the judgment of the Regional Administrator:

- there are unreasonable consequences;
- the dispute is between a State and a Tribe (i.e., not between a Tribe and another Tribe or a State and another State);
- a reasonable effort has been made to resolve the dispute before requesting EPA involvement;
- the requested relief is within the authority of the Act (i.e., not a request to replace State or Tribe standards that comply with the Act with less stringent Federal standards);
- the differing standards have been adopted pursuant to State or Tribe law and approved by EPA;
- a valid written request for EPA involvement has been submitted to the Regional Administrator by the State or Tribe.

Although the Regional Administrator may decline to initiate a dispute resolution action based on any of the above factors, EPA is willing to discuss specific situations. EPA is also willing to informally mediate disputes between Tribes consistent with the procedures for mediating disputes between States (see 48 F.R. 51412).

The regulation does not define "unreasonable consequences" because:

- it would be a presumptuous and unjustified Federal intrusion into local and State concerns for EPA to define what an unreasonable consequence might be as a basis for a national rule;
- EPA does not want to unnecessarily narrow the scope of problems to be addressed by the dispute resolution mechanism; and
- the possibilities of what might constitute an unreasonable consequence are so numerous as to defy a logical regulatory requirement.

Also, the occurrence of such "unreasonable" consequences is dependent on the unique

circumstances associated with the dispute. For example, what might be viewed as an unreasonable consequence on a stream segment in a large, relatively unpopulated, water-poor area with a single discharge would likely be viewed quite differently in or near an area characterized by numerous discharges and/or large water resources. The Regional Administrator has discretion to determine when consequences warrant initiating a dispute resolution action.

1.7.3 Who May Request Dispute Resolution and How

Either the State or the Tribe may request EPA involvement in the dispute. The requesting party must include the following items in its written request:

- a statement describing the unreasonable consequences;
- description of the actions taken to resolve the dispute before requesting EPA involvement;
- a statement describing the water quality standards provision (such as the particular criterion) that has resulted in the unreasonable consequences;
- factual data substantiating the claim of unreasonable consequences; and
- a statement of relief sought (that is, the desired outcome of the dispute resolution action).

1.7.4 EPA Procedures in Response to Request

When the Regional Administrator decides that EPA involvement is appropriate (based on the factors discussed in section 1.7.2, above), the Regional Administrator will notify the parties in writing that EPA dispute resolution action is being initiated and will solicit their written response. The Regional Administrator will also make reasonable efforts to ensure that other interested individuals or groups have notice of this action. These "reasonable efforts" will include, and are not limited to, the following:

- written notice to responsible Indian and State Agencies and other affected Federal Agencies;
- notice to the specific individual or entity that is claiming that an unreasonable consequence is resulting from differing standards having been adopted for a common water body;
- public notice in local newspapers, radio, and television, as appropriate;
- publication in trade journal newsletters; and
- other appropriate means.

1.7.5 When Tribe and State Agree to a Resolution

EPA encourages Tribes and States to resolve the differences without EPA involvement and to consider jointly establishing a mechanism to resolve disputes before such disputes arise. The Regional Administrator has responsibility to review and either approve or disapprove the Tribe-State agreement. Section 518(d) provides that Tribe-State agreements in general for water quality management are to be approved by EPA. As a general rule, EPA will defer to the procedure for resolving disputed jointly established by the Tribe and State so long as the procedure and the end result are consistent with the provisions of the CWA and Water Quality Standards Regulation.

1.7.6 EPA Options for Resolving the Dispute

The dispute resolution mechanism included in the final "Indian Rule" provides EPA Regional Administrators with several alternative courses of action. The alternatives are mediation, non-binding arbitration, and a default procedure.

The first technique, mediation, would allow the Regional Administrator to appoint a mediator whose primary function would be to facilitate discussions between the parties with the objective of arriving at a State/Tribe agreement or other resolution acceptable to the parties. The mediated negotiations could be informal or formal, public or private. The mediator could also establish an advisory group, consisting of representatives from the affected parties, to study the problem and recommend an appropriate resolution.

The second technique, non-binding arbitration, would require the Regional Administrator to appoint an arbitrator (or arbitration panel) whose responsibilities would include gathering all information pertinent to the dispute, considering the factors listed in the Act, and recommending an appropriate solution. The parties would not be obligated, however, to abide by the arbitrator's or arbitration panel's decision. The arbitrator or arbitration panel would be responsible for issuing a written recommendation to all parties and the Regional Administrator. Arbitrators or arbitration panel members who are EPA employees would be allowed to operate independently from the normal chain of commend within the Agency while conducting the arbitration process. Arbitrators or arbitration panel members would not be allowed to have *ex parte* communication pertaining to the dispute, except that they would be allowed to contact EPA's Office of the General Counsel for legal advise.

EPA has also provided for a dispute resolution default procedure to be used where one or more parties refuse to participate in mediation or arbitration. The default procedure will be used only as a last resort, after all other avenues of resolving the dispute have been exhausted. This dispute resolution technique would be similar to arbitration, but has been included as a separate Regional Administrator option because arbitration generally refers to a process whereby all parties participate voluntarily.

The default procedure simply provides for the Agency to review available information and to issue a recommendation for resolving the dispute. EPA's recommendation in this situation would have no enforceable impact. The Agency hopes that public presentation of its position will result in either public pressure or reconsideration by either affected party to continue resolution negotiations. Any written recommendation resulting from this procedure would be provided to all parties involved in the dispute.

EPA envisions a number of possible outcomes that, individually or in combination, would likely resolve most of the disputes that would arise. These actions might include, but are not limited to, the following:

- a State or Tribe agrees to revise the limits of a permit to ensure that downstream water quality standards are met;
- a State or Tribe agrees to permanently remove a use (consistent with 40 CFR 131.10(g));
- a State or Tribe issues a variance from water quality standards for a particular discharge;
- a permittee or landowner agrees to provide additional water pollution control;
- EPA assumes permit-issuing authority for a State or Tribe and re-issues a permit to ensure that downstream water quality standards are met; or
- EPA promulgates Federal water quality standards where a State or Tribe standard does not meet the requirements of the Act.

In some cases (last example, above), EPA recognizes that the Agency will have to act to

resolve the dispute. An example would be where a National Pollutant Discharge Elimination System (NPDES) permit for an upstream discharger does not provide for the attainment of the water quality standards for a downstream jurisdiction. The existing NPDES permitting and certification processes under the Act may be used by the downstream jurisdiction to prevent such situations. Today's rule does not alter or minimize the role of these processes in establishing appropriate permit limits to ensure attainment of water quality standards. States and Tribes are encouraged to participate in these permitting and certification processes rather than wait for unreasonable consequences to occur.

In these cases, EPA believes that the Agency has authority to object to the upstream NPDES permit and, if necessary, to assume permitting authority. This authority was upheld in a case in which EPA assumed authority to issue a permit for a North Carolina discharge that, among other factors, did not meet Tennessee's downstream water quality standards.[1]

Mediators and arbitrators may be EPA employees, employees of other Federal agencies, or other individuals with appropriate qualifications. Because of resource constraints, EPA anticipates that mediators and arbitrators will generally be EPA employees rather than consultants. Employees from other Federal agencies would be selected where appropriate, subject to their availability. EPA intends for mediators and arbitrators to conduct the dispute resolution mechanism in a fair and impartial manner, and will select individuals who have not been involved with the particular dispute. Members of arbitration panels will be selected by the Regional Administrator in consultation with the parties. In some cases, such panels may consist of one representative from each party to the dispute plus one neutral panel member. Implicit in the regulation is the sense that mediators and arbitrators will act fairly and impartially. Although not specifically covered in the regulation, EPA believes it is well within the Regional Administrator's power to remove any mediator or arbitrator for any reason (including showing bias or unfairness or taking illegal or unethical actions).

Arbitrators and arbitration panel members shall be selected to include only individuals who are agreeable to all affected parties, are knowledgeable concerning the water quality standards program requirements, have a basic understanding of the political and economic interests of Tribes, and will fulfill the duties fairly and impartially. These requirements are not applicable to mediators. EPA did not provide for State or Tribe approval of mediators because EPA believes that such an approval process would provide too great an opportunity to delay the initiation of the mediation process and because the role of the mediator is limited to acting as a neutral facilitator. There is no prohibition against the Regional Administrator consulting with the parties regarding a mediator; there is just no requirement to do so.

Where one of the parties to the dispute believes that an arbitrator has recommended an action to resolve the dispute which is not authorized by the Act, the regulation allows the party to appeal the arbitrator's decision to the Regional Administrator. Such requests must be in writing and must include a statement of the statutory basis for altering the arbitrator's recommendation.

1.7.7 Time Frame for Dispute Resolution

The regulation does not include a fixed time frame for resolving disputes. While EPA intends to proceed as quickly as possible and to encourage parties to the dispute to resolve it quickly and to establish informal time frames, the variety of potential disputes to be resolved would appear to preclude EPA from specifying a single regulatory time limit. EPA believes it is better to obtain a reasonable agreement or decision than to arbitrarily establish a time frame within which an agreement or decision must be made.

1.8 Requirements for Indian Tribes To Qualify for the WQS Program - 40 CFR 131.8

Consistent with the statutory requirement of section 518 of the Act, the Water Quality Standards Regulation establishes procedures by which an Indian Tribe may qualify for the water quality standards and section 401 certification programs. Section 131.8 of the Water Quality Standards Regulation is intended to ensure that Tribes treated as States for standards are qualified, consistent with Clean Water Act requirements, to conduct a standards program protective of public health and the environment. The procedures are not intended to act as a barrier to tribal program assumption. For the section 401 certification program, 131.4(c) establishes that where EPA determines that a Tribe is qualified for the water quality standards program, that Tribe would, without further effort or submission of information, also qualify for the section 401 certification program.

Section 518 authorizes EPA to qualify a Tribe for programs involving water resources that are:

> . . . held by an Indian Tribe, held by the U.S. in trust for Indians, held by a member of an Indian Tribe if such property interest is subject to a trust restriction on alienation, or otherwise within the borders of an Indian reservation . . . .

Tribes are limited to obtaining program authorization only for water resources within the borders of the reservation over which they possess authority to regulate water quality. The meaning of the term "reservation" must, of course, be determined in light of statutory law and with reference to relevant case law. EPA considers trust lands formally set apart for the use of Indians to be "within a reservation" for purposes of section 518 (e)(2), even if they have not been formally designated as "reservations."[2] This means it is the status and use of the land that determines if it is to be considered "within a reservation" rather than the label attached to it. EPA believes that it was the intent of Congress to limit Tribes authority to lands within the reservation. EPA bases this conclusion, in part, on the definition of "Indian Tribe" found in CWA section 518(h)(2). EPA also does not believe that section 518(e)(2) prevents EPA from recognizing tribal authority over non-Indian water resources located within the reservation if the Tribe can demonstrate (1) the requisite authority over such water resources, and (2) the authority to regulate as necessary to protect the public health, safety, and welfare of its tribal members.

1.8.1 Criteria Tribes Must Meet

New section 131.8 of the Water Quality Standards Regulation includes the criteria Tribes are required to meet to be authorized to administer the water quality standards and 401 certification programs. These criteria are provided in section 518 of the Act. The Tribe must:

- be federally recognized;
- carry out substantial governmental duties and powers over a Federal Indian reservation;
- have appropriate authority to regulate the quality of reservation waters; and
- be reasonably expected to be capable of administering the standards program.

The first criterion requires the Tribe to be recognized by the Department of the Interior. The Tribe may address this requirement by stating that it is included on the list of federally recognized Tribes published periodically by the Department of the Interior, or by submitting other appropriate documentation (e.g., the Tribe is federally recognized but not yet included on the Department of the Interior list).

The second criterion requires the Tribe to have a governing body that is carrying out substantial governmental duties and powers. EPA defines "substantial governmental duties and powers" to mean that the Tribe is currently performing governmental functions to promote the health, safety, and welfare of the affected population within a defined geographical area. Examples of such functions include, but are not limited to, the power to tax, the power of eminent domain, and police power. Federal recognition by the Department of the Interior does not, in and of itself, satisfy this criterion. Tribes must submit a narrative statement describing the form of tribal government, describing the types of essential governmental functions currently performed, and identifying the sources of authorities to perform these functions (e.g., tribal constitutions, codes).

The third criterion, concerning tribal authority, means that EPA may authorize an Indian Tribe to administer the water quality standards program only where the Tribe already possesses and can adequately demonstrate authority to manage and protect water resources within the reservation borders. The Clean Water Act authorizes use of existing tribal regulatory authority for managing EPA programs, but the Act does not grant additional authority to Tribes. EPA recognizes that, in general, Tribes possess the authority to regulate activities affecting water quality on the reservation. The Agency does not believe, however, that it is appropriate to recognize tribal authority and approve tribal administration of the water quality standards program in the absence of verifying documentation. EPA will not delegate water quality standards program authority to a Tribe unless the Tribe adequately shows that it possesses the requisite authority.

EPA does not read the Supreme Court's decision in *Brendale*[3] as preventing EPA from recognizing Tribes' authority to regulate water quality on fee lands within the reservation, even if section 518 is not an express delegation of authority. The primary significance of *Brendale* is its result, fully consistent with *Montana* v. *United States,*[4] which previously had held:

> To be sure, Indian tribes retain inherent sovereign power to exercise some forms of civil jurisdiction over non-Indians on their reservations, even on non-Indian fee lands. A tribe may regulate . . . the activities of non-members who enter consensual relationships with the tribe or its members, through commercial dealing, contracts, leases, or other arrangements. . . . A tribe may also retain inherent power to exercise civil authority over the conduct of non-Indians on fee lands within its reservation when that conduct threatens or has some direct effect on the political integrity, the economic security, or the health or welfare of the tribe.

The ultimate decision regarding tribal authority must be made on a Tribe-by-Tribe basis, and EPA has finalized the proposed process for making those determinations. EPA sees no reason in light of *Brendale* to assume that Tribes would be *per se* unable to demonstrate authority over water quality management on fee lands within reservation borders. EPA believes that as a general matter there are substantial legal and factual reasons to

assume that Tribes ordinarily have the legal authority to regulate surface water quality within a reservation.

In evaluating whether a Tribe has authority to regulate a particular activity on land owned in fee by nonmembers but located within a reservation, EPA will examine the Tribe's authority in light of the evolving case law as reflected in *Montana* and *Brendale*. The extent of such tribal authority depends on the effect of that activity on the Tribe. As discussed above, in the absence of a contrary statutory policy, a Tribe may regulate the activities of non-Indians on fee lands within its reservation when those activities threaten or have a direct effect on the political integrity, the economic security, or the health or welfare of the Tribe.

The Supreme Court, in recent cases, has explored several options to ensure that the impacts upon Tribes of the activities of non-Indians on fee land, under the *Montana* test, are more than *de minimis*, although to date the Court has not agreed, in a case on point, on any one reformulation of the test. In response to this uncertainty, the Agency will apply, as an interim operating rule, a formulation of the standard that will require a showing that the potential impacts of regulated activities on the Tribe are serious and substantial.

The choice of an Agency operating rule containing this standard is taken solely as a matter of prudence in light of judicial uncertainty and does not reflect an Agency endorsement of this standard *per se*. Moreover, as discussed below, the Agency believes that the activities regulated under the various environmental statutes generally have serious and substantial impacts on human health and welfare. As a result, the Agency believes that Tribes usually will be able to meet the Agency's operating rule, and that use of such a rule by the Agency should not create an improper burden of proof on Tribes or create the administratively undesirable result of checker-boarding reservations.

Whether a Tribe has jurisdiction over activities by nonmembers will be determined case by case, based on factual findings. The determination as to whether the required effect is present in a particular case depends on the circumstances.

Nonetheless, the Agency may also take into account the provisions of environmental statutes, and any legislative findings that the effects of the activity are serious, in making a generalized finding that Tribes are likely to possess sufficient inherent authority to control reservation environmental quality.[5] As a result, in making the required factual findings as to the impact of a water-related activity on a particular Tribe, it may not be necessary to develop an extensive and detailed record in each case. The Agency may also rely on its special expertise and practical experience regarding the importance of water management, recognizing that clean water, including critical habitat (e.g., wetlands, bottom sediments, spawning beds), is absolutely crucial to the survival of many Indian reservations.

The Agency believes that congressional enactment of the Clean Water Act establishes a strong Federal interest in effective management of water quality. Indeed, the primary objective of the CWA "is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (section 101(a)), and to achieve that objective, the Act establishes the goal of eliminating all discharges of pollutants into the navigable waters of the United States and attaining a level of water quality that is fishable and swimmable (sections 101(a)(1) and (2)). Thus the statute itself constitutes, in effect, a legislative determination that activities affecting surface water and critical habitat quality may have serious and substantial impacts.

EPA also notes that, because of the mobile nature of pollutants in surface waters and the relatively small length or size of stream segments or other water bodies on reservations, it would be very difficult to separate the effects of water quality impairment on non-Indian fee land within a reservation as compared with those on tribal

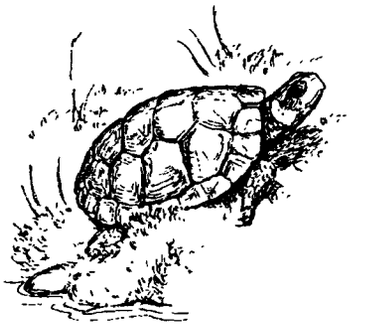
portions. In other words, any impairment that occurs on, or as a result of, activities on non-Indian fee lands is very likely to impair the water and critical habitat quality of the tribal lands. This also suggests that the serious and substantial effects of water quality impairment within the non-Indian portions of a reservation are very likely to affect the tribal interest in water quality. EPA believes that a "checkerboard" system of regulation, whereby the Tribe and State split up regulation of surface water quality on the reservation, would ignore the difficulties of assuring compliance with water quality standards when two different sovereign entities are establishing standards for the same small stream segments.

EPA also believes that Congress has expressed a preference for tribal regulation of surface water quality to ensure compliance with CWA goals. This is confirmed by the text and legislative history of section 518 itself. The CWA establishes a policy of "recogniz[ing], preserv[ing], and protect[ing] the primary responsibilities and rights of States to prevent, reduce, and eliminate pollution, [and] to plan the development and use (including restoration, preservation, and enhancement) of land and water resources" (section 101(b)). By extension, the treatment of Indian Tribes as States means that Tribes are to be primarily responsible for the protection of reservation water resources. As Senator Burdick, floor manager of the 1987 CWA Amendments, explained, the purpose of section 518 was to "provide clean water for the people of this Nation" (133 Congressional Record S1018, daily ed., Jan. 21, 1987). This goal was to be accomplished, he asserted, by giving "tribes . . . the primary authority to set water quality standards to assure fishable and swimmable water and to satisfy all beneficial uses."[6]

In light of the Agency's statutory responsibility for implementing the environmental statutes, its interpretations of the intent of Congress in allowing for tribal management of water quality within the reservation are entitled to substantial deference.[7]

The Agency also believes that the effects on tribal health and welfare necessary to support tribal regulation of non-Indian activities on the reservation may be easier to establish in the context of water quality management than with regard to zoning, which was at issue in *Brendale*. There is a significant distinction between land use planning and water quality management. The Supreme Court has explicitly recognized such a distinction: "Land use planning in essence chooses particular uses for the land; environmental regulation . . . does not mandate particular uses of the land but requires only that, however the land is used, damage to the environment is kept within prescribed limits."[8] The Court has relied on this distinction to support a finding that States retain authority to carry out environmental regulation even in cases where their ability to carry out general land use regulation is preempted by Federal law.[9]

Further, water quality management serves the purpose of protecting public health and safety, which is a core governmental function whose exercise is critical to self-government. The special status of governmental actions to protect public health and safety is well established. By contrast, the power to zone can be exercised to achieve purposes that have little or no direct nexus to public health and safety.[10] Moreover, water pollution is by nature highly mobile, freely migrating from one local jurisdiction to another, sometimes over large distances. By contrast, zoning regulates the uses of particular properties with impacts that are much more likely to be contained within a given local jurisdiction.



Operationally, EPA's generalized findings regarding the relationship of water quality to tribal health and welfare will affect the legal analysis of a tribal submission by, in effect, supplementing the factual showing a Tribe makes in applying for authority to administer the water quality standards program. Thus, a tribal submission meeting the requirements of section 131.8 of this regulation will need to make a relatively simple showing of facts that there are waters within the reservation used by the Tribe or tribal members (and thus that the Tribe or tribal members could be subject to exposure to pollutants present in, or introduced into, those waters), and that the waters and critical habitat are subject to protection under the Clean Water Act. The Tribe must also explicitly assert that impairment of such waters by the activities of non-Indians would have a serious and substantial effect on the health and welfare of the Tribe. Once the Tribe meets this initial burden, EPA will, in light of the facts presented by the Tribe and the generalized statutory and factual findings regarding the importance of reservation water quality discussed above, presume that there has been an adequate showing of tribal jurisdiction on fee lands, unless an appropriate governmental entity (e.g., an adjacent Tribe or State) demonstrates a lack of jurisdiction on the part of the Tribe.

The Agency recognizes that jurisdictional disputes between Tribes and States can be complex and difficult and that it will, in some circumstances, be forced to address such disputes. However, EPA's ultimate responsibility is protection of the environment. In view of the mobility of environmental problems, and the interdependence of various jurisdictions, it is imperative that all affected sovereigns work cooperatively for environmental protection rather than engage in confrontations over jurisdiction.

To verify authority, the Tribe is required to include a statement signed by the tribal legal counsel, or an equivalent official, explaining the legal basis for the Tribe's regulatory authority. Tribe also is required to provide appropriate additional documentation (e.g., maps, tribal codes, and ordinances).

The fourth criterion requires that the Tribe, in the Regional Administrator's judgment, should be reasonably capable of administering an effective standards program. The Agency recognizes that certain Tribes have not had substantial experience in administering surface water quality programs. For this reason, the Agency requires that Tribes either show that they have the necessary management and technical skills or submit a plan detailing steps for acquiring the necessary management and technical skills. The plan must also address how the Tribe will obtain the funds to acquire the administrative and technical expertise. When considering tribal capability, the Agency will also consider whether the Tribe can demonstrate the existence of institutions that exercise executive, legislative, and judicial functions, and whether the Tribe has a history of successful managerial performance of public health or environmental programs.

1.8.2 Application for Authority To Administer the Water Quality Standards Program

The specific information required for tribal applications to EPA is described in 40 CFR. The application is required, in general, to include a statement on tribal recognition by the Department of the Interior, documentation that the tribal governing body has substantial duties and powers, documentation of tribal authority to regulate water quality on the federally recognized reservation, a narrative statement of tribal capability to administer water quality standards programs, and any other information requested by the Regional Administrator.

When evaluating tribal experience in public health and environmental programs (under paragraph 131.8(b)(4)(ii), EPA will look for indications that the Tribe has participated in such programs, whether the programs are administered by EPA, other Federal agencies, or Tribes. For example, several Tribes are known to have participated in developing areawide water management plans or

tribal water quality standards. EPA will also look for evidence of historical budget allocations dealing with public health or environmental programs along with any experience in monitoring related programs.

The regulation allows a Tribe to describe either how it presently has the capability to manage an effective water quality standards program or how it proposes to acquire the additional administrative and technical expertise to manage such a program. EPA will carefully review for reasonableness any plans that propose to acquire expertise. EPA will not approve tribal capability demonstrations where such plans do not include reasonable provisions for acquisition of needed personnel as well as reliable funding sources. This requirement is consistent with other Clean Water Act programs. Tribes may wish to apply for section 106 funds to support their water quality standards programs and may include this source in any discussion of obtaining necessary funds.

If the Tribe has qualified to administer other Clean Water Act or Safe Drinking Water Act programs, then the Tribe need only provide the information that has not been submitted previously.

Qualifying for administration of the water quality standards program is optional for Indian Tribes and there is no time frame limiting when such application may be made. As a general policy, EPA will not deny a tribal application. Rather than formally deny the Tribe's request, EPA will continue to work cooperatively with the Tribe in a continuing effort to resolve deficiencies in the application or the tribal program so that tribal authorization may occur. EPA also concurs with the view that the intent of Congress and the EPA Indian Policy is to support tribal governments in assuming authority to manage various water programs. Authority exists for EPA to re-assert control over certain water programs due to the failure of the State or Tribe to execute the programs properly. Specifically, in the water quality standards program, the Administrator has authority to promulgate Federal standards.

1.8.3 Procedure Regional Administrator Will Apply

The review procedure established in section 131.8 is the same procedure applicable to all water programs. Although experience with the initial application in other programs indicated some delay in the process, EPA believes that as EPA and the Tribes gain experience with the procedures, delays will be minimal.

The EPA review procedure in paragraph 131.8(c) specifies that following receipt of tribal applications, the Regional Administrator will process such applications in a timely manner. The procedure calls for prompt notification to the Tribe that the application has been received, notification within 30 days to appropriate governmental entities (e.g., States and other governmental entities located contiguous to the reservation and that possess authority to regulate water quality under section 303 of the Act) of the application and the substance and basis for the Tribe's assertion of authority over reservation waters, and allowance of 30 days for review of the Tribe's assertion of authority.

EPA recognizes that city and county governments which may be subject to or affected by tribal standards may also want to comment on the Tribe's assertion of authority. Although EPA believes that the responsibility to coordinate with local governments falls primarily on the State, the Agency will make an effort to provide notice to local governments by placing an announcement in appropriate newspapers. Because the rule limits EPA to considering comments from governmental entities with Clean Water Act section 303 authority, such newspaper announcements will advise interested parties to direct comments on tribal authority to appropriate State governments.

Where a Tribe's assertion of authority is challenged, the Regional Administrator, in consultation with the Tribe, the governmental entity challenging the Tribe's assertion of authority, and the Secretary of the Interior, will determine whether the Tribe has adequately

demonstrated authority to regulate water quality on the reservation. Where the Regional Administrator concludes that the Tribe has not adequately demonstrated its authority with respect to an area in dispute, then tribal assumption of the standards program would be restricted accordingly. If the authority in dispute were focused on a limited area, this would not necessarily delay the Agency's decision to authorize the Tribe to administer the program for the nondisputed areas.

The procedure allowing participation by other governmental entities in EPA's review of tribal authority does not imply that States or Federal agencies (other than EPA) have veto power over tribal applications for treatment as a State. Rather, the procedure is simply intended to identify any competing jurisdictional claim and thereby ensure that the Tribe has the necessary authority to administer the standards program. EPA will not rely solely on the assertions of a commenter who challenges the Tribe's authority; EPA will make an independent evaluation of the tribal showing and all available information.

When evaluating tribal assertions of authority, EPA will apply the test from *Montana* v. *United States*, 450 U.S. 544 (1981), and will consider the following:

- all information submitted with the Tribe's assertion of authority;
- all information submitted during the required 30-day comment period by the governmental entities identified in 40 CFR 131.8(c)(2); and
- all information obtained by the Agency via consultation with the Department of the Interior (such consultation is required where the Tribe's assertion of authority is challenged).

EPA and the Department of the Interior have agreed to procedures for conducting consultations between the agencies. The procedure established as the Secretary of the Interior's designees the Associate Solicitor, Division of Indian Affairs, and the Deputy Assistant Secretary - Indian Affairs (Trust and Economic Development). EPA will forward a copy of the application and any documents asserting a competing or conflicting claim of authority to such designees as soon as possible. For most applications, an EPA-DOI conference will be scheduled from 1 to 3 weeks after the date the Associate Solicitor receives the application. Comments from the Interior Department will discuss primarily the law applicable to the issue to assist EPA in its own deliberations. Responsibility for legal advice to the EPA Administrator or other EPA decision makers will remain with the EPA General Counsel. EPA does not believe that the consultation process with the Department of the Interior should involve notice and opportunity for States and Tribes because such parties are elsewhere provided appropriate opportunities to participate in EPA's review of tribal authority.

EPA will take all reasonable means to advise interested parties of the decision reached regarding challenges of tribal assertions of authority. At least, written notice will be provided to State(s) and other governmental entities sent notice of the tribal application. In addition, the Water Quality Standards Regulation requires EPA to publish an annual list of standards approval actions taken within the preceding year. EPA will expand that listing to include Indian Tribes qualifying for treatment as States in the preceding year.

Comments on tribal compliance with criteria necessary for assuming the program is limited to the criterion for tribal authority. The Clean Water Act does not require EPA to provide public comment on the entire tribal application, nor does EPA believe that public comment will assist with EPA's decision- making regarding the other criteria. (The other criteria are the recognition of the Tribe by the Department of the Interior, a description of the tribal governing body, and the capability of the Tribe to administer an effective standards program.) EPA believes that providing public comment on these three criteria would

unnecessarily complicate and potentially delay the process.

1.8.4 Time Frame for Review of Tribal Application

EPA has not specified a time frame for review of tribal application. The Agency believes it is impossible to approve or disapprove all applications within a designated time frame. Because EPA has no reasonable way to predetermine how complete initial applications might be, what challenges might arise, or how numerous or complex the issues might be, the Agency deems it inappropriate to attempt to establish time frames that might not allow sufficient time for resolution. Similarly, EPA's experience with States applying for various EPA programs indicates that, at times, meetings and discussions between EPA and the States are necessary before all requirements are met. The Agency believes that the same communication with Tribes will be important to ensure expeditious processing of tribal applications.

1.8.5 Effect of Regional Administrator's Decision

A decision by the Regional Administrator that a Tribe does not meet the requirements for administering the water quality standards program does not preclude the Tribe from resubmitting the application at a future date. Rather than formally deny the Tribe's request, EPA will continue to work cooperatively with the Tribe in a continuing effort to resolve deficiencies in the application or the tribal program so that tribal authorization may occur. EPA believes that the intent of Congress and of EPA's Indian Policy is to support tribal governments in assuming authority to manage various water programs.

Where the Regional Administrator determines that the tribal application satisfies all of the requirements of section 131.8, the Regional Administrator will promptly notify the Tribe that the Tribe has qualified to administer the water quality standards program.

1.8.6 Establishing Water Quality Standards on Indian Lands

Where Tribes qualify to be treated as States for the purposes of water quality standards, EPA has the responsibility to assist the Tribe in establishing standards that are appropriate for the reservation and consistent with the Clean Water Act. EPA recognizes that Tribes have limited resources for development of water quality standards.

EPA considers the following three options acceptable to complete the task of establishing water quality standards on Indian lands:

- the Tribe may negotiate a cooperative agreement with an adjoining State to apply the State's standards to the Indian lands;
- the Tribe may incorporate the standards from an adjacent State as the Tribe's own; or
- the Tribe may independently develop and adopt standards that account for unique site-specific conditions and water body uses.

The first two options would be the quickest and least costly ways for establishing tribal water quality standards. Under option 1, the negotiated agreement could also cover requirements such as monitoring, permitting, certifications, and enforcement of water quality standards on the reservation. Option 2 would make full use of information and data developed by the State which may apply to the reservation. Tribes, as sovereign governments, have the legal authority to negotiate cooperative agreements with a State to apply that State's standards to waters on the reservation or to use State standards as the basis for tribal standards. These options do not suggest that the Tribe relinquishes its sovereign powers or enforcement authority or that the State can unilaterally apply its standards to reservation waters.

Option 3 would require more time and resources to implement because it would require the Tribe to create an entire set of standards "from

scratch." EPA does not intend to discourage this approach, but notes that Indian Tribes may want to make full use, where appropriate, of programs of adjacent States. Tribes should use this Handbook as guidance when developing standards.

EPA emphasizes that the development of tribal water quality standards is an iterative process, and that the standards development option initially selected by the Tribe can change in subsequent years. For example, a Tribe may want to use option 1 or 2 to get the standards program started. This does not preclude the Tribe from developing its own water quality standards in subsequent years.

Tribes establishing standards for the first time should carefully consider which water body uses are appropriate. Once designated uses are adopted, removing the use or adopting a subcategory of use would be subject to the requirements of section 131.10 of the Water Quality Standards Regulation.

EPA expects that, where Tribes qualify to be treated as States for the purposes of water quality standards, standards will be adopted and submitted to EPA for review within 3 years (a triennium) from the date that the Tribe is notified that it is qualified to administer the standards program. This time frame corresponds to that provided to States under the provisions of the 1965 Federal Water Pollution Control Act, when the water quality standards program was created. EPA believes that this is an equitable arrangement, and that the Tribes should be allowed sufficient time to develop their programs and adopt appropriate standards for reservation waters.

Once EPA determines that a Tribe qualifies to administer the standards program, tribal development, review, and adoption of water quality standards are subject to the same requirements that States are subject to under the Clean Water Act and EPA's implementing regulations.

Until Tribes qualify for the standards program and adopt standards under the Clean Water Act, EPA will, when possible, assume that existing water quality standards remain applicable. EPA's position on this issue was expressed in a September 9, 1988, letter from EPA's then General Counsel, Lawrence Jensen, to Dave Frohnmayer, Attorney General for the State of Oregon. This letter states: "if States have established standards that purport to apply to Indian reservations, EPA will assume without deciding that those standards remain applicable until a Tribe is authorized to establish its own standards or until EPA otherwise determines in consultation with a State and Tribe that the State lacks jurisdiction . . . ." This policy is not an assertion that State standards apply on reservations as a matter of law, but the policy merely recognizes that fully implementing a role for Tribes under the Act will require a transition period. EPA may apply State standards in this case because (1) there are no Federal standards that apply generally, and (2) to ignore previously developed State standards would be a regulatory void that EPA believes would not be beneficial to the reservation water quality. However, EPA will give serious consideration to Federal promulgation of water quality standards on Indian lands where EPA finds a particular need.

Where a State asserts authority to establish future water quality standards for a reservation, EPA policy is to ensure that the affected Tribe is made aware of the assertion so that any issues the Tribe may wish to raise can be reviewed as part of the normal standards setting process. EPA also encourages State-Tribe communication on

standards issues, with one possible outcome being the establishment of short-term cooperative working agreements pertaining to standards and NPDES permits on reservations.

1.8.7 EPA Promulgation of Standards for Reservations

If EPA determines that a Tribe possesses authority to regulate water quality on a reservation but the Tribe declines to seek authority to administer the water quality standards program, EPA has the authority under section 303 of the Act to promulgate Federal water quality standards. EPA's responsibility stems from the Act's directive to establish water quality standards for all "navigable waters." Depending on the circumstances, EPA may use the standards of an adjacent State as a starting point for such a promulgation. EPA will prioritize the promulgations based on various factors, not the least of which is availability of Agency resources to undertake the Federal rulemaking process. Because the Federal promulgation process is slow and complex, EPA may promulgate water quality standards in conjunction with re-issuing permits on the reservations.

The intent of the Clean Water Act is for States and Tribes qualifying for treatment as States to have the first opportunity to set standards. Thus, EPA prefers to work cooperatively with States and Tribes on water quality standards issues and to initiate Federal promulgation actions only where absolutely necessary.

EPA's entire policy with respect to Federal promulgation is straightforward. EPA much prefers to work with the States and have them adopt standards that comply with CWA requirements. Where Federal promulgation is necessary to achieve CWA compliance, however, EPA will act. This same philosophy will apply to Indian Tribes authorized to administer the program.

1.9 Adoption of Standards for Indian Reservation Waters

This guidance recognizes that Tribes have varying abilities to develop water quality standards. Some Tribes have more technical capability and experience in drafting implementable regulations than other Tribes and may be capable of adopting more complex standards. However, most Tribes may not have access to sufficient resources, either in personnel or in contractor funds, to pursue this course. Moreover, EPA does not have the resources to provide substantial technical assistance to individual Tribes to develop other than basic water quality standards.

1.9.1 EPA's Expectations for Tribal Water Quality Standards

Tribal water quality standards, initially at least, should focus on basic contents and reflect existing uses and existing water quality. The standards must be established for an inventory of "waters of the United States," including wetlands. The Tribes should focus on the basic structure of a water quality standards system: designated uses for identified water segments, appropriate narrative and numeric criteria, an antidegradation policy, and other general implementation policies. How complex or sophisticated these elements need to be depends upon the abilities of the Tribe and the environmental concerns affected by tribal standards.

EPA has consistently recommended to Tribes that they use directly, or with slight modification, the standards of the adjacent States as a beginning for tribal standards. Tribal water quality standards should be developed considering the quality and designated uses of waters entering and leaving reservations. It is important that the Tribes recognize what the surrounding State (or another Indian reservation) water quality standards are even though there is no requirement to match those standards, although the water quality standards regulation does require consideration of downstream water quality standards (see section 2.2, this Handbook).

At a minimum, tribal water quality standards should be established upstream and downstream from point sources where NPDES permits are applicable. It is also desirable that water quality standards be applied to waters where significant nonpoint sources enter so that the effectiveness of best management practices on the reservation's waters can be evaluated.

Water quality criteria should be carefully selected recognizing that making criteria more stringent in subsequent water quality standards reviews is more feasible than attempting relaxation of stringent criteria. While there is no mandatory list of criteria, the following should be considered the minimum:

- narrative "free froms";
- dissolved oxygen;
- pH;
- temperature;
- bacteriological criteria (for recreational and ceremonial uses); and
- toxics (including nonconventionals, e.g., ammonia and chlorine). [Use of option 1, section 2.1.3, is recommended.]

1.9.2 Optional Policies

The Tribes must also specify which optional policies they wish to use pursuant to 40 CFR 131.13 (see chapter 6, this Handbook). These include the following:

- mixing zones for point sources;
- variances for point sources;
- design low-flow specification for the application of numeric criteria; and
- schedules of compliance for criteria in NPDES, and permits.

Guidance for applying these policies are generally available in either this Handbook or in the *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a).

1.9.3 Tribal Submission and EPA Review

The initial submission of the tribal water quality standards must contain the items listed in 40 CFR 131.6 plus use attainability analyses for all waters not classified "fishable/swimmable" (see section 2.9, this Handbook). In addition, it should contain identification of endangered or threatened aquatic species or wildlife subject to protection by water quality standards. There should also be included a record containing information on the regulatory and public participation aspects of the water quality standards, public comments made, and the Tribe's responses to those comments and other relevant material required by 40 CFR 131.20.

1.9.4 Regional Reviews

The Regions should carefully coordinate the reviews within the Water Management Divisions to ensure:

- that the required items in section 131.6 are included;
- that all waters with NPDES permits have water quality standards; and
- that the tribal rulemaking meets the requirements of 40 CFR 131.20.

In commenting on tribal water quality standards, the Regions should identify situations where the dispute resolution mechanism in 40 CFR 131.7 may ultimately be called into play and should attempt to de-fuse such situations as early as possible in the standards adoption process. One possibility is to encourage Tribes and States to establish review procedures before any specific problem develops as suggested in section 131.7(e) of the regulation.

Where NPDES permits exist, the downstream jurisdiction and the Region should determine if total maximum daily loads or waste load allocations will be needed. Where this burden falls on the Tribe, EPA may need to assist the Tribe in these assessments or perform the necessary modeling for the Tribe. The Region also should assess the scope of any section 401 procedures needed in future NPDES permit renewals. The interstate nature of tribal water quality standards may become important to EPA because of the recent *Arkansas* v. *Oklahoma* U.S. Supreme Court case (112 section 1046, February 26, 1992), especially when EPA is the permit writing authority.

NOTE: Additional discussion supporting the Agency's rulemaking with respect to Indian Tribes and EPA's views on related questions may be found in the preamble discussion to the final rule (56 F.R. 64893, December 12, 1991).

Endnotes

1. *Champion International Corp. v. EPA,* 850 F.2d 182 (4th Cir. 1988)

2. *Oklahoma Tax Commission v. Citizen Band Potawatomi Indian Tribe of Oklahoma,* 111 S.Ct. 905, 910 (1991).

3. *Brendale v. Confederated Tribes and Bands of the Yakima Nation,* 492 U.S. 408, (1989)

4. *Montana v. United States,* 450 U.S. at 565-66 (citations omitted).

5. See, *e.g., Keystone Bituminous Coal Assoc. v. DeBenedictis,* 480 U.S. 470, 476-77 and notes 6, 7 (1987).

6. *Id.*

7. *Washington Dept. of Ecology v. EPA,* 752 F.2d 1465, 1469 (9th Cir. 1985); see generally *Chevron, USA v. NRDC,* 467 U.S. 837, 843-45 (1984).

8. *California Coastal Commission v. Granite Rock Co.,* 480 U.S. 572, 587 (1987).

9. *Id.* at 587-89.

10. See *e.g. Brendale,* 492 U.S. at 420 n.5 (White, J.) (listing broad range of consequences of state zoning decision).

CHAPTER 2

DESIGNATION OF USES

(40 CFR 131.10)

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CHAPTER 2
DESIGNATION OF USES

2.1 Use Classification - 40 CFR 131.10(a)

A water quality standard defines the water quality goals of a water body or portion thereof, in part, by designating the use or uses to be made of the water. States adopt water quality standards to protect public health or welfare, enhance the quality of water, and serve the purposes of the Clean Water Act. "Serve the purposes of the Act" (as defined in sections 101(a)(2), and 303(c) of the Act) means that water quality standards should:

- provide, wherever attainable, water quality for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water ("fishable/swimmable"), and

- consider the use and value of State waters for public water supplies, propagation of fish and wildlife, recreation, agriculture and industrial purposes, and navigation.

These sections of the Act describe various uses of waters that are considered desirable and should be protected. The States must take these uses into consideration when classifying State waters and are free to add use classifications. Consistent with the requirements of the Act and Water Quality Standards Regulation, States are free to develop and adopt any use classification system they see as appropriate, except that waste transport and assimilation is not an acceptable use in any case (see 40 CFR 131.10(a)). Among the uses listed in the Clean Water Act, there is no hierarchy. EPA's Water Quality Standards Regulation emphasizes the uses specified in section 101(a)(2) of the Act (first bullet, above). To be consistent with the 101(a)(2) interim goal of the Act, States must provide water quality for the *protection and propagation of fish, shellfish, and wildlife, and provide for recreation in and on the water* ("fishable/swimmable") where attainable (see 40 CFR 131.10(j)).

DESIGNATED USES
40 CFR 131.3(f)

Uses specified in Water Quality Standards for each water body or segment whether or not they are being attained.

2.1.1 Public Water Supplies

This use includes waters that are the source for drinking water supplies and often includes waters for food processing. Waters for drinking water may require treatment prior to distribution in public water systems.

2.1.2 Protection and Propagation of Fish, Shellfish, and Wildlife

This classification is often divided into several more specific subcategories, including coldwater fish, warmwater fish, and shellfish. For example, some coastal States have a use specifically for oyster propagation. The use may also include protection of aquatic flora. Many States differentiate between self-supporting fish populations and stocked fisheries. Wildlife protection should include waterfowl, shore birds, and other water-oriented wildlife.

To more fully protect aquatic habitats and provide more comprehensive assessments of aquatic life use attainment/non-attainment, it is EPA's policy that States should designate aquatic life uses that

appropriately address biological integrity and adopt biological criteria necessary to protect those uses (see Appendix R).

TYPES OF USES
CWA SECTION 303(c)(2)(A)

- Public water supplies
- Protection and propagation of fish, shellfish, and wildlife
- Recreation
- Agriculture
- Industry
- Navigation
- Coral reef preservation
- Marinas
- Groundwater recharge
- Aquifer protection
- Hydroelectric power

2.1.3 Recreation

Recreational uses have traditionally been divided into primary contact and secondary contact recreation. The primary contact recreation classification protects people from illness due to activities involving the potential for ingestion of, or immersion in, water. Primary contact recreation usually includes swimming, water-skiing, skin-diving, surfing, and other activities likely to result in immersion. The secondary contact recreation classification is protective when immersion is unlikely. Examples are boating, wading, and rowing. These two broad uses can be logically subdivided into an almost infinite number of subcategories (e.g., wading, fishing, sailing, powerboating, rafting.). Often fishing is considered in the recreational use categories.

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

A number of acceptable State options may be considered for designation of recreational uses.

Option 1

Designate primary contact recreational uses for all waters of the State, and set bacteriological criteria sufficient to support primary contact recreation. This option fully conforms with the requirement in section 131.6 of the Water Quality Standards Regulation to designate uses consistent with the provisions of sections 101(a)(2) and 303(c)(2) of the CWA. States are not required to conduct use attainability analyses (for recreation) when primary contact recreational uses are designated for all waters of the State.

Option 2

Designate either primary contact recreational uses or secondary contact recreational uses for all waters of the State and, where secondary contact recreation is designated, set bacteriological criteria sufficient to support primary contact recreation. EPA believes that a secondary contact recreational use (with criteria sufficient to support primary contact recreation) is consistent with the CWA section 101(a)(2) goal. The rationale for this option is discussed in the preamble to the Water Quality Standards Regulation, which states: ". . . even though it may not make sense to encourage use of a stream for swimming because of the flow, depth or the velocity of the water, the States and EPA must recognize that swimming and/or wading may occur anyway. In order to protect public health, States must set criteria to reflect recreational uses if it appears that recreation will in fact occur in the stream." Under this option, future revisions to the bacteriological criterion for specific stream segments would be subject to the downgrading provisions of the Federal Water Quality Standards Regulation (40 CFR 131.10).

Option 3

Designate either primary contact recreation, secondary contact recreation (with bacteriological criteria sufficient to support primary contact recreation), or conduct use attainability analyses demonstrating that recreational uses consistent with the CWA section 101(a)(2) goal are not attainable for all waters of the State. Such use attainability analyses are required by section 131.10 of the Water Quality Standards Regulation, which also specifies six factors that may be used by States in demonstrating that attaining a use is not feasible. Physical factors, which are important in determining attainability of aquatic life uses, may not be used as the basis for not designating a recreational use consistent with the CWA section 101(a)(2) goal. This precludes States from using 40 CFR 131.10(g) factor 2 (pertaining to low-flows) and factor 5 (pertaining to physical factors in general). The basis for this policy is that the States and EPA have an obligation to do as much as possible to protect the health of the public. In certain instances, people will use whatever water bodies are available for recreation, regardless of the physical conditions. In conducting use attainability analyses (UAAs) where available data are scarce or nonexistent, sanitary surveys are useful in determining the sources of bacterial water quality indicators. Information on land use is also useful in predicting bacteria levels and sources.

Other Options

- States may apply bacteriological criteria sufficient to support primary contact recreation with a rebuttable presumption that the indicators show the presence of human fecal pollution. Rebuttal of this presumption, however, must be based on a sanitary survey that demonstrates a lack of contamination from human sources. The basis for this option is the absence of data demonstrating a relationship between high densities of bacteriological water quality indicators and increased risk of swimming-associated illness in animal-contaminated waters. Maine is an example of a State that has successfully implemented this option.

- Where States adopt a standards package that does not support the swimmable goal and does not contain a UAA to justify the omission, EPA may conditionally approve the package provided that (1) the State commits, in writing, to a schedule for rapid completion of the UAAs, generally within 90 days (see conditional approval guidance in section 6.2 of this Handbook); and (2) the omission may be considered a minor deficiency (i.e., after consultation with the State, EPA determines that there is no basis for concluding that the UAAs would support upgrading the use of the water body). Otherwise, failure to support the swimmable goal is a major deficiency and must be disapproved to allow prompt Federal promulgation action.

- States may conduct basinwide use attainability analyses if the circumstances relating to the segments in question are sufficiently similar to make the results of the basinwide analyses reasonably applicable to each segment.

States may add other recreation classifications as they see fit. For example, one State protects "consumptive recreation" (i.e., "human consumption of aquatic life, semi-aquatic life, or terrestrial wildlife that depend on surface waters for survival and well-being"). States also may adopt seasonal recreational uses (see section 2.6, this Handbook).

2.1.4 Agriculture and Industry

The agricultural use classification defines waters that are suitable for irrigation of crops, consumption by livestock, support of vegetation for range grazing, and other uses in support of farming and ranching and protects livestock and crops from injury due to irrigation and other exposures.

The industrial use classification includes industrial cooling and process water supplies. This

classification protects industrial equipment from damage from cooling and/or process waters. Specific criteria would depend on the industry involved.

The *Report of the Committee on Water Quality Criteria*, the "Green Book" (FWPCA, 1968) and *Water Quality Criteria 1972*, the "Blue Book" (NAS/NAE, 1973) provide information for certain parameters on protecting agricultural and industrial uses, although section 304(a)(1) criteria for protecting these uses have not been specifically developed for numerous other parameters, including toxics.

Where criteria have not been specifically developed for agricultural and industrial uses, the criteria developed for human health and aquatic life are usually sufficiently stringent to protect these uses. States also may establish criteria specifically designed to protect these uses.

2.1.5 Navigation

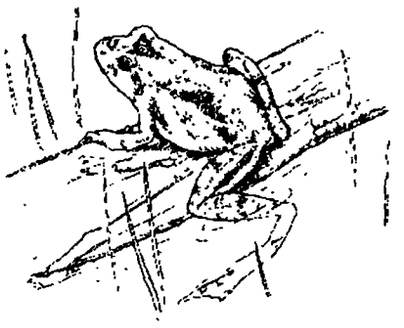
This use classification is designed to protect ships and their crews and to maintain water quality so as not to restrict or prevent navigation.

2.1.6 Other Uses

States may adopt other uses they consider to be necessary. Some examples include coral reef preservation, marinas, groundwater recharge, aquifer protection, and hydroelectric power. States also may establish criteria specifically designed to protect these uses.

2.2 Consider Downstream Uses - 40 CFR 131.10(b)

When designating uses, States should consider extraterritorial effects of their standards. For example, once States revise or adopt standards, upstream jurisdictions will be required, when revising their standards and issuing permits, to provide for attainment and maintenance of the downstream standards.



Despite the regulatory requirement that States ensure downstream standards are met when designating and setting criteria for waters, occasionally downstream standards are not met owing to an upstream pollutant source. The Clean Water Act offers three solutions to such problems.

First, the opportunity for public participation for new or revised water quality standards provides potentially affected parties an approach to avoiding conflicts of water quality standards. States and Tribes are encouraged to keep other States informed of their water quality standards efforts and to invite comment on standards for common water bodies.

Second, permit limits under the National Pollutant Discharge Elimination System (NPDES) program (see section 402 of the Act) are required to be developed such that applicable water quality standards are achieved. The permit issuance process also includes opportunity for public participation and, thus, provides a second opportunity to consider and resolve potential problems regarding extraterritorial effects of water quality standards. In a decision in *Arkansas v. Oklahoma* (112 section 1046, February 26, 1992), the U.S. Supreme Court held that the Clean Water Act clearly authorized EPA to require that point sources in upstream States not violate water quality standards in downstream States, and that EPA's interpretation of those standards should govern.

Third, NPDES permits issued by EPA are subject to certification under the requirements of section 401 of the Act. Section 401 requires that States grant, deny, or condition "certification" for

federally permitted or licensed activities that may result in a discharge to waters of the United States. The decision to grant or to deny certification, or to grant a conditional certification is based on a State's determination regarding whether the proposed activity will comply with applicable water quality standards and other provisions. Thus, States may deny certification and prohibit EPA from issuing an NPDES permit that would violate water quality standards. Section 401 also allows a State to participate in extraterritorial actions that will affect that State's waters if a federally issued permit is involved.

In addition to the above sources for solutions, when the problem arises between a State and an Indian Tribe qualified for treatment as a State for water quality standards, the dispute resolution mechanism could be invoked (see section 1.7, of this Handbook).

2.3 Use Subcategories - 40 CFR 131.10(c)

States are required to designate uses considering, at a minimum, those uses listed in section 303(c) of the Clean Water Act (i.e., public water supplies, propagation of fish and wildlife, recreation, agriculture and industrial purposes, and navigation). However, flexibility inherent in the State process for designating uses allows the development of subcategories of uses within the Act's general categories to refine and clarify specific use classes. Clarification of the use class is particularly helpful when a variety of surface waters with distinct characteristics fit within the same use class, or do not fit well into any category. Determination of non-attainment in waters with broad use categories may be difficult and open to alternative interpretations. If a determination of non-attainment is in dispute, regulatory actions will be difficult to accomplish (USEPA, 1990a).

The State selects the level of specificity it desires for identifying designated uses and subcategories of uses (such as whether to treat recreation as a single use or to define a subcategory for secondary recreation). However, the State must be at least as specific as the uses listed in sections 101(a) and 303(c) of the Clean Water Act.

Subcategories of aquatic life uses may be on the basis of attainable habitat (e.g., coldwater versus warmwater habitat); innate differences in community structure and function (e.g., high versus low species richness or productivity); or fundamental differences in important community components (e.g., warmwater fish communities dominated by bass versus catfish). Special uses may also be designated to protect particularly unique, sensitive, or valuable aquatic species, communities, or habitats.

Data collected from biosurveys as part of a developing biocriteria program may assist States in refining aquatic life use classes by revealing consistent differences among aquatic communities inhabiting different waters of the same designated use. Measurable biological attributes could then be used to divide one class into two or more subcategories (USEPA, 1990a).

If States adopt subcategories that do not require criteria sufficient to fully protect the goal uses in section 101(a)(2) of the Act (see section 2.1, above), a use attainability analysis pursuant to 40 CFR 131.10(j) must be conducted for waters to which these subcategories are assigned. Before adopting subcategories of uses, States must provide notice and opportunity for a public hearing because these actions are changes to the standards.

2.4 Attainability of Uses - 40 CFR 131.10(d)

When designating uses, States may wish to designate only the uses that are attainable. However, if the State does not designate the uses specified in section 101(a)(2) of the Act, the State must perform a use attainability analysis under section 131.10(j) of the regulation. States are encouraged to designate uses that the State believes can be attained in the future.

"Attainable uses" are, at a minimum, the uses (based on the State's system of water use classification) that can be achieved 1) when effluent limits under sections 301(b)(1)(A) and (B) and section 306 of the Act are imposed on point source dischargers and 2) when cost-effective and reasonable best management practices are imposed on nonpoint source dischargers.

2.5 Public Hearing for Changing Uses - 40 CFR 131.10(e)

The Water Quality Standards Regulation requires States to provide opportunity for public hearing before adding or removing a use or establishing subcategories of a use. As mentioned in section 2.2 above, the State should consider extraterritorial effects of such changes.

2.6 Seasonal Uses - 40 CFR 131.10(f)

In some areas of the country, uses are practical only for limited seasons. EPA recognizes seasonal uses in the Water Quality Standards Regulation. States may specify the seasonal uses and criteria protective of that use as well as the time frame for the ". . . season, so long as the criteria do not prevent the attainment of any more restrictive uses attainable in other seasons."

For example, in many northern areas, body contact recreation is possible only a few months out of the year. Several States have adopted primary contact recreational uses, and the associated microbiological criteria, for only those months when primary contact recreation actually occurs, and have relied on less stringent secondary contact recreation criteria to protect for incidental exposure in the "non-swimming" season.

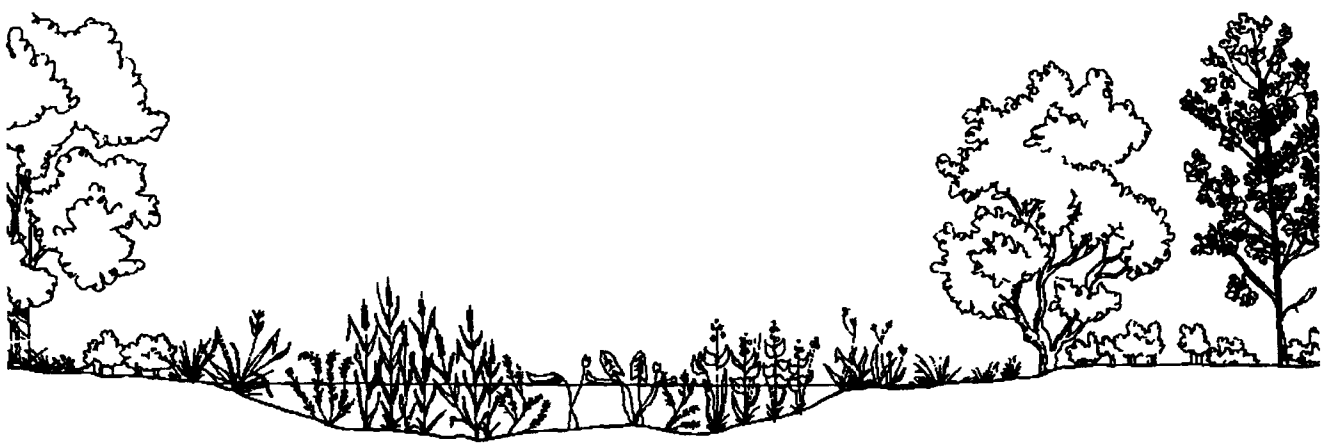
Seasonal uses that may require more stringent criteria are uses that protect sensitive organisms or life stages during a specific season such as the early life stages of fish and/or fish migration (e.g., EPA's *Ambient Water Quality Criteria for Dissolved Oxygen* (see Appendix I) recommends more stringent dissolved oxygen criteria for the early life stages of both coldwater and warmwater fish).

2.7 Removal of Designated Uses - CFR 40 131.10(g) and (h)

Figure 2-1 shows how and when designated uses may be removed.

2.7.1 Step 1 - Is the Use Existing?

Once a use has been designated for a particular water body or segment, the water body or water body segment cannot be reclassified for a different use except under specific conditions. If a designated use is an existing use (as defined in 40 CFR 131.3) for a particular water body, the existing use cannot be removed unless a use requiring more stringent criteria is added (see



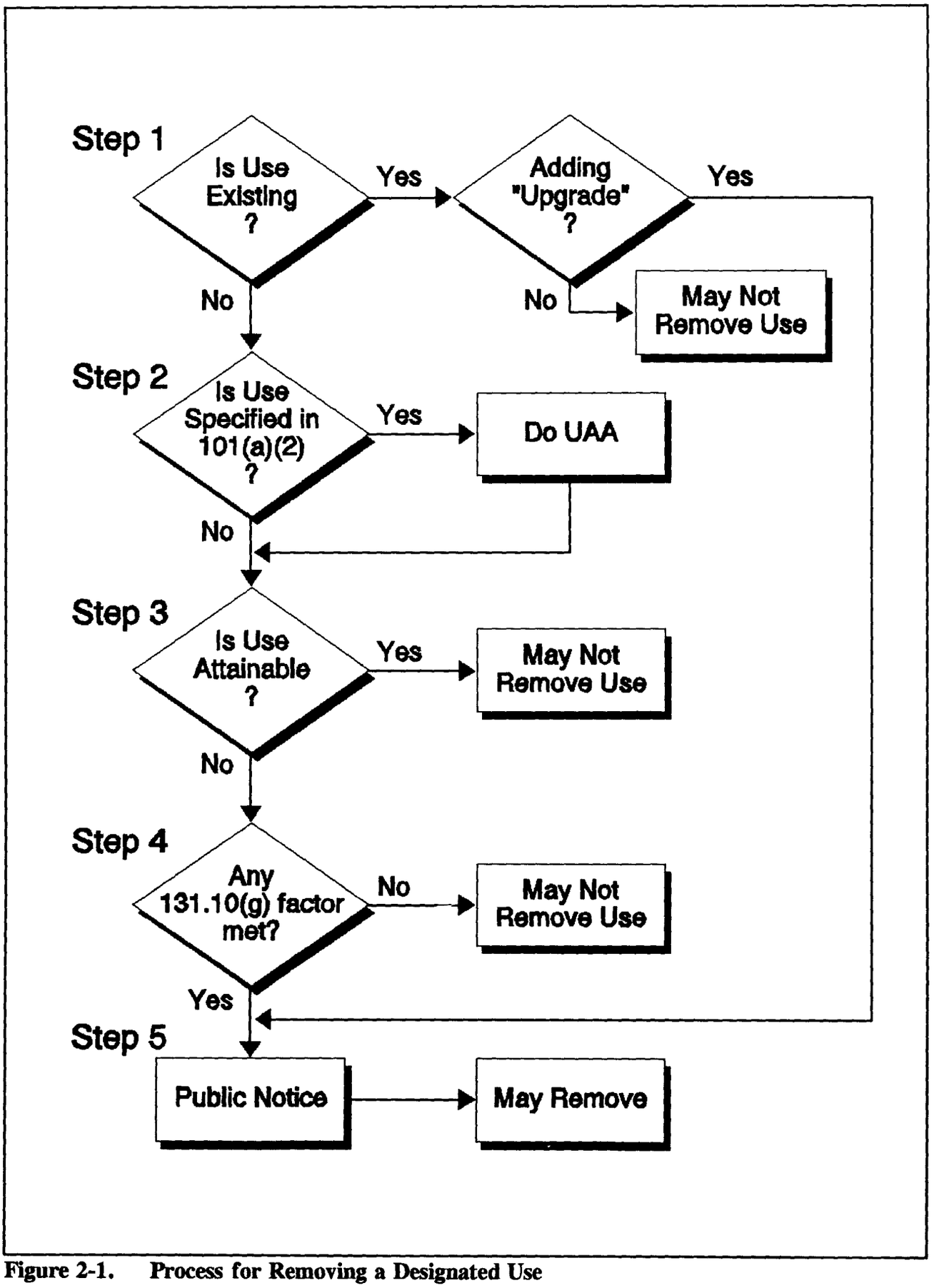


Figure 2-1. Process for Removing a Designated Use

section 4.4, this Handbook, for further discussion of existing uses). However, uses requiring more stringent criteria may always be added because doing so reflects the goal of further improvement of water quality. Thus, a recreational use for wading may be deleted if a recreational use for swimming is added, or the State may add the swimming use and keep the wading use as well.

2.7.2 Step 2 - Is the Use Specified in Section 101(a)(2)?

If the State wishes to remove a designated use specified in section 101(a)(2) of the Act, the State must perform a use attainability analysis (see section 131.10(j)). Section 2.9 of this Handbook discusses use attainability analyses for aquatic life uses.

2.7.3 Step 3 - Is the Use Attainable?

A State may change activities within a specific use category but may not change to a use that requires less stringent criteria, unless the State can demonstrate that the designated use cannot be attained. (See section 2.4, above, for the definition of "attainable uses.") For example, if a State has a broad aquatic life use, EPA generally assumes that the use will support all aquatic life. The State may demonstrate that, for a specific water body, such parameters as dissolved oxygen or temperature will not support trout but will support perch when technology-based effluent limitations are applied to point source dischargers and when cost-effective and reasonable best management practices are applied to nonpoint sources.

2.7.4 Step 4 - Is a Factor from 131.10(g) Met?

Even after the previous steps have been considered, the designated use may be removed, or subcategories of a use established, only under the conditions given in section 131.10(g). The State must be able to demonstrate that attaining the designated use is not feasible because:

(1) naturally occurring pollutant concentrations prevent the attainment of the use;

(2) natural, ephemeral, intermittent, or low-flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met;

(3) human-caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place;

(4) dams, diversions, or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use;

(5) physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to [chemical] water quality, preclude attainment of aquatic life protection uses; or

(6) controls more stringent than those required by sections 301(b)(1)(A) and (B) and 306 of the Act would result in substantial and widespread economic and social impact.

2.7.5 Step 5 - Provide Public Notice

As provided for in section 131.10(e), States must provide notice and opportunity for public hearing in accordance with section 131.20(b) (discussed in section 6.1 of this Handbook). Of course, EPA intends for States to make appropriate use of all public comments received through such notice.

2.8 Revising Uses to Reflect Actual Attainment - 40 CFR 131.10(i)

When performing its triennial review, the State must evaluate what uses are being attained. If a water body is designated for a use that requires less stringent criteria than a use that is being attained, the State must revise the use on that water body to reflect the use that is being attained.

2.9 Use Attainability Analyses - 40 CFR 131.10(j) and (k)

Under section 131.10(j) of the Water Quality Standards Regulation, States are required to conduct a use attainability analysis (UAA) whenever:

(1) the State designates or has designated uses that do not include the uses specified in section 101(a)(2) of the Act; or

(2) the State wishes to remove a designated use that is specified in section 101(a)(2) of the Act or adopt subcategories of uses specified in section 101(a)(2) that require less stringent criteria.

States are not required to conduct UAAs when designating uses that include those specified in section 101(a)(2) of the Act, although they may conduct these or similar analyses when determining the appropriate subcategories of section 101(a)(2) goal uses.

States may also conduct generic use attainability analyses for groups of water body segments provided that the circumstances relating to the segments in question are sufficiently similar to make the results of the generic analyses reasonably applicable to each segment.

As defined in the Water Quality Standards Regulation (40 CFR 131.3), a use attainability analysis is:

> . . . a structured scientific assessment of the factors affecting the attainment of a use which may include physical, chemical, biological, and economic factors as described in section 131.10(g).

The evaluations conducted in a UAA will determine the attainable uses for a water body (see sections 2.4 and 2.8, above).

The physical, chemical, and biological factors affecting the attainment of a use are evaluated through a *water body survey and assessment*. The guidance on water body survey and assessment techniques that appears in this Handbook is for the evaluation of fish, aquatic life, and wildlife uses only (EPA has not developed guidance for assessing recreational uses). Water body surveys and assessments conducted by the States should be sufficiently detailed to answer the following questions:

- What are the aquatic use(s) currently being achieved in the water body?
- What are the causes of any impairment of the aquatic uses?
- What are the aquatic use(s) that can be attained based on the physical, chemical, and biological characteristics of the water body?

The analysis of economic factors determines whether substantial and widespread economic and social impact would be caused by pollution control requirements more stringent than (1) those required under sections 301(b)(1)(A) and (B) and

section 306 of the Act for point source dischargers, and (2) cost-effective and reasonable best management practices for nonpoint source dischargers.

2.9.1 Water Body Survey and Assessment - Purpose and Application

The purpose of this section is to identify the physical, chemical, and biological factors that may be examined to determine whether an aquatic life protection use is attainable for a given water body. The specific analyses included in this guidance are optional. However, they represent the type of analyses EPA believes are sufficient for States to justify changes in uses designated in a water quality standard and to determine uses that are attainable. States may use alternative analyses as long as they are scientifically and technically supportable. This guidance specifically addresses streams and river systems. More detailed guidance is given in the *Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses, Volume I* (USEPA, 1983c). EPA has also developed guidance for estuarine and marine systems and lakes, which is summarized in following sections. More detailed guidance for these aquatic systems is available in the *Technical Support Manual, Volume II, Estuarine Systems*, and *Volume III, Lake Systems* (USEPA, 1984a,b).

Several approaches for analyzing the aquatic life protection uses to determine if such uses are appropriate for a given water body are discussed. States are encouraged to use existing data to perform the physical, chemical, and biological evaluations presented in this guidance document. Not all of these evaluations are necessarily applicable. For example, if an assessment reveals that the physical habitat is the limiting factor precluding a use, a chemical evaluation would not be required. In addition, wherever possible, States also should consider grouping together water bodies having similar physical, chemical, and biological characteristics either to treat several water bodies or stream segments as a single unit or to establish representative conditions applicable to other similar water bodies or stream segments within a river basin. Using existing data and establishing representative conditions applicable to a number of water bodies or segments should conserve the limited resources available to the States.

Table 2-1 summarizes the types of physical, chemical, and biological factors that may be evaluated when conducting a UAA. Several approaches can be used for conducting the physical, chemical, and biological evaluations, depending on the complexity of the situation. Details on the various evaluations can be found in the *Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses, Volume I* (USEPA, 1983c). A survey need not consider all of the parameters listed; rather, the survey should be designed on the basis of the water body characteristics and other considerations relevant to a particular survey.

These approaches may be adapted to the water body being examined. Therefore, a close working relationship between EPA and the States is essential so that EPA can assist States in determining the appropriate analyses to be used in support of any water quality standards revisions. These analyses should be made available to all interested parties before any public forums on the water quality standards to allow for full discussion of the data and analyses.

2.9.2 Physical Factors

Section 101(a) of the Clean Water Act recognizes the importance of preserving the physical integrity of the Nation's water bodies. Physical habitat plays an important role in the overall aquatic ecosystem and impacts the types and number of species present in a particular body of water. Physical parameters of a water body are examined to identify factors that impair the propagation and protection of aquatic life and to determine what uses could be obtained in the water body given such limitations. In general, physical parameters such as flow, temperature, water depth, velocity,

PHYSICAL FACTORS	CHEMICAL FACTORS	BIOLOGICAL FACTORS
♦ **instream characteristics** - size (mean width/depth) - flow/velocity - annual hydrology - total volume - reaeration rates - gradient/pools/ riffles - temperature - sedimentation - channel modifications - channel stability ♦ **substrate composition and characteristics** ♦ **channel debris** ♦ **sludge deposits** ♦ **riparian characteristics** ♦ **downstream characteristics**	♦ **dissolved oxygen** ♦ **toxicants** ♦ **suspended solids** ♦ **nutrients** - nitrogen - phosphorus ♦ **sediment oxygen demand** ♦ **salinity** ♦ **hardness** ♦ **alkalinity** ♦ **pH** ♦ **dissolved solids**	♦ **biological inventory (existing use analysis)** - fish - macroinvertebrates - microinvertebrates - phytoplankton - periphyton - macrophytes ♦ **biological potential analysis** - diversity indices - HSI models - tissue analyses - recovery index - intolerant species analysis - omnivore-carnivore analysis ♦ **biological potential analysis** - reference reach comparison

Table 2-1. Summary of Typical Factors Used in Conducting a Water Body Survey and Assessment

substrate, reaeration rates, and other factors are used to identify any physical limitations that may preclude attainment of the designated use. Depending on the water body in question, any of the physical parameters listed in Table 2-1 may be appropriately examined. A State may use any of these parameters to identify physical limitations and characteristics of a water body. Once a State has identified any physical limitations based on evaluating the parameters listed, careful consideration of "reversibility" or the ability to restore the physical integrity of the water body should be made. Such considerations may include whether it would cause more environmental damage to correct the problem than to leave the water body as is, or whether physical impediments such as dams can be operated or modified in a way that would allow attainment of the use.

Several assessment techniques have been developed that correlate physical habitat characteristics to fishery resources. The identification of physical factors limiting a fishery is a critical assessment that provides important data for management of the water body. The U.S. Fish and Wildlife Service has developed habitat evaluation procedures (HEP) and habitat

suitability indices (HSI). Several States have begun developing their own models and procedures for habitat assessments. Parameters generally included in habitat assessment procedures are temperature, turbidity, velocity, depth, cover, pool and riffle sizes, riparian vegetation, bank stability, and siltation. These parameters are correlated to fish species by evaluating the habitat variables important to the life cycle of the species. The value of habitat for other groups of aquatic organisms such as macroinvertebrates and periphyton also may be considered. Continued research and refinement of habitat evaluation procedures reflect the importance of physical habitat.

If physical limitations of a stream restrict the use, a variety of habitat modification techniques might restore a habitat so that a species could thrive where it could not before. Some of the techniques that have been used are bank stabilization, flow control, current deflectors, check dams, artificial meanders, isolated oxbows, snag clearing when determined not to be detrimental to the life cycle or reproduction of a species, and installation of spawning beds and artificial spawning channels. If the habitat is a limiting factor to the propagation and/or survival of aquatic life, the feasibility of modifications might be examined before additional controls are imposed on dischargers.

2.9.3 Chemical Evaluations

The chemical characteristics of a water body are examined to determine why a designated use is not being met and to determine the potential of a particular species to survive in the water body if the concentration of particular chemicals were modified. The State has the discretion to determine the parameters required to perform an adequate water chemistry evaluation. A partial list of the parameters that may be evaluated is provided in Table 2-1.

As part of the evaluation of the water chemistry composition, a natural background evaluation is useful in determining the relative contribution of natural background contaminants to the water body; this may be a legitimate factor that effectively prevents a designated use from being met. To determine whether the natural background concentration of a pollutant is adversely impacting the survival of species, the concentration may be compared to one of the following:

- 304(a) criteria guidance documents; or
- site-specific criteria; or
- State-derived criteria.

Another way to obtain an indication of the potential for the species to survive is to determine if the species are found in other waterways with similar chemical concentrations.

In determining whether human-caused pollution is irreversible, consideration needs to be given to the permanence of the damage, the feasibility of abating the pollution, or the additional environmental damage that may result from removing the pollutants. Once a State identifies the chemical or water quality characteristics that are limiting attainment of the use, differing levels of remedial control measures may be explored. In addition, if instream toxicants cannot be removed by natural processes and cannot be removed by human effort without severe long-term environmental impacts, the pollution may be considered irreversible.

In some areas, the water's chemical characteristics may have to be calculated using predictive water quality models. This will be true if the receiving water is to be impacted by new dischargers, changes in land use, or improved treatment facilities. Guidance is available on the selection and use of receiving water models for biochemical oxygen demand, dissolved oxygen, and ammonia for instream systems (USEPA, 1983d,e) and dissolved oxygen, nitrogen, and phosphorus for lake systems, reservoirs, and impoundments (USEPA, 1983f).

2.9.4 Biological Evaluations

In evaluating what aquatic life protection uses are attainable, the biology of the water body should be evaluated. The interrelationships between the physical, chemical, and biological characteristics are complex, and alterations in the physical and/or chemical parameters result in biological changes. The biological evaluation described in this section encourages States to:

- provide a more precise statement of which species exist in the water body and should be protected;
- determine the biological health of the water body; and
- determine the species that could potentially exist in the water body if the physical and chemical factors impairing a use were corrected.

This section of the guidance will present the conceptual framework for making these evaluations. States have the discretion to use other scientifically and technically supportable assessment methodologies deemed appropriate for specific water bodies on a case-by-case basis. Further details on each of the analyses presented can be found in the *Technical Support Manual for Conducting Use Attainability Analyses* (USEPA, 1983c).

Biological Inventory (Existing Use Analysis)

The identification of which species are in the water body and should be protected serves several purposes:

- By knowing what species are present, the biologist can analyze, in general terms, the health of the water body. For example, if the fish species present are principally carnivores, the quality of the water is generally higher than in a water body dominated by omnivores. It also allows the biologist to assess the presence or absence of intolerant species.
- Identification of the species enables the State to develop baseline conditions against which to evaluate any remedial actions. The development of a regional baseline based upon several site-specific species lists increases an understanding of the regional fauna. This allows for easier grouping of water bodies based on the biological regime of the area.
- By identifying the species, the decision-maker has the data needed to explain the present condition of the water body to the public and the uses that must be maintained.

The evaluation of the existing biota may be simple or complex depending on data availability. As much information as possible should be gathered on the categories of organisms listed in Table 2-1. It is not necessary to obtain complete data for all six categories. However, it is recommended that fish should be included in any combination of categories chosen because:

- the general public can relate better to statements about the condition of the fish community;
- fish are typically present even in the smallest streams and in all but the most polluted waters;
- fish are relatively easy to identify, and samples can be sorted and identified at the field site;
- life-history information is extensive for many fish species so that stress effects can be evaluated (Karr, 1981). In addition, since fish are mobile, States are encouraged to evaluate other categories of organisms.

Before any field work is conducted, existing data should be collected. EPA can provide data from intensive monitoring surveys and special studies. Data, especially for fish, may be available from State fish and game departments, recreation agencies, and local governments, or through environmental impact statements, permit reviews, surveys, and university or other studies.

Biological Condition/Biological Health Assessment

The biological inventory can be used to gain insight into the biological health of the water body by evaluating:

- species richness or the number of species;
- presence of intolerant species;
- proportion of omnivores and carnivores;
- biomass or production; and
- number of individuals per species.

The role of the biologist becomes critical in evaluating the health of the biota because the knowledge of expected richness or expected species comes only from understanding the general biological traits and regimes of the area. Best professional judgments by local biologists are important. These judgments are based on many years of experience and on observations of the physical and chemical changes that have occurred over time.

Many methods for evaluating biotic communities have been and continue to be developed. The *Technical Support Manual for Conducting Use Attainability Analyses* (USEPA, 1983c) and *Rapid Bioassessment Protocols for Use in Streams and Rivers* (USEPA, 1989e) describe methods that States may want to consider using in their biological evaluations.

A number of other methods have been and are being developed to evaluate the health of biological components of the aquatic ecosystem including short-term *in situ* or laboratory bioassays and partial or full life-cycle toxicity tests. These methods are discussed in several EPA publications, including the *Biological Methods Manual* (USEPA, 1972). Again, it is not the intent of this document to specify tests to be conducted by the States. This will depend on the information available, the predictive accuracy required, site-specific conditions of the water body being examined, and the cooperation and assistance the State receives from the affected municipalities and industries.

Biological Potential Analysis

A significant step in the use attainability analysis is the evaluation of what communities could potentially exist in a particular water body if pollution were abated or if the physical habitat were modified. The approach presented is to compare the water body in question to reference reaches within a region. This approach includes the development of baseline conditions to facilitate the comparison of several water bodies at less cost. As with the other analyses mentioned previously, available data should be used to minimize resource impacts.

The biological potential analysis involves:

- defining boundaries of fish faunal regions;
- selecting control sampling sites in the reference reaches of each area;
- sampling fish and recording observations at each reference sampling site;
- establishing the community characteristics for the reference reaches of each area; and
- comparing the water body in question to the reference reaches.

In establishing faunal regions and sites, it is important to select reference areas for sampling sites that have conditions typical of the region.

The establishment of reference areas may be based on physical and hydrological characteristics. The number of reference reaches needed will be

determined by the State depending on the variability of the waterways within the State and the number of classes that the State may wish to establish. For example, the State may want to use size, flow, and substrate as the defining characteristics and may consequently desire to establish classes such as small, fast running streams with sandy substrate or large, slow rivers with cobble bottom. It is at the option of the State to:

- choose the parameters to be used in classifying and establishing reference reaches; and
- determine the number of classes (and thus the refinement) within the faunal region.

This approach can also be applied to other aquatic organisms such as macroinvertebrates (particularly freshwater mussels) and algae.

Selection of the reference reaches is of critical importance because the characteristics of the aquatic community will be used to establish baseline conditions against which similar reaches (based on physical and hydrological characteristics) are compared. Once the reference reaches are established, the water body in question can be compared to the reference reach. The results of this analysis will reveal whether the water body in question has the typical biota for that class or a less desirable community and will provide an indication of what species may potentially exist if pollution were abated or the physical habitat limitations were remedied.

2.9.5 Approaches to Conducting the Physical, Chemical, and Biological Evaluations

In some cases, States that assess the status of their aquatic resources, will have relatively simple situations not requiring extensive data collection and evaluation. In other situations, however, the complexity resulting from variable environmental conditions and the stress from multiple uses of the resource will require both intensive and extensive studies to produce a sound evaluation of the system. Thus, procedures that a State may develop for conducting a water body assessment should be flexible enough to be adaptable to a variety of site-specific conditions.

A common experimental approach used in biological assessments has been a hierarchical approach to the analyses. This can be a rigidly tiered approach. An alternative is presented in Figure 2-2.

The flow chart is a general illustration of a thought process used to conduct a use attainability analysis. The process illustrates several alternative approaches that can be pursued separately or, to varying degrees, simultaneously depending on:

- the amount of data available on the site;
- the degree of accuracy and precision required;
- the importance of the resource;
- the site-specific conditions of the study area; and
- the controversy associated with the site.

The degree of sophistication is variable for each approach. Emphasis is placed on evaluating available data first. If information is found to be lacking or incomplete, then field testing or field surveys should be conducted.

The major elements of the process are briefly described below.

Steps 1 and 2

Steps 1 and 2 are the basic organizing steps in the evaluation process. By carefully defining the objectives and scope of the evaluation, there will be some indication of the level of sophistication required in subsequent surveys and testing. States and the regulated community can then adequately plan and allocate resources to the analyses. The designated use of the water body in question

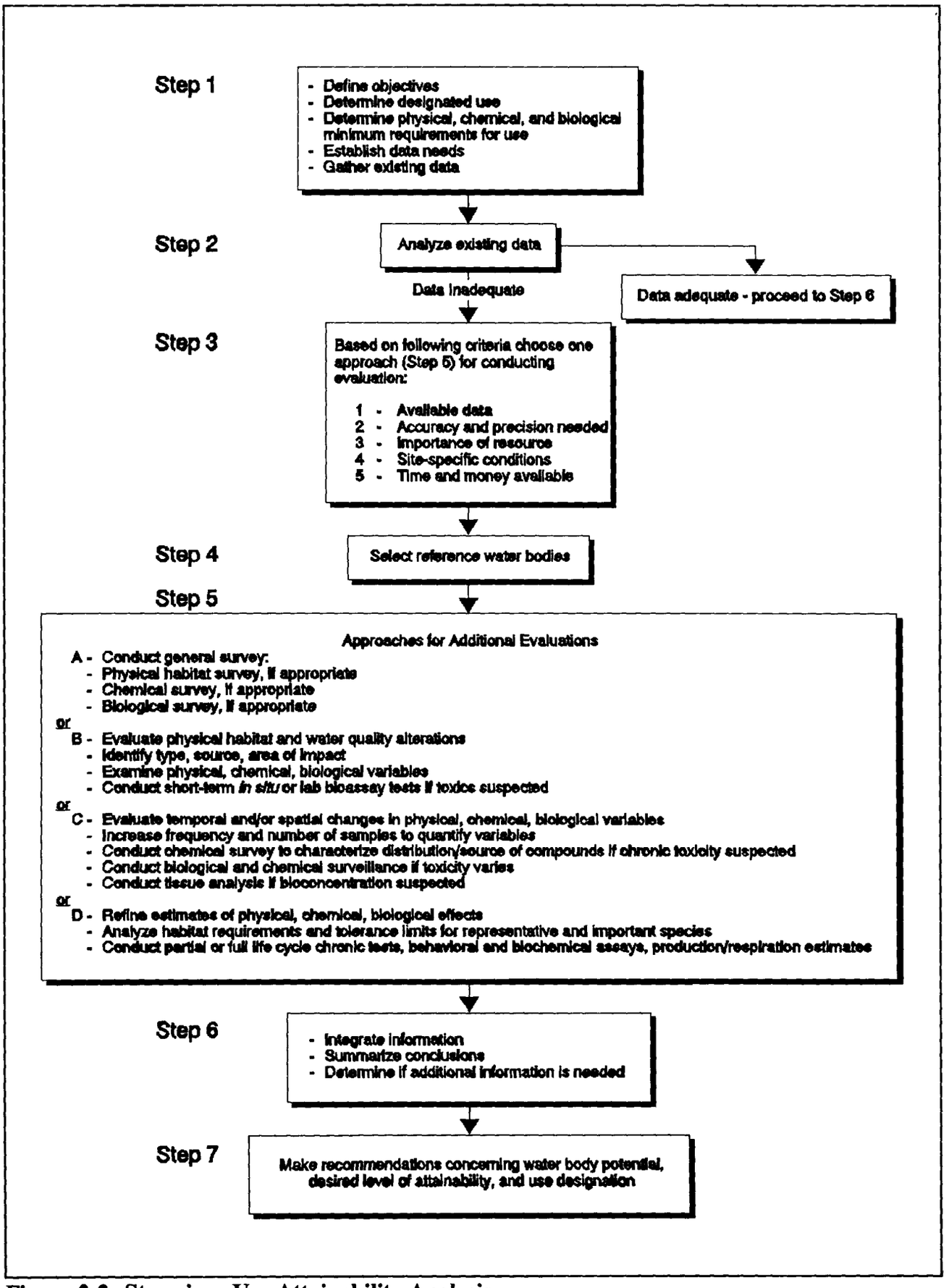


Figure 2-2. Steps in a Use Attainability Analysis

should be identified as well as the minimum chemical, physical, and biological requirements for maintaining the use. Minimum requirements may include, for example, dissolved oxygen levels, flow rates, temperature, and other factors. All relevant information on the water body should be collected to determine if the available information is adequate for conducting an appropriate level of analysis. It is assumed that all water body evaluations, based on existing data, will either formally or informally be conducted through Steps 1 and 2.

Steps 3 and 4

If the available information proves inadequate, then decisions regarding the degree of sophistication required in the evaluation process will need to be made. These decisions will, most likely, be based on the five criteria listed in Step 3 of Figure 2-2. Based on these decisions, reference areas should be chosen (Step 4), and one or more of the testing approaches should be followed.

Steps 5A, B, C, D

These approaches are presented to illustrate several possible ways of analyzing the water body. For example, in some cases chemical data may be readily available for a water body but little or no biological information is known. In this case, extensive chemical sampling may not be required, but enough samples should be taken to confirm the accuracy of the available data set. Thus, to accurately define the biological condition of the resource, 5C may be chosen, but 5A may be pursued in a less intensive way to supplement the chemical data already available.

Step 5A is a general survey to establish relatively coarse ranges for physical and chemical variables, and the numbers and relative abundances of the biological components (fishes, invertebrates, primary producers) in the water body. Reference areas may or may not need to be evaluated here, depending on the types of questions being asked and the degree of accuracy required.

Step 5B focuses more narrowly on site-specific problem areas with the intent of separating, where possible, biological impacts due to physical habitat alteration versus those due to chemical impacts. These categories are not mutually exclusive but some attempt should be made to define the causal factors in a stressed area so that appropriate control measures can be implemented if necessary.

Step 5C would be conducted to evaluate possibly important trends in the spatial and/or temporal changes associated with the physical, chemical, and biological variables of interest. In general, more rigorous quantification of these variables would be needed to allow for more sophisticated statistical analyses between reference and study areas which would, in turn, increase the degree of accuracy and confidence in the predictions based on this evaluation. Additional laboratory testing may be included, such as tissue analyses, behavioral tests, algal assays, or tests for flesh tainting. Also, high-level chemical analyses may be needed, particularly if the presence of toxic compounds is suspected.

Step 5D is, in some respects, the most detailed level of study. Emphasis is placed on refining cause-effect relationships between physical-chemical alterations and the biological responses previously established from available data or steps 5A through 5C. In many cases, state-of-the-art techniques will be used. This pathway would be conducted by the States only where it may be necessary to establish, with a high degree of confidence, the cause-effect relationships that are producing the biological community characteristics of those areas. Habitat requirements or tolerance limits for representative or important species may have to be determined for those factors limiting the potential of the ecosystem. For these evaluations, partial or full life-cycle toxicity tests, algal assays, and sediment bioassays may be needed along with the shorter term bioassays designed to elucidate sublethal effects not readily apparent in toxicity tests (e.g., preference-avoidance responses,

production-respiration estimates, and bioconcentration estimates).

Steps 6 and 7

After field sampling is completed, all data must be integrated and summarized. If this information is still not adequate, then further testing may be required and a more detailed pathway chosen. With adequate data, States should be able to make reasonably specific recommendations concerning the natural potential of the water body, levels of attainability consistent with this potential, and appropriate use designations.

The evaluation procedure outlined here allows States a significant degree of latitude for designing assessments to meet their specific goals in water quality and water use.

2.9.6 Estuarine Systems

This section provides an overview of the factors that should be considered in developing use attainability analyses for estuaries. Anyone planning to conduct a use attainability analysis for an estuary should consult the *Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses, Volume II: Estuarine Systems* (USEPA, 1984a) for more detailed guidance. Also, much of the information for streams and rivers that is presented above and in Volume I of the Technical Support Manual, particularly with respect to chemical evaluations, will apply to estuaries and is not repeated here.

The term "estuaries" is generally used to denote the lower reaches of a river where tide and river flows interact. Estuaries are very complex receiving waters that are highly variable in description and are not absolutes in definition, size, shape, aquatic life, or other attributes. Physical, chemical, and biological attributes may require consideration unique to estuaries and are discussed below.

Physical Processes

Estuarine flows are the result of a complex interaction of the following physical factors:

- tides;
- wind shear;
- freshwater inflow (momentum and buoyancy);
- topographic frictional resistance;
- Coriolis effect;
- vertical mixing; and
- horizontal mixing.

In performing a use attainability study, one may simplify the complex prototype system by determining which of these effects or combination of effects is most important at the time scale of the evaluation (days, months, seasons, etc.).

Other ways to simplify the approach to analyzing an estuary is to place it in a broad classification system to permit comparison of similar types of estuaries. The most common groupings are based on geomorphology, stratification, circulation patterns, and time scales. Each of these groupings is discussed below.

Geomorphological classifications can include types such as drowned river valleys (coastal plain estuaries), fjords, bar-built estuaries, and other estuaries that do not fit the first three classifications (those produced by tectonic activity, faulting, landslides, or volcanic eruptions).

Stratification is most often used for classifying estuaries influenced by tides and freshwater inflows. Generally, highly stratified estuaries have large river discharges flowing into them, partially mixed estuaries have medium river discharges; and vertically homogeneous have small river discharges.

Circulation in an estuary (i.e., the velocity patterns as they change over time) is primarily affected by the freshwater outflow, the tidal inflow, and the effect of wind. In turn, the difference in density between outflow and inflow

sets up secondary currents that ultimately affect the salinity distribution across the estuary. The salinity distribution is important because it affects the distribution of fauna and flora within the estuary. It is also important because it is indicative of the mixing properties of the estuary as they may affect the dispersion of pollutants (flushing properties). Additional factors such as friction forces and the size and geometry of the estuary also contribute to the circulation patterns. The complex geometry of estuaries, in combination with the presence of wind, the effect of the Earth's rotation (Coriolis effect), and other effects, often results in residual currents (i.e., of longer period than the tidal cycle) that strongly influence the mixing processes in estuaries.

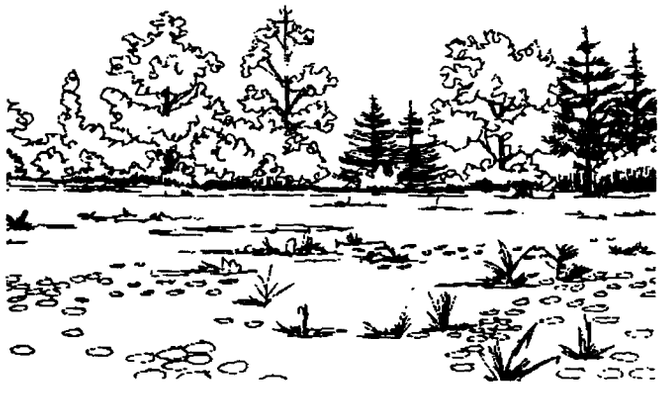
Consideration of time scales of the physical processes being evaluated is very important for any water quality study.

Short-term conditions are much more influenced by a variety of short-term events that perhaps have to be analyzed to evaluate a "worst case" scenario. Longer term (seasonal) conditions are influenced predominantly by events that are averaged over the duration of that time scale.

Estuary Substrate Composition

Characterization of sediment/substrate properties is important in a use attainability analysis because such properties:

- determine the extent to which toxic compounds in sediments are available to the biota; and
- determine what types of plants and animals could potentially become established, assuming no interference from other factors such as nutrient, dissolved oxygen (DO), and/or toxics problems.



The bottom of most estuaries is a mix of sand, silt, and mud that has been transported and deposited by ocean currents or by freshwater sources. Rocky areas may also be present, particularly in the fjord-type estuary. None of these substrate types is particularly hospitable to aquatic plants and animals, which accounts in part for the paucity of species seen in an estuary.

The amount of material transported to the estuary will be determined by the types of terrain through which the river passes, and upon land use practices that may encourage runoff and erosion. It is important to take land use practices into consideration when examining the attainable uses of the estuary. Deposition of particles varies with location in the estuaries and velocity of the currents.

It is often difficult for plants to colonize estuaries because of a lack of suitable anchorage points and because of the turbidity of the water, which restricts light penetration (McLusky, 1971). Submerged aquatic vegetation (SAV) (macrophytes) develops in sheltered areas where silt and mud accumulate. These plants help to slow the currents, leading to further deposition of silt. The growth of plants often keeps pace with rising sediment levels so that over a long period of time substantial deposits of sediment and plant material may be seen.

SAV serves very important roles as habitat and as a food source for much of the biota of the estuary. Major estuary studies have shown that the health of SAV communities serves as an important indicator of estuary health.

Adjacent Wetlands

Tidal and freshwater wetlands adjacent to the estuary can serve as a buffer to protect the estuary

from external phenomena. This function may be particularly important during wet weather periods when relatively high stream flows discharge high loads of sediment and pollutants to the estuary. The wetlands slow the peak velocity, to some extent alleviate the sudden shock of salinity changes, and filter some of the sediments and nutrients that would otherwise be discharged directly into the estuary.

Hydrology and Hydraulics

The two most important sources of freshwater to the estuary are stream flow and precipitation. Stream flow generally represents the greatest contribution to the estuary. The location of the salinity gradient in a river-controlled estuary is to a large extent a function of stream flow. Location of the iso-concentration lines may change considerably, depending upon whether stream flow is high or low. This in turn may affect the biology of the estuary, resulting in population shifts as biological species adjust to changes in salinity. Most estuarine species are adapted to survive temporary changes in salinity either by migration or some other mechanism (e.g., mussels can close their shells). However, many cannot withstand these changes indefinitely. Response of an estuary to rainfall events depends upon the intensity of rainfall, the drainage area affected by the rainfall, and the size of the estuary. Movement of the salt front is dependent upon tidal influences and freshwater flow to the estuary. Variations in salinity generally follow seasonal patterns such that the salt front will occur farther down-estuary during a rainy season than during a dry season. The salinity profile also may vary from day to day, reflecting the effect of individual rainfall events, and may undergo major changes due to extreme meteorological events.

Anthropogenic activity also may have a significant effect on salinity in an estuary. When feeder streams are used as sources of public water supply and the withdrawals are not returned, freshwater flow to the estuary is reduced, and the salt wedge is found farther up the estuary. If the water is returned, usually in the form of wastewater effluent, the salinity gradient of the estuary may not be affected, although other problems attributable to nutrients and other pollutants in the wastewater may occur.

Salinity also may be affected by the way that dams along the river are operated. Flood control dams result in controlled discharges to the estuary rather than relatively short but massive discharge during high-flow periods. Dams operated to impound water for water supplies during low-flow periods may drastically alter the pattern of freshwater flow to the estuary, and although the annual discharge may remain the same, seasonal changes may have significant impact on the estuary and its biota.

Influence of Physical Characteristics on Use Attainability

"Segmentation" of an estuary can provide a useful framework for evaluating the influence of estuarine physical characteristics such as circulation, mixing, salinity, and geomorphology on use attainability. Segmentation is the compartmentalization of an estuary into subunits with homogeneous physical characteristics. In the absence of water pollution, physical characteristics of different regions of the estuary tend to govern the suitability for major water uses. Once the segment network is established, each segment can be subjected to a use attainability analysis. In addition, the segmentation process offers a useful management structure for monitoring conformance with water quality goals in future years.

The segmentation process is an evaluation tool that recognizes that an estuary is an interrelated ecosystem composed of chemically, physically, and biologically diverse areas. It assumes that an ecosystem as diverse as an estuary cannot be effectively managed as only one unit because different uses and associated water quality goals will be appropriate and feasible for different regions of the estuary. However, after developing a network based upon physical characteristics,

sediment boundaries can be refined with available chemical and biological data to maximize the homogeneity of each segment.

A potential source of concern about the construction and utility of the segmentation scheme for use attainability evaluations is that the estuary is a fluid system with only a few obvious boundaries, such as the sea surface and the sediment-water interface. Fixed boundaries may seem unnatural to scientists, managers, and users, who are more likely to view the estuary as a continuum than as a system composed of separable parts. The best approach to dealing with such concerns is a segmentation scheme that stresses the dynamic nature of the estuary. The scheme should emphasize that the segment boundaries are operationally defined constructs to assist in understanding a changeable, intercommunicating system of channels, embayments, and tributaries.

To account for the dynamic nature of the estuary, it is recommended that estuarine circulation patterns be a prominent factor in delineating the segment network. Circulation patterns control the transport of and residence times for heat, salinity, phytoplankton, nutrients, sediment, and other pollutants throughout the estuary. Salinity should be another important factor in delineating the segment network. The variations in salinity concentrations from head of tide to the mouth typically produce a separation of biological communities based on salinity tolerances or preferences.

Chemical Parameters

The most critical chemical water quality indicators for aquatic use attainment in an estuary are dissolved oxygen, nutrients and chlorophyll-a, and toxicants. Dissolved oxygen (DO) is an important water quality indicator for all fisheries uses. In evaluating use attainability, assessments of DO impacts should consider the relative contributions of three different sources of oxygen demand:

- photosynthesis/respiration demand from phytoplankton;
- water column demand; and
- benthic oxygen demand.

If use impairment is occurring, assessments of the significance of each oxygen sink can be used to evaluate the feasibility of achieving sufficient pollution control to attain the designated use.

Chlorophyll-a is the most popular indicator of algal concentrations and nutrient overenrichment, which in turn can be related to diurnal DO depressions due to algal respiration. Typically, the control of phosphorus levels can limit algal growth near the head of the estuary, while the control of nitrogen levels can limit algal growth near the mouth of the estuary; however, these relationships are dependent upon factors such as nitrogen phosphorus ("N/P") ratios and light penetration potential, which can vary from one estuary to the next. Excessive phytoplankton concentrations, as indicated by chlorophyll-a levels, can cause adverse DO impacts such as:

- wide diurnal variations in surface DO due to daytime photosynthetic oxygen production and nighttime oxygen depletion by respiration; and
- depletion of bottom DO through the decomposition of dead algae.

Excessive chlorophyll-a levels also result in shading, which reduces light penetration for submerged aquatic vegetation (SAV). Consequently, the prevention of nutrient over-enrichment is probably the most important water quality requirement for a healthy SAV community.

The nutrients of greatest concern in the estuary are nitrogen and phosphorus. Their sources typically are discharges from sewage treatment plants and industries and runoff from urban and agricultural areas. Increased nutrient levels lead to phytoplankton blooms and a subsequent

reduction in DO levels and light penetration, as discussed above.

Sewage treatment plants are typically the major source of nutrients, particularly phosphorus, to estuaries in urban areas. Agricultural land uses and urban land uses represent significant nonpoint sources of nutrients, particularly nitrogen. It is important to base control strategies on an understanding of the sources of each type of nutrient, both in the estuary and in its feeder streams.

Point sources of nutrients are typically much more amenable to control than nonpoint sources. Because phosphorus removal for municipal wastewater discharges is typically less expensive than nitrogen removal operations, the control of phosphorus discharges is often the method of choice for the prevention or reversal of use impairment in the upper estuary (i.e., tidal fresh zone). However, nutrient control in the upper reaches of the estuary may cause algal blooms in the lower reaches, e.g., control of phosphorus in the upper reaches may reduce the algal blooms there, but in doing so also increase the amount of nitrogen transported to the lower reaches where nitrogen is the limiting nutrient causing a bloom there. Tradeoffs between nutrient controls for the upper and lower estuary should be considered in evaluating measures for prevention of reversing use impairment.

Potential interferences from toxic substances, such as pesticides, herbicides, heavy metals, and chlorinated effluents, also need to be considered in a use attainability study. The presence of certain toxicants in excessive concentrations within bottom sediments of the water column may prevent the attainment of water uses (particularly fisheries propagation/harvesting and sea grass habitat uses) in estuary segments that satisfy water quality criteria for DO, chlorophyll-a/nutrient enrichment, and fecal coliform.

Biological Community Characteristics

The *Technical Support Manual, Volume II* (USEPA, 1984a) provides a discussion of the organisms typically found in estuaries in more detail than is appropriate for this Handbook. Therefore, this discussion will focus on more general characteristics of estuarine biota and their adaptations to accommodate a fluctuating environment.

Salinity, light penetration, and substrate composition are the most critical factors to the distribution and survival of plant and animal communities in an estuary. The estuarine environment is characterized by variations in circulation, salinity, temperature, and dissolved oxygen supply. Colonizing plants and animals must be able to withstand the fluctuating conditions in estuaries.

The depth to which attached plants may become established is limited by turbidity because plants require light for photosynthesis. Estuaries are typically turbid because of large quantities of detritus and silt contributed by surrounding marshes and rivers. Algal growth also may hinder light penetration. If too much light is withheld from the lower depths, animals cannot rely heavily on visual cues for habitat selection, feeding, or finding a mate.

Estuarine organisms are recruited from the sea, freshwater environments, and the land. The major environmental factors to which organisms must adjust are periodic submersion and desiccation as well as fluctuating salinity, temperature, and dissolved oxygen.

Several generalizations concerning the responses of estuarine organisms to salinity have been noted (Vernberg, 1983) and reflect a correlation of an organism's habitat to its tolerance:

- organisms living in estuaries subjected to wide salinity fluctuations can withstand a wider range of salinities than species that occur in high-salinity estuaries;

- intertidal zone animals tend to tolerate wider ranges of salinities than do subtidal and open-ocean organisms;

- low intertidal species are less tolerant of low salinities than are high intertidal species; and

- more sessile animals are likely to be more tolerant of fluctuating salinities than organisms that are highly mobile and capable of migrating during times of salinity stress.

Estuaries are generally characterized by low diversity of species but high productivity because they serve as the nursery or breeding grounds for some species. Methods to measure the biological health and diversity of estuaries are discussed in USEPA (1984a).

Techniques for Use Attainability Evaluations

In assessing use levels for aquatic life protection, determination of the present use and whether this corresponds to the designated use is evaluated in terms of biological measurements and indices. However, if the present use does not correspond to the designated use, physical and chemical factors are used to explain the lack of attainment and the highest level the system can achieve.

The physical and chemical evaluations may proceed on several levels depending on the level of detail required, amount of knowledge available about the system (and similar systems), and budget for the use attainability study. As a first step, the estuary is classified in terms of physical processes so that it can be compared with reference estuaries in terms of differences in water quality and biological communities, which can be related to man-made alteration (i.e., pollution discharges).

The second step is to perform desktop or simple computer model calculations to improve the understanding of spatial and temporal water quality conditions in the present system. These calculations include continuous point source and simple box model-type calculations. A more detailed discussion of the desktop and computer calculations is given in USEPA (1984a).

The third step is to perform detailed analyses through the use of more sophisticated computer models. These tools can be used to evaluate the system's response to removing individual point and nonpoint source discharges, so as to assist with assessments of the cause(s) of any use impairment.

2.9.7 Lake Systems

This section will focus on the factors that should be considered in performing use attainability analyses for lake systems. Lake systems are in most cases linked physically to rivers and streams and exhibit a transition from riverine habitat and conditions to lacustrine habitat and conditions. Therefore, the information presented in section 2.9.1 through 2.9.5 and the *Technical Support Manual, Volume I* (USEPA, 1983c) will to some extent apply to lake systems. EPA has provided guidance specific to lake systems in the *Technical Support Manual for Conducting Use Attainability Analyses, Volume III: Lake Systems* (USEPA, 1984b). This manual should be consulted by anyone performing a use attainability analysis for lake systems.

Aquatic life uses of a lake are defined in reference to the plant and animal life in a lake. However, the types and abundance of the biota are largely determined by the physical and chemical characteristics of the lake. Other contributing factors include the location, climatological conditions, and historical events affecting the lake.

Physical Parameters

The physical parameters that describe the size, shape, and flow regime of a lake represent the basic characteristics that affect physical, chemical, and biological processes. As part of a use attainability analysis, the physical parameters must be examined to understand non-water quality factors that affect the lake's aquatic life.

The origins of a lake determine its morphologic characteristics and strongly influence the physical, chemical, and biological conditions that will prevail. Therefore, grouping lakes formed by the same process often will allow comparison of similar lake systems. Measurement of the following morphological characteristics may be of importance to a water body survey:

- surface area;
- volume;
- inflow and outflow;
- mean depth;
- maximum depth;
- length;
- length of shoreline;
- depth-area relationships;
- depth-volume relationships; and
- bathymetry (submerged contours).

These physical parameters can in some cases be used to predict biological parameters. For example, mean depth has been used as an indicator of productivity. Shallow lakes tend to be more productive, and deep, steep-sided lakes tend to be less productive. These parameters may also be used to calculate other characteristics of the lake such as mass flow rate of a chemical, surface loading rate, and detention time.

Total lake volume and inflow and outflow rates are physical characteristics that indirectly affect the lake's aquatic community. Large inflows and outflows for lakes with small volumes produce low detention times or high flow-through rates. Aquatic life under these conditions may be different than when relatively small inflows and outflows occur for a large-volume lake where long detention times occur.

The shape factor (lake length divided by lake width) also may be correlated to chemical and biological characteristics. This factor has been used to predict parameters such as chlorophyll-a levels in lakes. For more detailed lake analysis, information describing the depth-area and depth-volume relationships and information describing the bathymetry may be required.

In addition to the physical parameters listed above, it is also important to obtain and analyze information concerning the lake's contributing watershed. Two major parameters of concern are the drainage area of the contributing watershed and the land uses of that watershed. Drainage area will aid in the analysis of inflow volumes to the lake due to surface runoff. The land use classification of the area around the lake can be used to predict flows and also nonpoint source pollutant loadings to the lake.

The physical parameters discussed above may be used to understand and analyze the various physical processes that occur in lakes. They can also be used directly in simplistic relationships that predict productivity to aid in aquatic use attainability analyses.

Physical Processes

Many complex and interrelated physical processes occur in lakes. These processes are highly dependent on the lake's physical parameters, location, and characteristics of the contributing watershed. Several of the major processes are discussed below.

Lake Currents

Water movement in a lake affects productivity and the biota because it influences the distribution of nutrients, microorganisms, and plankton. Lake currents are propagated by wind, inflow/outflow, and the Coriolis force. For small shallow lakes, particularly long and narrow lakes, inflow/outflow characteristics are most important, and the predominant current is a steady-state flow through the lake. For very large lakes, wind is the primary generator of currents, and except for local effects, inflow/outflow have a relatively minor effect on lake circulation. Coriolis effect, a deflecting force that is the function of the Earth's rotation, also plays a role in circulation in large lakes such as the Great Lakes.

Heat Budget

Temperature and its distribution within lakes and reservoirs affects not only the water quality within the lake but also the thermal regime and quality of a river system downstream of the lake. The thermal regime of a lake is a function of the heat balance around the body of water. Heat transfer modes into and out of the lake include heat transfer through the air-water interface, conduction through the mud-water interface, and inflow and outflow heat advection.

Heat transfer through the air-water interface is primarily responsible for typical annual temperature cycles. Heat is transferred across the air-water interface by three different processes: radiation exchange, evaporation, and conduction. The heat flux of the air-water interface is a function of location (latitude/longitude and elevation), season, time of day, and meteorological conditions (cloud cover, dew-point, temperature, barometric pressure, and wind).

Light Penetration

Transmission of light through the water column influences primary productivity (phytoplankton and macrophytes), distribution of organisms, and behavior of fish. The reduction of light through the water column of a lake is a function of scattering and absorption. Light transmission is affected by the water surface film, floatable and suspended particulates, turbidity, dense populations of algae and bacteria, and color.

An important parameter based on the transmission of light is the depth to which photosynthetic activity is possible. The minimum light intensity required for photosynthesis has been established to be about 1.0 percent of the incident surface light (Cole, 1979). The portion of the lake from the surface to the depth at which the 1.0 percent intensity occurs is referred to as the "euphotic zone."

Lake Stratification

Lakes in temperate and northern latitudes typically exhibit vertical density stratification during certain seasons of the year. Stratification in lakes is primarily due to temperature differences, although salinity and suspended solids concentrations may also affect density. Typically, three zones of thermal stratification are formed.

The upper layer of warmer, lower density water is termed the "epilimnion," and the lower, stagnant layer of colder, higher density water is termed the "hypolimnion." The transition zone between the epilimnion and the hypolimnion, referred to as the "metalimnion," is characterized by the maximum rate of temperature decline with depth (the thermocline). During stratification, the presence of the thermocline suppresses many of the mass transport phenomena that are otherwise responsible for the vertical transport of water quality constituents within a lake. The aquatic community present in a lake is highly dependent on the thermal structure.

With respect to internal flow structure, three distinct classes of lakes are defined:

- strongly stratified, deep lakes characterized by horizontal isotherms;
- weakly stratified lakes characterized by isotherms that are tilted along the longitudinal axis of the reservoir; and
- non-stratified, completely mixed lakes characterized by isotherms that are essentially vertical.

Retardation of mass transport between the hypolimnion and the epilimnion results in sharply differentiated water quality and biology between the lake strata. One of the most important differences between the layers is often dissolved oxygen. As this is depleted from the hypolimnion without being replenished, life functions of many organisms are impaired, and the biology and

biologically mediated reactions fundamental to water quality are altered.

Vertical stratification of a lake with respect to nutrients can also occur. Dissolved nutrients are converted to particulate organic material through photosynthetic processes in the epilimnion in ecologically advanced lakes. This assimilation lowers the ambient nutrient concentrations in the epilimnion. When the algae die and sink to the bottom, nutrients are carried to the hypolimnion where they are released by decomposition.

Temperature also has a direct effect on biology of a lake because most biological processes (e.g., growth, respiration, reproduction, migration, mortality, and decay) are strongly influenced by ambient temperature.

Annual Circulation Pattern and Lake Classification

Lakes can be classified on the basis of their pattern of annual mixing. These classifications are described below.

(1) Amictic - Lakes that never circulate and are permanently covered with ice, primarily in the Antarctic and very high mountains.

(2) Holomictic - Lakes that mix from top to bottom as a result of wind-driven circulation. Several subcategories are defined:

- Oligomictic - Lakes characterized by circulation that is unusual, irregular, and short in duration; generally small to medium tropical lakes or very deep lakes.
- Monomictic - Lakes that undergo one regular circulation per year.
- Dimictic - Lakes that circulate twice a year, in spring and fall, one of the most common types of annual mixing in cool temperate regions such as central and eastern North America.
- Polymictic - Lakes that circulate frequently or continuously, cold lakes that are continually near or slightly above 4°C, or warm equatorial lakes where air temperature changes very little.

(3) Meromictic - Lakes that do not circulate throughout the entire water column. The lower water stratum is perennially stagnant.

Lake Sedimentation

Deposition of sediment received from the surrounding watershed is an important physical process in lakes. Because of the low water velocities through the lake or reservoir, sediments transported by inflowing waters tend to settle out.

Sediment accumulation rates are strongly dependent both on the physiographic characteristics of a specific watershed and on various characteristics of the lake. Prediction of sedimentation rates can be estimated in two basic ways:

- periodic sediment surveys on a lake; and
- estimation of watershed erosion and bed load.

Accumulation of sediment in lakes can, over many years, reduce the life of the water body by reducing the water storage capacity. Sediment flow into the lake also reduces light penetration, eliminates bottom habitat for many plants and

animals, and carries with it adsorbed chemicals and organic matter that settle to the bottom and can be harmful to the ecology of the lake. Where sediment accumulation is a major problem, proper watershed management including erosion and sediment control must be put into effect.

Chemical Characteristics

Freshwater chemistry is discussed in section 2.9.3 and in the *Technical Support Manual, Volume I* (USEPA, 1983c). Therefore, the discussion here will focus on chemical phenomena that are of particular importance to lakes. Nutrient cycling and eutrophication are the primary factors of concern in this discussion, but the effects of pH, dissolved oxygen, and redox potential on lake processes are also involved.

Water chemistry in a lake is closely related to the stages in the annual lake turnover. Once a thermocline has formed, the dissolved oxygen levels in the hypolimnion tend to decline. This occurs because the hypolimnion is isolated from surface waters by the thermocline and there is no mechanism for aeration.

The decay of organic matter and the respiration of fish and other organisms in the hypolimnion serve to deplete DO. Extreme depletion of DO may occur in ice- and snow-covered lakes in which light is insufficient for photosynthesis. If depletion of DO is great enough, fish kills may result. With the depletion of DO, reducing conditions prevail and many compounds that have accumulated in the sediment by precipitation are released to the surrounding water. Chemicals solubilized under such conditions include compounds of nitrogen, phosphorus, iron, manganese, and calcium. Phosphorus and nitrogen are of particular concern because of their role in the eutrophication process in lakes.

Nutrients released from the bottom sediments during stratified conditions are not available to phytoplankton in the epilimnion. However, during overturn periods, mixing of the layers distributes the nutrients throughout the water column. The high nutrient availability is short-lived because the soluble reduced forms are rapidly oxidized to insoluble forms that precipitate out and settle to the bottom. Phosphorus and nitrogen are also deposited through sorption to particles that settle to the bottom and as dead plant material that is added to the sediments.

Of the many raw materials required by aquatic plants (phytoplankton and macrophytes) for growth, carbon, nitrogen, and phosphorus are the most important. Carbon is available from carbon dioxide, which is in almost unlimited supply. Since growth is generally limited by the essential nutrient that is in lowest supply, either nitrogen or phosphorus is usually the limiting nutrient for growth of primary producers. If these nutrients are available in adequate supply, massive algal and macrophyte blooms may occur with severe consequences for the lake. Most commonly in lakes, phosphorus is the limiting nutrient for aquatic plant growth. In these situations, adequate control of phosphorus, particularly from anthropogenic sources, can control growth of aquatic vegetation. Phosphorus can in some cases, be removed from the water column by precipitation, as described in the *Technical Support Manual, Volume III* (USEPA, 1984b).

Eutrophication and Nutrient Cycling

The term "eutrophication" is used in two general ways: (1) eutrophication is defined as the process of nutrient enrichment in a water body; and (2) eutrophication is used to describe the effects of nutrient enrichment, that is, the uncontrolled growth of plants, particularly phytoplankton, in a lake or reservoir. The second use also encompasses changes in the composition of animal communities in the water body. Both uses are commonly found in the literature, and the distinction, if important, must be discerned from the context of use.

Eutrophication is often greatly accelerated by anthropogenic nutrient enrichment, which has been termed "cultural eutrophication." Nutrients are transported to lakes from external sources,

and once in the lake, may be recycled internally. A consideration of attainable uses in a lake must include an understanding of the sources of nitrogen and phosphorus, the significance of internal cycling, especially of phosphorus, and the changes that might be anticipated if eutrophication could be controlled.

Significance of Chemical Phenomena to Use Attainability

The most critical water quality indicators for aquatic use attainment in a lake are DO, nutrients, chlorophyll-a, and toxicants. In evaluating use attainability, the relative importance of three forms of oxygen demand should be considered: respiratory demand of phytoplankton and macrophytes during non-photosynthetic periods, water column demand, and benthic demand. If use impairment is occurring, assessments of the significance of each oxygen sink can be useful in evaluating the feasibility of achieving sufficient pollution control, or in implementing the best internal nutrient management practices to attain a designated use.

Chlorophyll-a is a good indicator of algal concentrations and of nutrient overenrichment. Excessive phytoplankton concentrations, as indicated by high chlorophyll-a levels, can cause adverse DO impacts such as:

- wide diurnal variation in surface DO due to daytime photosynthesis and nighttime respiration, and
- depletion of bottom DO through the decomposition of dead algae.

As discussed previously, nitrogen and phosphorus are the nutrients of concern in most lake systems, particularly where anthropogenic sources result in increased nutrient loading. It is important to base control strategies on an understanding of the sources of each type of nutrient, both in the lake and in its feeder streams.

Also, the presence of toxics such as pesticides, herbicides, and heavy metals in sediments or the water column should by considered in evaluating uses. These pollutants may prevent the attainment of uses (particularly those related to fish propagation and maintenance in water bodies) that would otherwise be supported by the water quality criteria for DO and other parameters.

Biological Characteristics

A major concern for lake biology is the eutrophication due to anthropogenic sources of nutrients. The increased presence of nutrients may result in phytoplankton blooms that can, in turn, have adverse impacts on other components of the biological community. A general trend that results from eutrophication is an increase in numbers of organisms but a decrease in diversity of species, particularly among nonmotile species. The biological characteristics of lakes are discussed in more detail in the *Technical Support Manual, Volume III.*

Techniques for Use Attainability Evaluations

Techniques for use attainability evaluations of lakes are discussed in detail in the *Technical Support Manual, Volume III.* Several empirical (desktop) and simulation (computer-based mathematical) models that can be used to characterize and evaluate lakes for use attainability are presented in that document and will not be included here owing to the complexity of the subject.

CHAPTER 3

WATER QUALITY CRITERIA

(40 CFR 131.11)

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CHAPTER 3
WATER QUALITY CRITERIA

The term "water quality criteria" has two different definitions under the Clean Water Act (CWA). Under section 304(a), EPA publishes water quality criteria that consist of scientific information regarding concentrations of specific chemicals or levels of parameters in water that protect aquatic life and human health (see section 3.1 of this Handbook). The States may use these contents as the basis for developing enforceable water quality standards. Water quality criteria are also elements of State water quality standards adopted under section 303(c) of the CWA (see sections 3.2 through 3.5 of this Handbook). States are required to adopt water quality criteria that will protect the designated use(s) of a water body. These criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use.

3.1 EPA Section 304(a) Guidance

EPA and a predecessor agency have produced a series of scientific water quality criteria guidance documents. Early Federal efforts were the "Green Book" (FWPCA, 1968) and the "Red Book" (USEPA, 1976). EPA also sponsored a contract effort that resulted in the "Blue Book" (NAS/NAE, 1973). These early efforts were premised on the use of literature reviews and the collective scientific judgment of Agency and advisory panels. However, when faced with the need to develop criteria for human health as well as aquatic life, the Agency determined that new procedures were necessary. Continued reliance solely on existing scientific literature was deemed inadequate because essential information was not available for many pollutants. EPA scientists developed formal methodologies for establishing scientifically defensible criteria. These were subjected to review by the Agency's Science Advisory Board of outside experts and the public. This effort culminated on November 28, 1980, when the Agency published criteria development guidelines for aquatic life and for human health, along with criteria for 64 toxic pollutants (USEPA, 1980a,b). Since that initial publication, the aquatic life methodology was slightly amended (Appendix H), and additional criteria were proposed for public comment and finalized as Agency criteria guidance. EPA summarized the available criteria information in the "*Gold Book*" (USEPA, 1986a), which is updated from time to time. However, the individual criteria documents (see Appendix I), as updated, are the official guidance documents.

EPA's criteria documents provide a comprehensive toxicological evaluation of each chemical. For toxic pollutants, the documents tabulate the relevant acute and chronic toxicity information for aquatic life and derive the criteria maximum concentrations (acute criteria) and criteria continuous concentrations (chronic criteria) that the Agency recommends to protect aquatic life resources. The methodologies for these processes are described in Appendices H and J and outlined in sections 3.1.2 and 3.1.3 of this Handbook.

3.1.1 State Use of EPA Criteria Documents

EPA's water quality criteria documents are available to assist States in:

- adopting water quality standards that include appropriate numeric water quality criteria;
- interpreting existing water quality standards that include narrative "no toxics in toxic amounts" criteria;

- making listing decisions under section 304(1) of the CWA;
- writing water quality-based NPDES permits and individual control strategies; and
- providing certification under section 401 of the CWA for any Federal permit or license (e.g., EPA-issued NPDES permits, CWA section 404 permits, or Federal Energy Regulatory Commission licenses).

In these situations, States have primary authority to determine the appropriate level to protect human health or welfare (in accordance with section 303(c)(2) of the CWA) for each water body. However, under the Clean Water Act, EPA must also review and approve State water quality standards; section 304(1) listing decisions and draft and final State-issued individual control strategies; and in States where EPA writes NPDES permits, EPA must develop appropriate water quality-based permit limitations. The States and EPA therefore have a strong interest in assuring that the decisions are legally defensible, are based on the best information available, and are subject to full and meaningful public comment and participation. It is very important that each decision be supported by an adequate record. Such a record is critical to meaningful comment, EPA's review of the State's decision, and any subsequent administrative or judicial review.

Any human health criterion for a toxicant is based on at least three interrelated considerations:

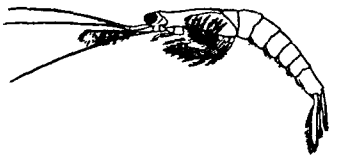
- cancer potency or systemic toxicity,
- exposure, and
- risk characterization.

States may make their own judgments on each of these factors within reasonable scientific bounds, but documentation to support their judgments, when different from EPA's recommendation, must be clear and in the public record. If a State relies on EPA's section 304(a) criteria document (or other EPA documents), the State may reference and rely on the data in these documents and need not create duplicative or new material for inclusion in their records. However, where site-specific issues arise or the State decides to adopt an approach to any one of these three factors that differs from the approach in EPA's criteria document, the State must explain its reasons in a manner sufficient for a reviewer to determine that the approach chosen is based on sound scientific rationale (40 CFR 131.11(b)).

3.1.2 Criteria for Aquatic Life Protection

The development of national numerical water quality criteria for the protection of aquatic organisms is a complex process that uses information from many areas of aquatic toxicology. (See Appendix H for a detailed discussion of this process.) After a decision is made that a national criterion is needed for a particular material, all available information concerning toxicity to, and bioaccumulation by, aquatic organisms is collected and reviewed for acceptability. If enough acceptable data for 48- to 96-hour toxicity tests on aquatic plants and animals are available, they are used to derive the acute criterion. If sufficient data on the ratio of acute to chronic toxicity concentrations are available, they are used to derive the chronic or long-term exposure criteria. If justified, one or both of the criteria may be related to other water quality characteristics, such as pH, temperature, or hardness. Separate criteria are developed for freshwaters and saltwaters.

The Water Quality Standards Regulation allows States to develop numerical criteria or modify



EPA's recommended criteria to account for site-specific or other scientifically defensible factors. (Ed. note: EPA is currently revising the 1984 guideline for developing site-specific criteria. These revisions will be made available shortly as an update to this Handbook.) When a criterion must be developed for a chemical for which a national criterion has not been established, the regulatory authority should refer to the EPA guidelines (Appendix H).

Magnitude for Aquatic Life Criteria

Water quality criteria for aquatic life contain two expressions of allowable magnitude: a criterion maximum concentration (CMC) to protect against acute (short-term) effects; and a criterion continuous concentration (CCC) to protect against chronic (long-term) effects. EPA derives acute criteria from 48- to 96-hour tests of lethality or immobilization. EPA derives chronic criteria from longer term (often greater than 28-day) tests that measure survival, growth, reproduction, or in some cases, bioconcentration. Where appropriate, the calculated criteria may be lowered to be protective of economically important species.

Duration for Aquatic Life Criteria

The quality of an ambient water typically varies in response to variations of effluent quality, stream flow, and other factors. Organisms in the receiving water are not experiencing constant, steady exposure but rather are experiencing fluctuating exposures, including periods of high concentrations, which may have adverse effects. Thus, EPA's criteria indicate a time period over which exposure is to be averaged, as well as a maximum concentration, thereby limiting the duration of exposure to elevated concentrations. For acute criteria, EPA recommends an averaging period of 1 hour. That is, to protect against acute effects, the 1-hour average exposure should not exceed the CMC. For chronic criteria, EPA recommends an averaging period of 4 days. That is, the 4-day average exposure should not exceed the CCC.

Frequency for Aquatic Life Criteria

To predict or ascertain the attainment of criteria, it is necessary to specify the allowable frequency for exceeding the criteria. This is because it is statistically impossible to project that criteria will never be exceeded. As ecological communities are naturally subjected to a series of stresses, the allowable frequency of pollutant stress may be set at a value that does not significantly increase the frequency or severity of all stresses combined.

EPA recommends an average frequency for excursions of both acute and chronic criteria not to exceed once in 3 years. In all cases, the recommended frequency applies to actual ambient concentrations, and excludes the influence of measurement imprecision. EPA established its recommended frequency as part of its guidelines for deriving criteria (Appendix H). EPA selected the maximum 3-year return interval with the intent of providing a degree of protection roughly equivalent to a 7Q10 design flow condition, and with some consideration of rates of ecological recovery from a variety of severe stresses. Because of the nature of the ecological recovery studies available, the severity of criteria excursions could not be rigorously related to the resulting ecological impacts. Nevertheless, EPA derives its criteria intending that a single marginal criteria excursion (i.e., a slight excursion over a 1-hour period for acute or over a 4-day period for chronic) would require little or no time for recovery. If the frequency of marginal criteria excursions is not high, it can be shown that the frequency of severe stresses, requiring measurable recovery periods, would be extremely small. EPA thus expects the 3-year return interval to provide a very high degree of protection.

3.1.3 Criteria for Human Health Protection

This section reviews EPA's procedures used to develop assessments of human health effects in developing water quality criteria and reference ambient concentrations. A more complete human health effects discussion is included in the *Guidelines and Methodology Used in the*

Preparation of Health Effects Assessment Chapters of the Consent Decree Water Documents (Appendix J). The procedures contained in this document are used in the development and updating of EPA water quality criteria and may be used in updating State criteria and in developing State criteria for those pollutants lacking EPA human health criteria. The procedures may also be applied as site-specific interpretations of narrative standards and as a basis for permit limits under 40 CFR 122.44 (d)(1)(vi).

Magnitude and Duration

Water quality criteria for human health contain only a single expression of allowable magnitude; a criterion concentration generally to protect against long-term (chronic) human health effects. Currently, national policy and prevailing opinion in the expert community establish that the duration for human health criteria for carcinogens should be derived assuming lifetime exposure, taken to be a 70-year time period. The duration of exposure assumed in deriving criteria for noncarcinogens is more complicated owing to a wide variety of endpoints: some developmental (and thus age-specific and perhaps gender-specific), some lifetime, and some, such as organoleptic effects, not duration-related at all. Thus, appropriate durations depend on the individual noncarcinogenic pollutants and the endpoints or adverse effects being considered.

Human Exposure Considerations

A complete human exposure evaluation for toxic pollutants of concern for bioaccumulation would encompass not only estimates of exposures due to fish consumption but also exposure from background concentrations and other exposure routes, The more important of these include recreational and occupational contact, dietary intake from other than fish, intake from air inhalation, and drinking water consumption. For section 304(a) criteria development, EPA typically considers only exposures to a pollutant that occur through the ingestion of water and contaminated fish and shellfish. This is the exposure default assumption, although the human health guidelines provide for considering other sources where data are available (see 45 F.R. 79354). Thus the criteria are based on an assessment of risks related to the surface water exposure route only (57 F.R. 60862-3).

The consumption of contaminated fish tissue is of serious concern because the presence of even extremely low ambient concentrations of bioaccumulative pollutants (sublethal to aquatic life) in surface waters can result in residue concentrations in fish tissue that can pose a human health risk. Other exposure route information should be considered and incorporated in human exposure evaluations to the extent available.

Levels of actual human exposures from consuming contaminated fish vary depending upon a number of case-specific consumption factors. These factors include type of fish species consumed, type of fish tissue consumed, tissue lipid content, consumption rate and pattern, and food preparation practices. In addition, depending on the spatial variability in the fishery area, the behavior of the fish species, and the point of application of the criterion, the average exposure of fish may be only a small fraction of the expected exposure at the point of application of the criterion. If an effluent attracts fish, the average exposure might be greater than the expected exposure.

With shellfish, such as oysters, snails, and mussels, whole-body tissue consumption commonly occurs, whereas with fish, muscle tissue and roe are most commonly eaten. This difference in the types of tissues consumed has implications for the amount of available bioaccumulative contaminants likely to be ingested. Whole-body shellfish consumption presumably means ingestion of the entire burden of bioaccumulative contaminants. However, with most fish, selective cleaning and removal of internal organs, and sometimes body fat as well, from edible tissues, may result in removal of much of the lipid material in which bioaccumulative contaminants tend to concentrate.

Fish Consumption Values

EPA's human health criteria have assumed a human body weight of 70 kg and the consumption of 6.5 g of fish and shellfish per day. Based on data collected in 1973-74, the national per capita consumption of freshwater and estuarine fish was estimated to average 6.5 g/day. Per capita consumption of all seafood (including marine species) was estimated to average 14.3 g/day. The 95th percentile for consumption of all seafood by individuals over a period of 1 month was estimated to be 42 g/day. The mean lipid content of fish tissue consumed in this study was estimated to be 3.0 percent (USEPA, 1980c).

Currently, four levels of fish consumption are provided in EPA guidance (USEPA, 1991a):

- 6.5 g/day to represent an estimate of average consumption of fish and shellfish from estuarine and freshwaters by the entire U.S. population. This fish consumption level is based on the average of both consumers and nonconsumers of fish.

- 20 g/day to represent an estimate of the average consumption of fish and shellfish from marine, estuarine, and freshwaters by the U.S. population. This average fish consumption level also includes both consumers and nonconsumers of fish.

- 165 g/day to represent consumption of fish and shellfish from marine, estuarine, and freshwaters by the 99.9th percentile of the U.S. population consuming the most fish or seafood.

- 180 g/day to represent a "reasonable worst case" based on the assumption that some individuals would consume fish at a rate equal to the combined consumption of red meat, poultry, fish, and shellfish in the United States.

EPA is currently updating the national estuarine and freshwater fish and shellfish consumption default values and will provide a range of recommended national consumption values. This range will include:

- mean values appropriate to the population at large; and

- values appropriate for those individuals who consume a relatively large proportion of fish in their diets (maximally exposed individuals).

Many States use EPA's 6.5 g/day consumption value. However, some States use the above-mentioned 20 g/day value and, for saltwaters, 37 g/day. In general, EPA recommends that the consumption values used in deriving criteria from the formulas in this chapter reflect the most current, relevant, and/or site-specific information available.

Bioaccumulation Considerations

The ratio of the contaminant concentrations in fish tissue versus that in water is termed either the bioconcentration factor (BCF) or the bioaccumulation factor (BAF). Bioconcentration is defined as involving contaminant uptake from water only (not from food). The bioaccumulation factor (BAF) is defined similarly to the BCF except that it includes contaminant uptake from both water and food. Under laboratory conditions, measurements of tissue/water partitioning are generally considered to involve uptake from water only. On the other hand, both processes are likely to apply in the field since the entire food chain is exposed.

The BAF/BCF ratio ranges from 1 to 100, with the highest ratios applying to organisms in higher trophic levels, and to chemicals with logarithm of the octanol-water partitioning coefficient (log P) close to 6.5.

Bioaccumulation considerations are integrated into the criteria equations by using food chain multipliers (FMs) in conjunction with the BCF.

The bioaccumulation and bioconcentration factors for a chemical are related as follows:

$$BAF = FM \times BCF$$

By incorporating the FM and BCF terms into the criteria equations, bioaccumulation can be addressed.

In Table 3-1, FM values derived from the work of Thomann (1987, 1989) are listed according to log P value and trophic level of the organism. For chemicals with log P values greater than about 7, there is additional uncertainty regarding the degree of bioaccumulation, but generally, trophic level effects appear to decrease due to slow transport kinetics of these chemicals in fish, the growth rate of the fish, and the chemical's relatively low bioavailability. Trophic level 4 organisms are typically the most desirable species for sport fishing and, therefore, FMs for trophic level 4 should generally be used in the equations for calculating criteria. In those very rare situations where only lower trophic level organisms are found, e.g., possibly oyster beds, an FM for a lower trophic level might be considered.

Measured BAFs (especially for those chemicals with log P values above 6.5) reported in the literature should be used when available. To use experimentally measured BAFs in calculating the criterion, the (FM x BCF) term is replaced by the BAF in the equations in the following section. Relatively few BAFs have been measured accurately and reported, and their application to sites other than the specific ecosystem where they were developed is problematic and subject to uncertainty. The option is also available to develop BAFs experimentally, but this will be extremely resource intensive if done on a site-specific basis with all the necessary experimental and quality controls.

	Trophic Levels		
Log P	2	3	4
3.5	1.0	1.0	1.0
3.6	1.0	1.0	1.0
3.7	1.0	1.0	1.0
3.8	1.0	1.0	1.0
3.9	1.0	1.0	1.0
4.0	1.1	1.0	1.0
4.1	1.1	1.1	1.1
4.2	1.1	1.1	1.1
4.3	1.1	1.1	1.1
4.4	1.2	1.1	1.1
4.5	1.2	1.2	1.2
4.6	1.2	1.3	1.3
4.7	1.3	1.4	1.4
4.8	1.4	1.5	1.6
4.9	1.5	1.8	2.0
5.0	1.6	2.1	2.6
5.1	1.7	2.5	3.2
5.2	1.9	3.0	4.3
5.3	2.2	3.7	5.8
5.4	2.4	4.6	8.0
5.5	2.8	5.9	11
5.6	3.3	7.5	16
5.7	3.9	9.8	23
5.8	4.6	13	33
5.9	5.6	17	47
6.0	6.8	21	67
6.1	8.2	25	75
6.2	10	29	84
6.3	13	34	92
6.4	15	39	98
6.5	19	45	100
≥6.5	19.2*	45*	100*

* These recommended FMs are conservative estimates; FMs for log P values greater than 6.5 may range from the values given to as low as 0.1 for contaminants with very low bioavailability.

Table 3-1. Estimated Food Chain Multipliers (FMs)

Updating Human Health Criteria Using IRIS

EPA recommends that States use the most current risk information in the process of updating human

health criteria. The Integrated Risk Information System (IRIS) (Barns and Dourson, 1988; Appendix N) is an electronic data base of the USEPA that provides chemical-specific risk information on the relationship between chemical exposure and estimated human health effects. Risk assessment information contained in IRIS, except as specifically noted, has been reviewed and agreed upon by an interdisciplinary group of scientists representing various Program Offices within the Agency and represent an Agency-wide consensus. Risk assessment information and values are updated on a monthly basis and are approved for Agency-wide use. IRIS is intended to make risk assessment information readily available to those individuals who must perform risk assessments and also to increase consistency among risk assessment/risk management decisions.

IRIS contains two types of quantitative risks values: the oral Reference Dose (RfD) and the carcinogenic potency estimate or slope factor. The RfD (formerly known as the acceptable daily intake or ADI) is the human health hazard assessment for noncarcinogenic (target organ) effects. The carcinogenic potency estimate (formerly known as q_1^*) represents the upper bound cancer-causing potential resulting from lifetime exposure to a substance. The RfD or the oral carcinogenic potency estimate is used in the derivation of EPA human health criteria.

EPA periodically updates risk assessment information, including RfDs, cancer potency estimates, and related information on contaminant effects, and reports the current information on IRIS. Since IRIS contains the Agency's most recent quantitative risk assessment values, current IRIS values should be used by States in updating or developing new human health criteria. This means that the 1980 human health criteria should be updated with the latest IRIS values. The procedure for deriving an updated human health water quality criterion would require inserting the current Rfd or carcinogenic potency estimate on IRIS into the equations in Exhibit 3.1 or 3.2, as appropriate.

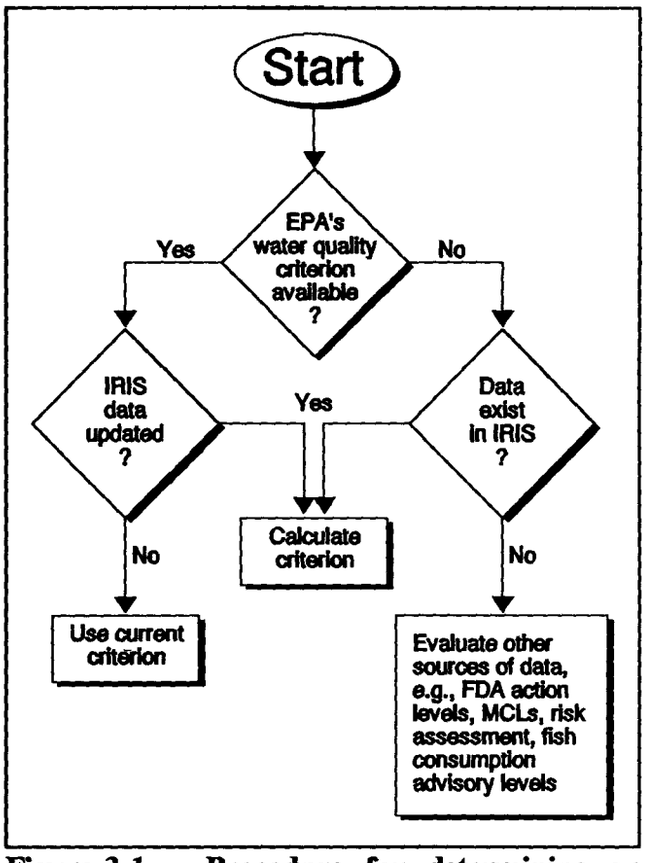


Figure 3-1. Procedure for determining an updated criterion using IRIS data.

Figure 3-1 shows the procedure for determining an updated criterion using IRIS data. If a chemical has both carcinogenic and non-carcinogenic effects, i.e., both a cancer potency estimate and a RfD, both criteria should be calculated. The most stringent criterion applies.

Calculating Criteria for Non-carcinogens

The RfD is an estimate of the daily exposure to the human population that is likely to be without appreciable risk of causing deleterious effects during a lifetime. The RfD is expressed in units of mg toxicant per kg human body weight per day.

RfDs are derived from the "no-observed-adverse-effect level" (NOAEL) or the "lowest-observed-adverse-effect level" (LOAEL) identified from chronic or subchronic human epidemiology studies or animal exposure studies. (Note: "LOAEL"

and "NOAEL" refer to animal and human toxicology and are therefore distinct from the aquatic toxicity terms "no-observed-effect concentration" (NOEC) and "lowest-observed-effect concentration" (LOEC).) Uncertainty factors are then applied to the NOAEL or LOAEL to account for uncertainties in the data associated with variability among individuals, extrapolation from nonhuman test species to humans, data on other than long-term exposures, and the use of a LOAEL (USEPA, 1988a). An additional uncertainty factor may be applied to account for significant weakness or gaps in the database.

The RfD is a threshold below which systemic toxic effects are unlikely to occur. While exposures above the RfD increase the probability of adverse effects, they do not produce a certainty of adverse effects. Similarly, while exposure at or below the RfD reduces the probability, it does not guarantee the absence of effects in all persons. The RfDs contained in IRIS are values that represent EPA's consensus (and have uncertainty spanning perhaps an order of magnitude). This means an RfD of 1.0 mg/kg/day could range from 0.3 to 3.0 mg/kg/day.

For noncarcinogenic effects, an updated criterion can be derived using the equation in Exhibit 3-1.

If the receiving water body is not used as a drinking water source, the factor WI can be deleted. Where dietary and/or inhalation exposure values are unknown, these factors may be deleted from the above calculation.

Calculating Criteria for Carcinogens

Any human health criterion for a carcinogen is based on at least three interrelated considerations: cancer potency, exposure, and risk characterization. When developing State criteria, States may make their own judgments on each of these factors within reasonable scientific bounds, but documentation to support their judgments must be clear and in the public record.

Maximum protection of human health from the potential effects of exposure to carcinogens through the consumption of contaminated fish and/or other aquatic life would require a criterion of zero. The zero level is based upon the assumption of nonthreshold effects (i.e., no safe level exists below which any increase in exposure does not result in an increased risk of cancer) for carcinogens. However, because a publicly acceptable policy for safety does not require the absence of all risk, a numerical estimate of pollutant concentration (in μg/l) which corresponds to a given level of risk for a population of a specified size is selected instead. A cancer risk level is defined as the number of new cancers that may result in a population of specified size due to an increase in exposure (e.g., 10^{-6} risk level = 1 additional cancer in a population of 1 million). Cancer risk is calculated by multiplying the experimentally derived cancer potency estimate by the concentration of the chemical in the fish and the average daily human consumption of contaminated fish. The risk for a specified population (e.g., 1 million people or 10^{-6}) is then calculated by dividing the risk level by the specific cancer risk. EPA's ambient water quality criteria documents provide risk levels ranging from 10^{-5} to 10^{-7} as examples.

The cancer potency estimate, or slope factor (formerly known as the q_1^*), is derived using animal studies. High-dose exposures are extrapolated to low-dose concentrations and adjusted to a lifetime exposure period through the use of a linearized multistage model. The model calculates the upper 95 percent confidence limit of the slope of a straight line which the model postulates to occur at low doses. When based on human (epidemiological) data, the slope factor is based on the observed increase in cancer risk and is not extrapolated. For deriving criteria for carcinogens, the oral cancer potency estimates or slope factors from IRIS are used.

It is important to note that cancer potency factors may overestimate or underestimate the actual risk. Such potency estimates are subject to great uncertainty because of two primary factors:

$$C\ (mg/l) = \frac{(RfD \times WT) - (DT + IN) \times WT}{WI + [FC \times L \times FM \times BCF]}$$

where:

C = updated water quality criterion (mg/l)

RfD = oral reference dose (mg toxicant/kg human body weight/day)

WT = weight of an average human adult (70 kg)

DT = dietary exposure (other than fish) (mg toxicant/kg body human weight/day)

IN = inhalation exposure (mg toxicant/kg body human weight/day)

WI = average human adult water intake (2 l/day)

FC = daily fish consumption (kg fish/day)

L = ratio of lipid fraction of fish tissue consumed to 3%

FM = food chain multiplier (from Table 3-1)

BCF = bioconcentration factor (mg toxicant/kg fish divided by mg toxicant/L water) for fish with 3% lipid content

Exhibit 3-1. Equation for Deriving Human Health Criteria Based on Noncarcinogenic Effects

- adequacy of the cancer data base (i.e., human vs. animal data); and
- limited information regarding the mechanism of cancer causation.

Risk levels of 10^{-5}, 10^{-6}, and 10^{-7} are often used by States as minimal risk levels in interpreting their standards. EPA considers risks to be additive, i.e., the risk from individual chemicals is not necessarily the overall risk from exposure to water. For example, an individual risk level of 10^{-6} may yield a higher overall risk level if multiple carcinogenic chemicals are present.

For carcinogenic effects, the criterion can be determined by using the equation in Exhibit 3-2. If the receiving water body is not designated as a drinking water source, the factor WI can be deleted.

Deriving Quantitative Risk Assessments in the Absence of IRIS Values

The RfDs or cancer potency estimates comprise the existing dose-response factors for developing criteria. When IRIS data are unavailable, quantitative risk level information may be developed according to a State's own procedures. Some States have established their own procedures whereby dose-response factors can be developed based upon extrapolation of acute and/or chronic animal data to concentrations of exposure protective of fish consumption by

$$C\ (mg/l) = \frac{(RL \times WT)}{q_1^* [WI + FC \times L \times (FM \times BCF)]}$$

where:

C	=	updated water quality criterion (mg/l)
RL	=	risk level (10^{-x}) where x is usually in the range of 4 to 6
WT	=	weight of an average human adult (70 kg)
q_1^*	=	carcinogenic potency factor (kg day/mg)
WI	=	average human adult water intake (2 l/day)
FC	=	daily fish consumption (kg fish/day)
L	=	ratio of lipid fraction of fish tissue consumed to 3% assumed by EPA
FM	=	food chain multiplier (from Table 3-1)
BCF	=	bioconcentration factor (mg toxicant/kg fish divided by mg toxicant/L water) for fish with 3% lipid content

Exhibit 3-2. Equation for Deriving Human Health Criteria Based on Carcinogenic Effects

humans.

3.2 Relationship of Section 304(a) Criteria to State Designated Uses

The section 304(a)(1) criteria published by EPA from time to time can be used to support the designated uses found in State standards. The following sections briefly discuss the relationship between certain criteria and individual use classifications. Additional information on this subject also can be found in the "Green Book" (FWPCA, 1968); the "Blue Book" (NAS/NAE, 1973); the "Red Book" USEPA, 1976); the EPA *Water Quality Criteria Documents* (see Appendix I); the"Gold Book" (USEPA, 1986a); and future EPA section 304(a)(1) water quality criteria publications.

Where a water body is designated for more than one use, criteria necessary to protect the most sensitive use must be applied. The following four sections discuss the major types of use categories.

3.2.1 Recreation

Recreational uses of water include activities such as swimming, wading, boating, and fishing. Often insufficient data exist on the human health effects of physical and chemical pollutants, including most toxics, to make a determination of criteria for recreational uses. However, as a general guideline, recreational waters that contain chemicals in concentrations toxic or otherwise harmful to man if ingested, or irritating to the skin or mucous membranes of the human body

upon brief immersion, should be avoided. The section 304(a)(1) human health effects criteria based on direct human drinking water intake and fish consumption might provide useful guidance in these circumstances. Also, section 304(a)(1) criteria based on human health effects may be used to support this designated use where fishing is included in the State definition of "recreation." In this latter situation, only the portion of the criterion based on fish consumption should be used. Section 304(a)(1) criteria to protect recreational uses are also available for certain physical, microbiological, and narrative "free from" aesthetic criteria.

Research regarding bacteriological indicators has resulted in EPA recommending that States use *Escherichia coli* or enterococci as indicators of recreational water quality (USEPA, 1986b) rather than fecal coliform because of the better correlation with gastroenteritis in swimmers.

The "Green Book" and "Blue Book" provide additional information on protecting recreational uses such as pH criteria to prevent eye irritation and microbiological criteria based on aesthetic considerations.

3.2.2 Aquatic Life and Wildlife

The section 304(a)(1) criteria for aquatic life should be used directly to support this designated use. If subcategories of this use are adopted (e.g., to differentiate between coldwater and warmwater fisheries), then appropriate criteria should be set to reflect the varying needs of such subcategories.

3.2.3 Agricultural and Industrial Uses

The "Green Book" (FWPCA, 1968) and "Blue Book" (NAS/NAE, 1973) provide some information on protecting agricultural and industrial uses. Section 304(a)(1) criteria for protecting these uses have not been specifically developed for numerous parameters pertaining to these uses, including most toxics. Where criteria have not been specifically developed for these uses, the criteria developed for human health and aquatic life are usually sufficiently stringent to protect these uses. States may also establish criteria specifically designed to protect these uses.

3.2.4 Public Water Supply

The drinking water exposure component of the section 304(a)(1) criteria based on human health effects can apply directly to this use classification. The criteria also may be appropriately modified depending upon whether the specific water supply system falls within the auspices of the Safe Drinking Water Act's (SDWA) regulatory control and the type and level of treatment imposed upon the supply before delivery to the consumer. The SDWA controls the presence of contaminants in finished ("at-the-tap") drinking water.

A brief description of relevant sections of the SDWA is necessary to explain how the Act will work in conjunction with section 304(a)(1) criteria in protecting human health from the effects of toxics due to consumption of water. Pursuant to section 1412 of the SDWA, EPA has promulgated "National Primary Drinking Water Standards" for certain radionuclide, microbiological, organic, and inorganic substances. These standards establish maximum contaminant levels (MCLs), which specify the maximum permissible level of a contaminant in water that may be delivered to a user of a public water system now defined as serving a minimum of 25 people. MCLs are established based on consideration of a range of factors including not only the health effects of the contaminants but also treatment capability, monitoring availability, and costs. Under section 1401(1)(D)(i) of the SDWA, EPA is also allowed to establish the minimum quality criteria for water that may be taken into a public water supply system.

Section 304(a)(1) criteria provide estimates of pollutant concentrations protective of human health, but do not consider treatment technology, costs, and other feasibility factors. The section

304(a)(1) criteria also include fish bioaccumulation and consumption factors in addition to direct human drinking water intake. These numbers were not developed to serve as "at-the-tap" drinking water standards, and they have no regulatory significance under the SDWA. Drinking water standards are established based on considerations, including technological and economic feasibility, not relevant to section 304(a)(1) criteria. Section 304(a)(1) criteria are more analogous to the maximum contaminant level goals (MCLGs) (previously known as RMCLs) under section 1412(b)(1)(B) of the SDWA in which, based upon a report from the National Academy of Sciences, the Administrator should set target levels for contaminants in drinking water at which "no known or anticipated adverse effects occur and which allow an adequate margin of safety." MCLGs do not take treatment, cost, and other feasibility factors into consideration. Section 304(a)(1) criteria are, in concept, related to the health-based goals specified in the MCLGs.

MCLs of the SDWA, where they exist, control toxic chemicals in finished drinking water. However, because of variations in treatment, ambient water criteria may be used by the States as a supplement to SDWA regulations. When setting water quality criteria for public water supplies, States have the option of applying MCLs, section 304(a)(1) human health effects criteria, modified section 304(a)(1) criteria, or controls more stringent than these three to protect against the effects of contaminants by ingestion from drinking water.

For treated drinking water supplies serving 25 people or greater, States must control contaminants down to levels at least as stringent as MCLs (where they exist for the pollutants of concern) in the finished drinking water. However, States also have the options to control toxics in the ambient water by choosing section 304(a)(1) criteria, adjusted section 304(a)(1) criteria resulting from the reduction of the direct drinking water exposure component in the criteria calculation to the extent that the treatment process reduces the level of pollutants, or a more stringent contaminant level than the former three options.

3.3 State Criteria Requirements

Section 131.11(a)(1) of the Regulation requires States to adopt water quality criteria to protect the designated use(s). The State criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use(s). For waters with multiple use designations, the criteria must support the most sensitive use.

In section 131.11, States are encouraged to adopt both numeric and narrative criteria. Aquatic life criteria should protect against both short-term (acute) and long-term (chronic) effects. Numeric criteria are particularly important where the cause of toxicity is known or for protection against pollutants with potential human health impacts or bioaccumulation potential. Numeric water quality criteria may also be the best way to address nonpoint source pollution problems. Narrative criteria can be the basis for limiting toxicity in waste discharges where a specific pollutant can be identified as causing or contributing to the toxicity but where there are no numeric criteria in the State standards. Narrative criteria also can be used where toxicity cannot be traced to a particular pollutant.

Section 131.11(a)(2) requires States to develop implementation procedures which explain how the State will ensure that narrative toxics criteria are met.

To more fully protect aquatic habitats, it is EPA's policy that States fully integrate chemical-specific, whole-effluent, and biological assessment approaches in State water quality programs (see Appendix R). Specifically, each of these three methods can provide a valid assessment of designated aquatic life use impairment. Therefore, EPA supports a policy of independent application of these three water quality assessment approaches. Independent application means that

the validity of the results of any one of the approaches does not depend on confirmation by one or both of the other methods. This policy is based on the unique attributes, limitations, and program applications of each of the three approaches. Each method alone can provide valid and independently sufficient evidence of attainment or non-attainment of water quality standards, irrespective of any evidence, or lack thereof, derived from the other two approaches. The failure of one method to confirm impacts identified by another method does not negate the results of the initial assessment (USEPA, 1991i).

It is also EPA's policy that States should designate aquatic life uses that appropriately address biological integrity and adopt biological criteria necessary to protect those uses (see section 3.5.3 and Appendices C, K, and R).

3.4 Criteria for Toxicants

Applicable requirements for State adoption of water quality criteria for toxicants vary depending upon the toxicant. The reason for this is that the 1983 Water Quality Standards Regulation (Appendix A) and the Water Quality Act of 1987 which amended the Clean Water Act (Public Law 100-4) include more specific requirements for the particular toxicants listed pursuant to CWA section 307(a). For regulatory purposes, EPA has translated the 65 compounds and families of compounds listed pursuant to section 307(a) into 126 more specific substances, which EPA refers to as "priority toxic pollutants." The 126 priority toxic pollutants are listed in the WQS regulation and in Appendix P of this Handbook. Because of the more specific requirements for priority toxic pollutants, it is convenient to organize the requirements applicable to State adoption of criteria for toxicants into three categories:

- requirements applicable to priority toxic pollutants that have been the subject of CWA section 304(a)(1) criteria guidance (see section 3.4.1);
- requirements applicable to priority toxic pollutants that have not been the subject of CWA section 304(a)(1) criteria guidance (see section 3.4.1); and
- requirements applicable to all other toxicants (e.g., non-conventional pollutants like ammonia and chlorine) (see section 3.4.2).

3.4.1 Priority Toxic Pollutant Criteria

The criteria requirements applicable to priority toxic pollutants (i.e., the first two categories above) are specified in CWA section 303(c)(2)(B). Section 303(c)(2)(B), as added by the Water Quality Act of 1987, provides that:

> Whenever a State reviews water quality standards pursuant to paragraph (1) of this subsection, or revises or adopts new standards pursuant to this paragraph, such State shall adopt criteria for all toxic pollutants listed pursuant to section 307(a)(1) of this Act for which criteria have been published under section 304(a), the discharge or presence of which in the affected waters could reasonably be expected to interfere with those designated uses adopted by the State, as necessary to support such designated uses. Such criteria shall be specific numerical criteria for such toxic pollutants. Where such numerical criteria are not available, whenever a State reviews water quality standards pursuant to paragraph (1), or revises or adopts new standards pursuant to this paragraph, such State shall adopt criteria based on biological monitoring or assessment methods consistent with information published pursuant to section 304(a)(8). Nothing in this section shall be construed to limit or delay the use of effluent limitations or other permit conditions based on or involving biological monitoring or assessment

methods or previously adopted numerical criteria.

EPA, in devising guidance for section 303(c)(2)(B), attempted to provide States with the maximum flexibility that complied with the express statutory language but also with the overriding congressional objective: prompt adoption and implementation of numeric toxics criteria. EPA believed that flexibility was important so that each State could comply with section 303(c)(2)(B) and to the extent possible, accommodate its existing water quality standards regulatory approach.

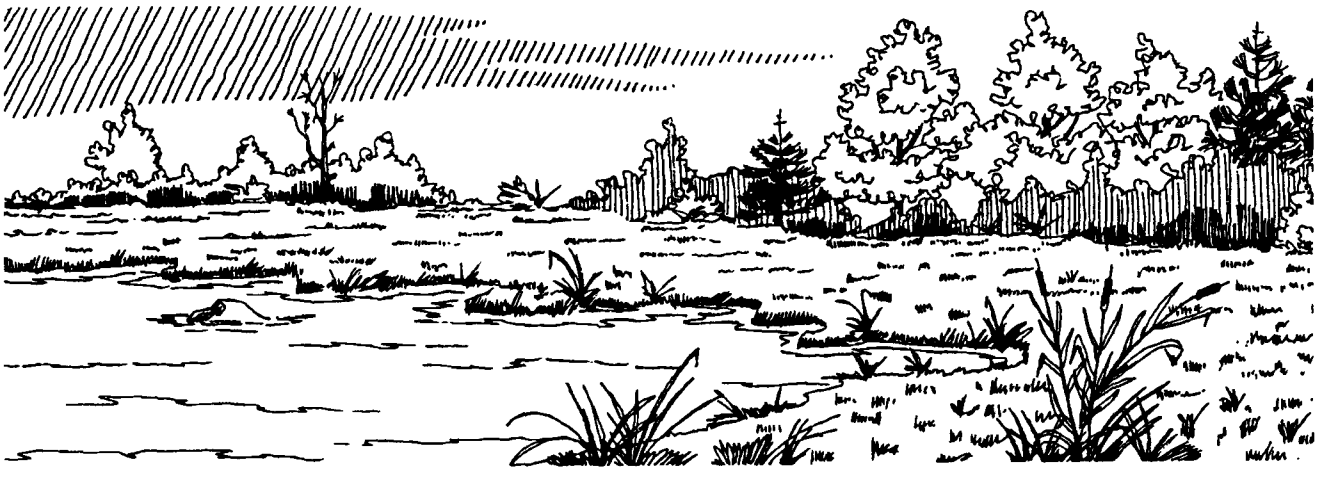
General Requirements

To carry out the requirements of section 303(c)(2)(B), whenever a State revises its water quality standards, it must review all available information and data to first determine whether the discharge or the presence of a toxic pollutant is interfering with or is likely to interfere with the attainment of the designated uses of any water body segment.

If the data indicate that it is reasonable to expect the toxic pollutant to interfere with the use, or it actually is interfering with the use, then the State must adopt a numeric limit for the specific pollutant. If a State is unsure whether a toxic pollutant is interfering with, or is likely to interfere with, the designated use and therefore is unsure that control of the pollutant is necessary to support the designated use, the State should undertake to develop sufficient information upon which to make such a determination. Presence of facilities that manufacture or use the section 307(a) toxic pollutants or other information indicating that such pollutants are discharged or will be discharged strongly suggests that such pollutants could be interfering with attaining designated uses. If a State expects the pollutant not to interfere with the designated use, then section 303(1)(2)(B) does not require a numeric standard for that pollutant.

Section 303(c)(2)(B) addresses only pollutants listed as "toxic" pursuant to section 307(a) of the Act, which are codified at 40 CFR 131.36(b). The section 307(a) list contains 65 compounds and families of compounds, which potentially include thousands of specific compounds. The Agency has interpreted that list to include 126 "priority" toxic pollutants for regulatory purposes. Reference in this guidance to toxic pollutants or section 307(a) toxic pollutants refers to the 126 priority toxic pollutants unless otherwise noted. Both the list of priority toxic pollutants and recommended criteria levels are subject to change.

The national criteria recommendations published by EPA under section 304(a) (see section 3.1, above) of the Act include values for both acute and chronic aquatic life protection; only chronic criteria recommendations have been established to



protect human health. To comply with the statute, a State needs to adopt aquatic life and human health criteria where necessary to support the appropriate designated uses. Criteria for the protection of human health are needed for water bodies designated for public water supply. When fish ingestion is considered an important activity, then the human health-related water quality criteria recommendation developed under section 304(a) of the CWA should be used; that is, the portion of the criteria recommendation based on fish consumption. For those pollutants designated as carcinogens, the recommendation for a human health criterion is generally more stringent than the aquatic life criterion for the same pollutant. In contrast, the aquatic life criteria recommendations for noncarcinogens are generally more stringent than the human health recommendations. When a State adopts a human health criterion for a carcinogen, the State needs to select a risk level. EPA has estimated risk levels of 10^{-5}, 10^{-6}, and 10^{-7} in its criteria documents under one set of exposure assumptions. However, the State is not limited to choosing among the risk levels published in the section 304(a) criteria documents, nor is the State limited to the base case exposure assumptions; it must choose the risk level for its conditions and explain its rationale.

EPA generally regulates pollutants treated as carcinogens in the range of 10^{-6} to 10^{-4} to protect average exposed individuals and more highly exposed populations. However, if a State selects a criterion that represents an upper bound risk level less protective than 1 in 100,000 (e.g., 10^{-5}), the State needs to have substantial support in the record for this level. This support focuses on two distinct issues. First, the record must include documentation that the decision maker considered the public interest of the State in selecting the risk level, including documentation of public participation in the decision making process as required by the Water Quality Standards Regulation at 40 CFR 131.20(b). Second, the record must include an analysis showing that the risk level selected, when combined with other risk assessment variables, is a balanced and reasonable estimate of actual risk posed, based on the best and most representative information available. The importance of the estimated actual risk increases as the degree of conservatism in the selected risk level diminishes. EPA carefully evaluates all assumptions used by a State if the State chose to alter any one of the standard EPA assumption values (57 F.R. 60864, December 22, 1993).

EPA does not intend to propose changes to the current requirements regarding the bases on which a State can adopt numeric criteria (40 CFR 131.11(b)(1)). Under EPA's regulation, in addition to basing numeric criteria on EPA's section 304(a) criteria documents, States may also base numeric criteria on site-specific determinations or other scientifically defensible methods.

EPA expects each State to comply with the new statutory requirements in any section 303(c) water quality standards review initiated after enactment of the Water Quality Act of 1987. The structure of section 303(c) is to require States to review their water quality standards at least once each 3 year period. Section 303(c)(2)(B) instructs States to include reviews for toxics criteria whenever they initiate a triennial review. Therefore, even if a State has complied with section 303(c)(2)(B), the State must review its standards each triennium to ensure that section 303(c)(2)(B) requirements continue to be met, considering that EPA may have published additional section 304(a) criteria documents and that the State will have new information on existing water quality and on pollution sources.

It should be noted that nothing in the Act or in the Water Quality Standards Regulation restricts the right of a State to adopt numeric criteria for any pollutant not listed pursuant to section 307(a)(1), and that such criteria may be expressed as concentration limits for an individual pollutant or for a toxicity parameter itself as measured by whole-effluent toxicity testing. However, neither numeric toxic criteria nor whole-effluent toxicity

should be used as a surrogate for, or to supersede the other.

State Options

States may meet the requirements of CWA section 303(c)(2)(B) by choosing one of three scientifically and technically sound options (or some combination thereof):

(1) Adopt statewide numeric criteria in State water quality standards for all section 307(a) toxic pollutants for which EPA has developed criteria guidance, regardless of whether the pollutants are known to be present;

(2) Adopt specific numeric criteria in State water quality standards for section 307(a) toxic pollutants as necessary to support designated uses where such pollutants are discharged or are present in the affected waters and could reasonably be expected to interfere with designated uses;

(3) Adopt a "translator procedure" to be applied to a narrative water quality standard provision that prohibits toxicity in receiving waters. Such a procedure is to be used by the State in calculating derived numeric criteria, which shall be used for all purposes under section 303(c) of the CWA. At a minimum, such criteria need to be developed for section 307(a) toxic pollutants, as necessary to support designated uses, where these pollutants are discharged or present in the affected waters and could reasonably be expected to interfere with designated uses.

Option 1 is consistent with State authority to establish water quality standards. Option 2 most directly reflects the CWA requirements and is the option recommended by EPA. Option 3, while meeting the requirements of the CWA, is best suited to supplement numeric criteria from option 1 or 2. The three options are discussed in more detail below.

OPTION 1

Adopt statewide numeric criteria in State water quality standards for all section 307(a) toxic pollutants for which EPA has developed criteria guidance, regardless of whether the pollutants are known to be present.

Pro:

- simple, straightforward implementation
- ensures that States will satisfy statute
- makes maximum uses of EPA recommendations
- gets specific numbers into State water quality standards fast, at first

Con:

- some priority toxic pollutants may not be discharged in State
- may cause unnecessary monitoring by States
- might result in "paper standards"

Option 1 is within a State's legal authority under the CWA to adopt broad water quality standards. This option is the most comprehensive approach to satisfy the statutory requirements because it would include all of the priority toxic pollutants for which EPA has prepared section 304(a) criteria guidance for either or both aquatic life protection and human health protection. In addition to a simple adoption of EPA's section 304(a) guidance as standards, a State must select a risk level for those toxic pollutants which are carcinogens (i.e., that cause or may cause cancer in humans).

Many States find this option attractive because it ensures comprehensive coverage of the priority toxic pollutants with scientifically defensible criteria without the need to conduct a resource-intensive evaluation of the particular segments and

pollutants requiring criteria. This option also would not be more costly to dischargers than other options because permit limits would be based only on the regulation of the particular toxic pollutants in their discharges and not on the total listing in the water quality standards. Thus, actual permit limits should be the same under any of the options.

The State may also exercise its authority to use one or more of the techniques for adjusting water quality standards:

- establish or revise designated stream uses based on use attainability analyses (see section 2.9);
- develop site-specific criteria; or
- allow short-term variances (see section 5.3) when appropriate.

All three of these techniques may apply to standards developed under any of the three options discussed in this guidance. It is likely that States electing to use option 1 will rely more on variances because the other two options are implemented with more site-specific data being available. It should be noted, however, that permits issued pursuant to such water quality variances still must comply with any applicable antidegradation and antibacksliding requirements.

OPTION 2

Adopt specific numeric criteria in State water quality standards for section 307(a) toxic pollutants as necessary to support designated uses where such pollutants are discharged or are present in the affected waters and could reasonably be expected to interfere with designated uses.

Pro:

- directly reflects statutory requirement
- standards based on demonstrated need to control problem pollutants
- State can use EPA's section 304(a) national criteria recommendations or other scientifically acceptable alternative, including site-specific criteria
- State can consider current or potential toxic pollutant problems
- State can go beyond section 307(a) toxics list, as desired

Con:

- may be difficult and time consuming to determine if, and which, pollutants are interfering with the designated use
- adoption of standards can require lengthy debates on correct criteria limit to be included in standards
- successful State toxic control programs based on narrative criteria may be halted or slowed as the State applies its limited resources to developing numeric standards
- difficult to update criteria once adopted as part of standards
- to be absolutely technically defensible, may need site-specific criteria in many situations, leading to a large workload for regulatory agency

EPA recommends that a State use this option to meet the statutory requirement. It directly reflects all the Act's requirements and is flexible, resulting in adoption of numeric water quality standards as needed. To assure that the State is capable of dealing with new problems as they arise, EPA also recommends that States adopt a translator procedure the same as, or similar to, that described in option 3, but applicable to all chemicals causing toxicity and not just priority pollutants as is the case for option 3.

Beginning in 1988, EPA provided States with candidate lists of priority toxic pollutants and water bodies in support of CWA section 304(l) implementation. These lists were developed because States were required to evaluate existing and readily available water-related data to comply with section 304(l), 40 CFR 130.10(d). A similar "strawman" analysis of priority pollutants potentially requiring adoption of numeric criteria under section 303(c)(2)(B) was furnished to most States in September or October of 1990 for their use in ongoing and subsequent triennial reviews. The primary differences between the "strawman" analysis and the section 304(l) candidate lists were that the "strawman" analysis (1) organized the results by chemical rather than by water body, (2) included data for certain STORET monitoring stations that were not used in constructing the candidate lists, (3) included data from the Toxics Release Inventory database, and (4) did not include a number of data sources used in preparing the candidate lists (e.g., those, such as fish kill information, that did not provide chemical-specific information).

EPA intends for States, at a minimum, to use the information gathered in support of section 304(l) requirements as a starting point for identifying (1) water segments that will need new and/or revised water quality standards for section 307(a) toxic pollutants, and (2) which priority toxic pollutants require adoption of numeric criteria. In the longer term, EPA expects similar determinations to occur during each triennial review of water quality standards as required by section 303(c).

In identifying the need for numeric criteria, EPA is encouraging States to use information and data such as:

- presence or potential construction of facilities that manufacture or use priority toxic pollutants;
- ambient water monitoring data, including those for sediment and aquatic life (e.g., fish tissue data);
- NPDES permit applications and permittee self-monitoring reports;
- effluent guideline development documents, many of which contain section 307(a)(1) priority pollutant scans;
- pesticide and herbicide application information and other records of pesticide or herbicide inventories;
- public water supply source monitoring data noting pollutants with Maximum Contaminant Levels (MCLs); and
- any other relevant information on toxic pollutants collected by Federal, State, interstate agencies, academic groups, or scientific organizations.

States are also expected to take into account newer information as it became available, such as information in annual reports from the Toxic Chemical Release Inventory requirements of the Emergency Planning and Community Right-To-Know Act of 1986 (Title III, Public Law 99-499).

Where the State's review indicates a reasonable expectation of a problem from the discharge or presence of toxic pollutants, the State should identify the pollutant(s) and the relevant segment(s). In making these determinations, States should use their own EPA-approved criteria or existing EPA water quality criteria for purposes of segment identification. After the review, the State may use other means to establish the final criterion as it revises its standards.

As with option 1, a State using option 2 must follow all its legal and administrative requirements for adoption of water quality standards. Since the resulting numeric criteria are part of a State's water quality standards, they are required to be submitted by the State to EPA for review and either approval or disapproval.

EPA believes this option offers the State optimum flexibility. For section 307(a) toxic pollutants

adversely affecting designated uses, numeric criteria are available for permitting purposes. For other situations, the State has the option of defining site-specific criteria.

OPTION 3

Adopt a procedure to be applied to the narrative water quality standard provision that prohibits toxicity in receiving waters. Such a procedure would be used by a State in calculating derived numeric criteria to be used for all purposes of water quality criteria under section 303(c) of the CWA. At a minimum such criteria need to be derived for section 307(a) toxic pollutants where the discharge or presence of such pollutants in the affected waters could reasonably be expected to interfere with designated uses, as necessary to support such designated uses.

Pro:

- allows a State flexibility to control priority toxic pollutants
- reduces time and cost required to adopt specific numeric criteria as water quality standards regulations
- allows immediate use of latest scientific information available at the time a State needs to develop derived numeric criteria
- revisions and additions to derived numeric criteria can be made without need to revise State law
- State can deal more easily with a situation where it did not establish water quality standards for the section 307(a) toxic pollutants during the most recent triennial review
- State can address problems from non-section 307(a) toxic pollutants

Con:

- EPA is currently on notice that a derived numeric criterion may invite legal challenge
- once the necessary procedures are adopted to enhance legal defensibility (e.g., appropriate scientific methods and public participation and review), actual savings in time and costs may be less than expected
- public participation in development of derived numeric criteria may be limited when such criteria are not addressed in a hearing on water quality standards

EPA believes that adoption of a narrative standard along with a translator mechanism as part of a State's water quality standard satisfies the substantive requirements of the statute. These criteria are subject to all the State's legal and administrative requirements for adoption of standards plus review and either approval or disapproval by EPA, and result in the development of derived numeric criteria for specific section 307(a) toxic pollutants. They are also subject to an opportunity for public participation. Nevertheless, EPA believes the most appropriate use of option 3 is as a supplement to either option 1 or 2. Thus, a State would have formally adopted numeric criteria for toxic pollutants that occur frequently; that have general applicability statewide for inclusion in NPDES permits, total maximum daily loads, and waste load allocations; and that also would have a sound and predictable method to develop additional numeric criteria as needed. This combination of options provides a complete regulatory scheme.

Although the approach in option 3 is similar to that currently allowed in the Water Quality Standards Regulation (40 CFR 131.11(a)(2)), this guidance discusses several administrative and scientific requirements that EPA believes are necessary to comply with section 303(c)(2)(B).

(1) The Option 3 Procedure Must Be Used To Calculate Derived Numeric Water Quality Criteria

States must adopt a specific procedure to be applied to a narrative water quality criterion. To satisfy section 303(c)(2)(B), this procedure shall be used by the State in calculating derived numeric criteria, which shall be used for all purposes under section 303(c) of the CWA. Such criteria need to be developed for section 307(a) toxic pollutants as necessary to support designated uses, where these pollutants are discharged or are present in the affected waters and could reasonably be expected to interfere with the designated uses.

To assure protection from short-term exposures, the State procedure should ensure development of derived numeric water quality criteria based on valid acute aquatic toxicity tests that are lethal to half the affected organisms (LC_{50}) for the species representative of or similar to those found in the State. In addition, the State procedure should ensure development of derived numeric water quality criteria for protection from chronic exposure by using an appropriate safety factor applicable to this acute limit. If there are saltwater components to the State's aquatic resources, the State should establish appropriate derived numeric criteria for saltwater in addition to those for freshwater.

The State's documentation of the tests should include a detailed discussion of its quality control and quality assurance procedures. The State should also include a description (or reference existing technical agreements with EPA) of the procedure it will use to calculate derived acute and chronic numeric criteria from the test data, and how these derived criteria will be used as the basis for deriving appropriate TMDLs, WLAs, and NPDES permit limits.

As discussed above, the procedure for calculating derived numeric criteria needs to protect aquatic life from both acute and chronic exposure to specific chemicals. Chronic aquatic life criteria are to be met at the edge of the mixing zone. The acute criteria are to be met (1) at the end-of-pipe if mixing is not rapid and complete and a high rate diffuser is not present; or (2) after mixing if mixing is rapid and complete or a high rate diffuser is present. (See EPA's *Technical Support Document for Water Quality-based Toxics Control*, USEPA 1991a.)

EPA has not established a national policy specifying the point of application in the receiving water to be used with human health criteria. However, EPA has approved State standards that apply human health criteria for fish consumption at the mixing zone boundary and/or apply the criteria for drinking water consumption, at a minimum, at the point of use. EPA has also proposed more stringent requirements for the application of human health criteria for highly bioaccumulative pollutants in the *Water Quality guidance for the Great Lakes System* (50 F.R. 20931, 21035, April 16, 1993) including elimination of mixing zones.

In addition, the State should also include an indication of potential bioconcentration or bioaccumulation by providing for:

- laboratory tests that measure the steady-state bioconcentration rate achieved by a susceptible organism; and/or
- field data in which ambient concentrations and tissue loads are measured to give an appropriate factor.

In developing a procedure to be used in calculating derived numeric criteria for the protection of aquatic life, the State should consider the potential impact that bioconcentration has on aquatic and terrestrial food chains.

The State should also use the derived bioconcentration factor to calculate chronically protective numeric criteria for humans that consume aquatic organisms. In calculating this derived numeric criterion, the State should indicate data requirements to be met when dealing

with either threshold (toxic) or nonthreshold (carcinogenic) compounds. The State should describe the species and the minimum number of tests, which may generally be met by a single mammalian chronic test if it is of good quality and if the weight of evidence indicates that the results are reasonable. The State should provide the method to calculate a derived numeric criterion from the appropriate test result.

Both the threshold and nonthreshold criteria for protecting human health should contain exposure assumptions, and the State procedure should be used to calculate derived numeric criteria that address the consumption of water, consumption of fish, and combined consumption of both water and fish. The State should provide the assumptions regarding the amount of fish and the quantity of water consumed per person per day, as well as the rationale used to select the assumptions. It needs to include the number of tests, the species necessary to establish a dose-response relationship, and the procedure to be used to calculate the derived numeric criteria. For nonthreshold contaminants, the State should specify the model used to extrapolate to low dose and the risk level. It should also address incidental exposure from other water sources (e.g., swimming). When calculating derived numeric criteria for multiple exposure to pollutants, the State should consider additive effects, especially for carcinogenic substances, and should factor in the contribution to the daily intake of toxicants from other sources (e.g., food, air) when data are available.

(2) The State Must Demonstrate That the Procedure Results in Derived Numeric Criteria Are Protective

The State needs to demonstrate that its procedures for developing criteria, including translator methods, yield fully protective criteria for human health and for aquatic life. EPA's review process will proceed according to EPA's regulation of 40 CFR 131.11, which requires that criteria be based on sound scientific rationale and be protective of all designated uses. EPA will use the expertise and experience it has gained in developing section 304(a) criteria for toxic pollutants by application of its own translator method (USEPA, 1980b; USEPA, 1985b).

Once EPA has approved the State's procedure, the Agency's review of derived numeric criteria, for example, for pollutants other than section 307(a) toxic pollutants resulting from the State's procedure, will focus on the adequacy of the data base rather than the calculation method. EPA also encourages States to apply such a procedure to calculate derived numeric criteria to be used as the basis for deriving permit limitations for nonconventional pollutants that also cause toxicity.

(3) The State Must Provide Full Opportunity for Public Participation in Adoption of the Procedure

The Water Quality Standards Regulation requires States to hold public hearings to review and revise water quality standards in accordance with provisions of State law and EPA's Public Participation Regulation (40 CFR 25). Where a State plans to adopt a procedure to be applied to the narrative criterion, it must provide full opportunity for public participation in the development and adoption of the procedure as part of the State's water quality standards.

While it is not necessary for the State to adopt each derived numeric criterion into its water quality standards and submit it to EPA for review and approval, EPA is very concerned that all affected parties have adequate opportunity to participate in the development of a derived

numeric criterion even though it is not being adopted directly as a water quality standard.

A State can satisfy the need to provide an opportunity for public participation in the development of derived numeric criteria in several ways, including:

- a specific hearing on the derived numeric criterion;
- the opportunity for a public hearing on an NPDES permits as long as public notice is given that a criterion for a toxic pollutant as part of the permit issuance is being contemplated; or
- a hearing coincidental with any other hearing as long as it is made clear that development of a specific criterion is also being undertaken.

For example, as States develop their lists and individual control strategies (ICSs) under section 304(1), they may seek full public participation. NPDES regulations also specify public participation requirements related to State permit issuance. Finally, States have public participation requirements associated with Water Quality Management Plan updates. States may take advantage of any of these public participation requirements to fulfill the requirement for public review of any resulting derived numeric criteria. In such cases, the State must give prior notice that development of such criteria is under consideration.

(4) The Procedure Must Be Formally Adopted and Mandatory

Where a State elects to supplement its narrative criterion with an accompanying implementing procedure, it must formally adopt such a procedure as a part of its water quality standards. The procedure must be used by the State to calculate derived numeric criteria that will be used as the basis for all standards' purposes, including the following: developing TMDLs, WLAs, and limits in NPDES permits; determining whether water use designations are being met; and identifying potential nonpoint source pollution problems.

(5) The Procedure Must Be Approved by EPA as Part of the State's Water Quality Standards Regulation

To be consistent with the requirements of the Act, the State's procedure to be applied to the narrative criterion must be submitted to EPA for review and approval, and will become a part of the State's water quality standards. (See 40 CFR 131.21 for further discussion.) This requirement may be satisfied by a reference in the standards to the procedure, which may be contained in another document, which has legal effect and is binding on the State, and all the requirements for public review, State implementation, and EPA review and approval are satisfied.

Criteria Based on Biological Monitoring

For priority toxic pollutants for which EPA has not issued section 304(a)(1) criteria guidance, CWA section 303(c)(2)(B) requires States to adopt criteria based on biological monitoring or assessment methods. The phrase "biological monitoring or assessment methods" includes:

- whole-effluent toxicity control methods;
- biological criteria methods; or
- other methods based on biological monitoring or assessment.

The phrase "biological monitoring or assessment methods" in its broadest sense also includes criteria developed through translator procedures. This broad interpretation of that phrase is consistent with EPA's policy of applying chemical-specific, biological, and whole-effluent toxicity methods independently in an integrated toxics control program. It is also consistent with the intent of Congress to expand State standards programs beyond chemical-specific approaches.

States should also consider developing protocols to derive and adopt numeric criteria for priority toxic pollutants (or other pollutants) where EPA has not issued section 304(a) criteria guidance. The State should consider available laboratory toxicity (bioassay) data that may be sufficient to support derivation of chemical-specific criteria. Existing data need not be as comprehensive as that required to meet EPA's 1985 guidelines in order for a State to use its own protocols to derive criteria. EPA has described such protocols in the proposed *Water Quality Guidance for the Great Lakes System* (58 F.R. 20892, at 21016, April 16, 1993.) This is particularly important where other components of a State's narrative criterion implementation procedure (e.g., WET controls or biological criteria) may not ensure full protection of designated uses. For some pollutants, a combination of chemical-specific and other approaches is necessary (e.g., pollutants where bioaccumulation in fish tissue or water consumption by humans is a primary concern).

Biologically based monitoring or assessment methods serve as the basis for control where no specific numeric criteria exist or where calculation or application of pollutant-by-pollutant criteria appears infeasible. Also, these methods may serve as a supplemental measurement of attainment of water quality standards in addition to numeric and narrative criteria. The requirement for both numeric criteria and biologically based methods demonstrates that section 303(c)(2)(B) contemplates that States develop a comprehensive toxics control program regardless of the status of EPA's section 304(a) criteria.

The whole-effluent toxicity (WET) testing procedure is the principal biological monitoring guidance developed by EPA to date. The purpose of the WET procedure is to control point source dischargers of toxic pollutants. The procedure is particularly useful for monitoring and controlling the toxicity of complex effluents that may not be well controlled through chemical-specific numeric criteria. As such, biologically based effluent testing procedures are a necessary component of a State's toxics control program under section 303(c)(2)(B) and a principal means for implementing a State's narrative "free from toxics" standard.

Guidance documents EPA considers to serve the purpose of section 304(a)(8) include the *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a; *Guidelines for Deriving National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* (Appendix H); *Guidelines and Methodology Used in the Preparation of Health Effect Assessment Chapters of the Consent Decree Water Criteria Documents* (Appendix J); *Methods for Measuring Acute Toxicity of Effluents to Freshwater and Marine Organisms* (USEPA, 1991d); *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms* (USEPA, 1991e); and *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms* (USEPA, 1991f).

3.4.2 Criteria for Nonconventional Pollutants

Criteria requirements applicable to toxicants that are not priority toxic pollutants (e.g., ammonia and chlorine), are specified in the 1983 Water Quality Standards Regulation (see 40 CFR 131.11). Under these requirements, States must adopt criteria based on sound scientific rationale that cover sufficient parameters to protect designated uses. Both numeric and narrative criteria (discussed in sections 3.5.1 and 3.5.2, below) may be applied to meet these requirements.

3.5 Forms of Criteria

States are required to adopt water quality criteria, based on sound scientific rationale, that contain sufficient parameters or constituents to protect the designated use. EPA believes that an effective State water quality standards program should include both parameter-specific (e.g., ambient numeric criteria) and narrative approaches.

3.5.1 Numeric Criteria

Numeric criteria are required where necessary to protect designated uses. Numeric criteria to protect aquatic life should be developed to address both short-term (acute) and long-term (chronic) effects. Saltwater species, as well as freshwater species, must be adequately protected. Adoption of numeric criteria is particularly important for toxicants known to be impairing surface waters and for toxicants with potential human health impacts (e.g., those with high bioaccumulation potential). Human health should be protected from exposure resulting from consumption of water and fish or other aquatic life (e.g., mussels, crayfish). Numeric water quality criteria also are useful in addressing nonpoint source pollution problems.

In evaluating whether chemical-specific numeric criteria for toxicants that are <u>not</u> priority toxic pollutants are required, States should consider whether other approaches (such as whole-effluent toxicity criteria or biological controls) will ensure full protection of designated uses. As mentioned above, a combination of independent approaches may be required in some cases to support the designated uses and comply with the requirements of the Water Quality Standards Regulation (e.g., pollutants where bioaccumulation in fish tissue or water consumption by humans is a primary concern).

3.5.2 Narrative Criteria

To supplement numeric criteria for toxicants, all States have also adopted narrative criteria for toxicants. Such narrative criteria are statements that describe the desired water quality goal, such as the following:

> All waters, including those within mixing zones, shall be free from substances attributable to wastewater discharges or other pollutant sources that:
>
> (1) Settle to form objectional deposits;
>
> (2) Float as debris, scum, oil, or other matter forming nuisances;
>
> (3) Produce objectionable color, odor, taste, or turbidity;
>
> (4) Cause injury to, or are toxic to, or produce adverse physiological responses in humans, animals, or plants; or
>
> (5) Produce undesirable or nuisance aquatic life (54 F.R. 28627, July 6, 1989).

EPA considers that the narrative criteria apply to all designated uses at all flows and are necessary to meet the statutory requirements of section 303(c)(2)(A) of the CWA.

Narrative toxic criteria (No. 4, above) can be the basis for establishing chemical-specific limits for waste discharges where a specific pollutant can be identified as causing or contributing to the toxicity and the State has not adopted chemical-specific numeric criteria. Narrative toxic criteria are cited as a basis for establishing whole-effluent toxicity controls in EPA permitting regulations at 40 CFR 122.44(d)(1)(v).

To ensure that narrative criteria for toxicants are attained, the Water Quality Standards Regulation requires States to develop implementation procedures (see 40 CFR 131.11(a)(2)). Such implementation procedures (Exhibit 3-3) should address all mechanisms to be used by the State to ensure that narrative criteria are attained. Because implementation of chemical-specific numeric criteria is a key component of State toxics control programs, narrative criteria implementation procedures must describe or reference the State's procedures to implement such chemical-specific numeric criteria (e.g., procedures for establishing chemical-specific permit limits under the NPDES permitting

program). Implementation procedures must also

State implementation procedures for narrative toxics criteria should describe the following:

- Specific, scientifically defensible methods by which the State will implement its narrative toxics standard for all toxicants, including:
  - methods for chemical-specific criteria, including methods for applying chemical-specific criteria in permits, developing or modifying chemical-specific criteria via a "translator procedure" (defined and discussed below), and calculating site-specific criteria based on local water chemistry or biology);
  - methods for developing and implementing whole-effluent toxicity criteria and/or controls; and
  - methods for developing and implementing biological criteria.
- How these methods will be integrated in the State's toxics control program (i.e., how the State will proceed when the specified methods produce conflicting or inconsistent results).
- Application criteria and information needed to apply numerical criteria, for example:
  - methods the State will use to identify those pollutants to be regulated in a specific discharge;
  - an incremental cancer risk level for carcinogens;
  - methods for identifying compliance thresholds in permits where calculated limits are below detection;
  - methods for selecting appropriate hardness, pH, and temperature variables for criteria expressed as functions;
  - methods or policies controlling the size and in-zone quality of mixing zones;
  - design flows to be used in translating chemical-specific numeric criteria for aquatic life and human health into permit limits; and
  - other methods and information needed to apply standards on a case-by-case basis.

Exhibit 3-3. Components of a State Implementation Procedure for Narrative Toxics Criteria

program). Implementation procedures must also address State programs to control whole-effluent toxicity (WET) and may address programs to implement biological criteria, where such programs have been developed by the State. Implementation procedures therefore serve as umbrella documents that describe how the State's various toxics control programs are integrated to ensure adequate protection for aquatic life and human health and attainment of the narrative toxics criterion. In essence, the procedure should apply the "independent application" principle, which provides for independent evaluations of attainment of a designated use based on chemical-specific, whole-effluent toxicity, and biological criteria methods (see section 3.5.3 and Appendices C, K, and R).

EPA encourages, and may ultimately require, State implementation procedures to provide for implementation of biological criteria. However, the regulatory basis for requiring whole-effluent toxicity (WET) controls is clear. EPA regulations at 40 CFR 122.44(d)(1)(v) require NPDES permits to contain WET limits where a permittee has been shown to cause, have the reasonable potential to cause, or contribute to an in-stream excursion of a narrative criterion. Implementation of chemical-specific controls is also required by EPA regulations at 40 CFR 122.44(d)(1). State implementation procedures should, at a minimum, specify or reference methods to be used in implementing chemical-specific and whole-effluent toxicity-based controls, explain how these methods are integrated, and specify needed application criteria.

In addition to EPA's regulation at 40 CFR 131, EPA has regulations at 40 CFR 122.44 that cover the National Surface Water Toxics Control Program. These regulations are intrinsically linked to the requirements to achieve water quality standards, and specifically address the control of pollutants both with and without numeric criteria. For example, section 122.44(d)(1)(vi) provides the permitting authority with several options for establishing effluent limits when a State does not have a chemical-specific numeric criterion for a pollutant present in an effluent at a concentration that causes or contributes to a violation of the State's narrative criteria.

3.5.3 Biological Criteria

The Clean Water Act of 1972 directs EPA to develop programs that will evaluate, restore, and maintain the chemical, physical, and biological integrity of the Nation's waters. In response to this directive, States and EPA have implemented chemically based water quality programs that address significant water pollution problems. However, over the past 20 years, it has become apparent that these programs alone cannot identify and address all surface water pollution problems. To help create a more comprehensive program, EPA is setting a priority for the development of biological criteria as part of State water quality standards. This effort will help States and EPA (1) achieve the biological integrity objective of the CWA set forth in section 101, and (2) comply with the statutory requirements under sections 303 and 304 of the Act (see Appendices C and K).

Regulatory Bases for Biocriteria

The primary statutory basis for EPA's policy that States should develop biocriteria is found in sections 101(a) and 303(c)(2)(B) of the Clean Water Act. Section 101(a) of the CWA gives the general goal of biological criteria. It establishes as the objective of the Act the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's waters. To meet this objective, water quality criteria should address biological integrity. Section 101(a) includes the interim water quality goal for the protection and propagation of fish, shellfish, and wildlife.

Section 304(a) of the Act provides the legal basis for the development of informational criteria, including biological criteria. Specific directives for the development of regulatory biocriteria can be found in section 303(c), which requires EPA to develop criteria based on biological assessment

methods when numerical criteria are not established.

Section 304(a) directs EPA to develop and publish water quality criteria and information on methods for measuring water quality and establishing water quality criteria for toxic pollutants on bases other than pollutant-by-pollutant, including biological monitoring and assessment methods that assess:

- the effects of pollutants on aquatic community components (". . . plankton, fish, shellfish, wildlife, plant life . . .") and community attributes (". . . biological community diversity, productivity, and stability . . .") in any body of water; and

- factors necessary " . . . to restore and maintain the chemical, physical, and biological integrity of all navigable waters . . ." for " . . . the protection of shellfish, fish, and wildlife for classes and categories of receiving waters . . . ."

Once biocriteria are formally adopted into State standards, biocriteria and aquatic life use designations serve as direct, legal endpoints for determining aquatic life use attainment/non-attainment. CWA section 303(c)(2)(B) provides that when numeric criteria are not available, States shall adopt criteria for toxics based on biological monitoring or assessment methods; biocriteria can be used to meet this requirement.

Development and Implementation of Biocriteria

Biocriteria are numerical values or narrative expressions that describe the expected reference biological integrity of aquatic communities inhabiting waters of a designated aquatic life use. In the most desirable scenario, these would be waters that are either in pristine condition or minimally impaired. However, in some areas these conditions no longer exist and may not be attainable. In these situations, the reference biological communities represent the best attainable conditions. In either case, the reference conditions then become the basis for developing biocriteria for major surface water types (streams, rivers, lakes, wetlands, estuaries, or marine waters).

Biological criteria support designated aquatic life use classifications for application in State standards (see chapter 2). Each State develops its own designated use classification system based on the generic uses cited in the Act (e.g., protection and propagation of fish, shellfish, and wildlife). Designated uses are intentionally general. However, States may develop subcategories within use designations to refine and clarify the use class. Clarification of the use class is particularly helpful when a variety of surface waters with distinct characteristics fit within the same use class, or do not fit well into any category.

For example, subcategories of aquatic life uses may be on the basis of attainable habitat (e.g., coldwater versus warmwater stream systems as represented by distinctive trout or bass fish communities, respectively). Special uses may also be designated to protect particularly unique, sensitive, or valuable aquatic species, communities, or habitats.

Resident biota integrate multiple impacts over time and can detect impairment from known and unknown causes. Biological criteria can be used to verify improvement in water quality in response to regulatory and other improvement efforts and to detect new or continuing degradation of waters. Biological criteria also provide a framework for developing improved best management practices and management measures for nonpoint source impacts. Numeric biological criteria can provide effective monitoring criteria for more definitive evaluation of the health of an aquatic ecosystem.

The assessment of the biological integrity of a water body should include measures of the structure and function of the aquatic community within a specified habitat. Expert knowledge of the system is required for the selection of

appropriate biological components and measurement indices. The development and implementation of biological criteria requires:

- selection of surface waters to use in developing reference conditions for each designated use;
- measurement of the structure and function of aquatic communities in reference surface waters to establish biological criteria;
- measurement of the physical habitat and other environmental characteristics of the water resource; and
- establishment of a protocol to compare the biological criteria to biota in comparable test waters to determine whether impairment has occurred.

These elements serve as an interactive network that is particularly important during early development of biological criteria where rapid accumulation of information is effective for refining both designated uses and developing biological criteria values and the supporting biological monitoring and assessment techniques.

3.5.4 Sediment Criteria

While ambient water quality criteria are playing an important role in assuring a healthy aquatic environment, they alone have not been sufficient to ensure appropriate levels of environmental protection. Sediment contamination, which can involve deposition of toxicants over long periods of time, is responsible for water quality impacts in some areas.

EPA has authority to pursue the development of sediment criteria in streams, lakes and other waters of the United States under sections 104 and 304(a)(1) and (2) of the CWA as follows:

- section 104(n)(1) authorizes the Administrator to establish national programs that study the effects of pollution, including sedimentation, in estuaries on aquatic life;
- section 304(a)(1) directs the Administrator to develop and publish criteria for water quality, including information on the factors affecting rates of organic and inorganic sedimentation for varying types of receiving waters;
- section 304(a)(2) directs the Administrator to develop and publish information on, among other issues, "the factors necessary for the protection and propagation of shellfish, fish, and wildlife for classes and categories of receiving waters. . . ."

To the extent that sediment criteria could be developed that address the concerns of the section 404(b)(1) Guidelines for discharges of dredged or fill material under the CWA or the Marine Protection, Research, and Sanctuaries Act, they could also be incorporated into those regulations.

EPA's current sediment criteria development effort, as described below, focuses on criteria for the protection of aquatic life. EPA anticipates potential future expansion of this effort to include sediment criteria for the protection of human health.

Chemical Approach to Sediment Criteria Development

Over the past several years, sediment criteria development activities have centered on evaluating and developing the Equilibrium Partitioning Approach for generating sediment criteria. The Equilibrium Partitioning Approach focuses on predicting the chemical interaction between sediments and contaminants. Developing an understanding of the principal factors that influence the sediment/contaminant interactions will allow predictions to be made regarding the level of contaminant concentration that benthic and other organisms may be exposed to. Chronic water quality criteria, or possibly other toxicological endpoints, can then be used to

predict potential biological effects. In addition to the development of sediment criteria, EPA is also working to develop a standardized sediment toxicity test that could be used with or independently of sediment criteria to assess chronic effects in fresh and marine waters.

> ***Equilibrium Partitioning (EqP) Sediment Quality Criteria (SQC) are the U.S. Environmental Protection Agency's best recommendation of the concentration of a substance in sediment that will not unacceptably affect benthic organisms or their uses.***

Methodologies for deriving effects-based SQC vary for different classes of compounds. For non-ionic organic chemicals, the methodology requires normalization to organic carbon. A methodology for deriving effects-based sediment criteria for metal contaminants is under development and is expected to require normalization to acid volatile sulfide. EqP SQC values can be derived for varying degrees of uncertainty and levels of protection, thus permitting use for ecosystem protection and remedial programs.

Application of Sediment Criteria

SQC would provide a basis for making more informed decisions on the environmental impacts of contaminated sediments. Existing sediment assessment methodologies are limited in their ability to identify chemicals of concern, responsible parties, degree of contamination, and zones of impact. To make the most informed decisions, EPA believes that a comprehensive approach using SQC and biological test methods is preferred.

Sediment criteria will be particularly valuable in site-monitoring applications where sediment contaminant concentrations are gradually approaching a criterion over time or as a preventive tool to ensure that point and nonpoint sources of contamination are controlled and that uncontaminated sediments remain uncontaminated. Also comparison of field measurements to sediment criteria will be a reliable method for providing early warning of a potential problem. An early warning would provide an opportunity to take corrective action before adverse impacts occur. For the reasons mentioned above, it has been identified that SQC are essential to resolving key contaminated sediment and source control issues in the Great Lakes.

Specific Applications

Specific applications of sediment criteria are under development. The primary use of EqP-based sediment criteria will be to assess risks associated with contaminants in sediments. The various offices and programs concerned with contaminated sediment have different regulatory mandates and, thus, have different needs and areas for potential application of sediment criteria. Because each regulatory need is different, EqP-based sediment quality criteria designed specifically to meet the needs of one office or program may have to be implemented in different ways to meet the needs of another office or program.

One mode of application of EqP-based numerical sediment quality criteria would be in a tiered approach. In such an application, when contaminants in sediments exceed the sediment quality criteria the sediments would be considered as causing unacceptable impacts. Further testing may or may not be required depending on site-specific conditions and the degree in which a criterion has been violated. (In locations where contamination significantly exceeds a criterion, no additional testing would be required. Where sediment contaminant levels are close to a criterion, additional testing might be necessary.) Contaminants in a sediment at concentrations less than the sediment criterion would not be of concern. However, in some cases the sediment could not be considered safe because it might contain other contaminants above safe levels for which no sediment criteria exist. In addition, the synergistic, antagonistic, or additive effects of

several contaminants in the sediments may be of concern.

Additional testing in other tiers of an evaluation approach, such as bioassays, could be required to determine if the sediment is safe. It is likely that such testing would incorporate site-specific considerations. Examples of specific applications of sediment criteria after they are developed include the following:

- Establish permit limits for point sources to ensure that uncontaminated sediments remain uncontaminated or sediments already contaminated have an opportunity to cleanse themselves. Of course, this would occur only after criteria and the means to tie point sources to sediment contamination are developed.

- Establish target levels for nonpoint sources of sediment contamination.

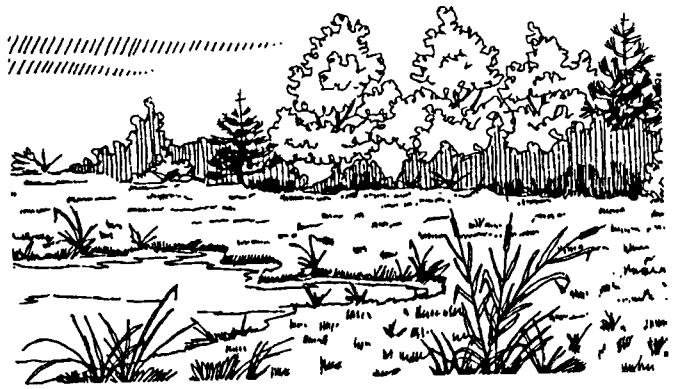
- For remediation activities, SQC would be valuable in identifying:

  - need for remediation,

  - spatial extent of remediation area,

  - benefits derived from remediation activities,

  - responsible parties,



  - impacts of depositing contaminated sediments in water environments, and

  - success of remediation activities.

In tiered testing sediment evaluation processes, sediment criteria and biological testing procedures work very well together.

Sediment Criteria Status

Science Advisory Board Review

The Science Advisory Board has completed a second review of the EqP approach to deriving sediment quality criteria for non-ionic contaminants. The November 1992 report (USEPA, 1992c) endorses the EqP approach to deriving criteria as ". . . sufficiently valid to be used in the regulatory process if the uncertainty associated with the method is considered, described, and incorporated," and that "EPA should . . . establish criteria on the basis of present knowledge within the bounds of uncertainty. . . ."

The Science Advisory Board also identified the need for ". . . a better understanding of the uncertainty around the assumptions inherent in the approach, including assumptions of equilibrium, bioavailability, and kinetics, all critical to the application of the EqP."

Sediment Criteria Documents and Application Guidance

EPA efforts at producing sediment criteria documents are being directed first toward phenanthrene, fluoranthene, dieldrin, acenaphthene, and endrin. Efforts are also being directed towards producing a guidance document on the derivation and interpretation of sediment quality criteria. A *Federal Register* Notice requesting public comment on the proposed methodology and criteria is expected in late fall 1993. The draft guidance is expected to be available in early spring 1994 for comments.

Methodology for Developing Sediment Criteria for Metal Contaminants

EPA is proceeding to develop a methodology for calculating sediment criteria for benthic toxicity to metal contaminants, with key work focused on identifying and understanding the role of acid volatile sulfides (AVS), and other binding factors, in controlling the bioavailability of metal contaminants. A variety of field and laboratory verification studies are under way to add additional support to the methodology. Standard AVS sampling and analytical procedures are under development. Presentation of the metals methodology to the SAB for review is anticipated for Fall 1993.

Biological Approach to Sediment Criteria Development

Under the Contaminated Sediment Management Strategy, EPA programs have committed to using consistent biological methods to determine if sediments are contaminated. In the water program, these biological methods will be used as a complement to the sediment-chemical criteria under development. The biological methods consist of both toxicity and bioaccumulation tests. Freshwater and saltwater benthic species, selected to represent the sensitive range of species' responses to toxicity, are used in bioassays to measure sediment toxicity. Insensitive freshwater and saltwater benthic species that form the base of the food chain are used in bioassays to measure the bioaccumulation potential of sediment. By December 1993, acute toxicity bioassays and bioaccumulation tests selected by all the Agency programs should be standardized and available for use. Training for States and EPA Regions on these methods is expected to begin in FY1994.

In the next few years, research will be conducted to develop standardized chronic toxicity tests for sediment as well as toxicity identification evaluation (TIE) methods. The TIE approach will be used to identify the specific chemicals in a sediment causing acute or chronic toxicity in the test organisms. Under the Contaminated Sediment Management Strategy, EPA's programs have also agreed to incorporate these chronic toxicity and TIE methods into their sediment testing when they are available.

3.5.5 Wildlife Criteria

Terrestrial and avian species are useful as sentinels for the health of the ecosystem as a whole. In many cases, damage to wildlife indicates that the ecosystem itself is damaged. Many wildlife species that are heavily dependent on the aquatic food web reflect the health of aquatic systems. In the case of toxic chemicals, terminal predators such as otter, mink, gulls, terns, eagles, ospreys, and turtles are useful as integrative indicators of the status or health of the ecosystem.

Statutory and Regulatory Authority

Section 101(a)(2) of the CWA sets, as an interim goal of,

> . . . wherever attainable . . . water quality which provides for the protection and propagation of fish, shellfish, and wildlife . . . (emphasis added).

Section 304(a)(1) of the Act also requires EPA to:

> . . . develop and publish . . . criteria for water quality accurately reflecting . . . the kind and extent of all identifiable effects on health and welfare including . . . wildlife.

The Water Quality Standards Regulation reflect the statutory goals and requirements by requiring States to adopt, where attainable, the CWA section 101(a)(2) goal uses of protection and propagation of fish, shellfish, and wildlife (40 CFR 131.10), and to adopt water quality criteria sufficient to protect the designated use (40 CFR 131.11).

Wildlife Protection in Current Aquatic Criteria

Current water quality criteria methodology is designed to protect fish, benthic invertebrates, and zooplankton; however, there is a provision in the current aquatic life criteria guidelines (Appendix H) that is intended to protect wildlife that consume aquatic organisms from the bioaccumulative potential of a compound. The final residue value can be based on either the FDA Action Level or a wildlife feeding study. However, if maximum permissible tissue concentration is not available from a wildlife feeding study, a final residue value cannot be derived and the criteria quantification procedure continues without further consideration of wildlife impacts. Historically, wildlife have been considered only after detrimental effects on wildlife populations have been observed in the environment (this occurred with relationship to DDT, selenium, and PCBs).

Wildlife Criteria Development

EPA's national wildlife criteria effort began following release of a 1987 Government Accounting Office study entitled *Wildlife Management - National Refuge Contamination Is Difficult To Confirm and Clean Up* (GAO, 1987). After waterfowl deformities observed at Kesterson Wildlife Refuge were linked to selenium contamination in the water, Congress requested this study and recommended that "the Administrator of EPA, in close coordination with the Secretary of the Interior, develop water quality criteria for protecting wildlife and their refuge habitat."

In November of 1988, EPA's Environmental Research Laboratory in Corvallis sponsored a workshop entitled *Water Quality Criteria To Protect Wildlife Resources*, (USEPA, 1989g) which was co-chaired by EPA and the Fish and Wildlife Service (FWS). The workshop brought together 26 professionals from a variety of institutions, including EPA, FWS, State governments, academia, and consultants who had expertise in wildlife toxicity, aquatic toxicity, ecology, environmental risk assessment, and conservation. Efforts at he workshop focused on evaluating the need for, and developing a strategy for production of wildlife criteria. Two recommendations came out of that workshop:

(1) The process by which ambient water quality criteria are established should be modified to consider effects on wildlife; and

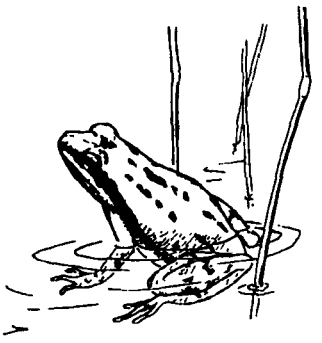
(2) chemicals should be prioritized based on their potential to adversely impact wildlife species.

Based on the workshop recommendations, screening level wildlife criteria (SLWC) were calculated for priority pollutants and chemicals of concern submitted by the FWS to gauge the extent of the problem by:

(1) evaluating whether existing water quality criteria for aquatic life are protective of wildlife, and

(2) prioritizing chemicals for their potential to adversely impact wildlife species.

There were 82 chemicals for which EPA had the necessary toxicity information as well as ambient water quality criteria, advisories, or lowest-observed-adverse-effect levels (LOAELs) to compare with the SLWC values. As would be expected, the majority of chemicals had SLWC larger than existing water quality criteria, advisories, or LOAELs for aquatic life. However, the screen identified classes of compounds for which current ambient water quality criteria may not be adequately protective of wildlife: chlorinated alkanes, benzenes, phenols, metals, DDT, and dioxins. Many of these compounds are produced in very large amounts and have a variety of uses (e.g., solvents, flame retardants, organic syntheses of fungicides and herbicides, and manufacture of plastics and textiles. The manufacture and use of



these materials produce waste byproduct). Also, 5 of the 21 are among the top 25 pollutants identified at Superfund sites in 1985 (3 metals, 2 organics).

Following this initial effort, EPA held a national meeting in April 1992[1] to constructively discuss and evaluate proposed methodologies for deriving wildlife criteria to build consensus among the scientific community as to the most defensible scientifically approach(es) to be pursued by EPA in developing useful and effective wildlife criteria.

The conclusions of this national meeting were as follows:

- wildlife criteria should have a tissue-residue component when appropriate;
- peer-review of wildlife criteria and data sets should be used in their derivation;
- wildlife criteria should incorporate methods to establish site-specific wildlife criteria;
- additional amphibian and reptile toxicity data are needed;
- further development of inter-species toxicological sensitivity factors are needed; and
- criteria methods should measure biomarkers in conjunction with other studies.

On April 16, 1993, EPA proposed wildlife criteria in the *Water Quality Guidance for the Great Lakes System* (58 F.R. 20802). The proposed wildlife criteria are based on the current EPA noncancer human health criteria approach. In this proposal, in addition to requesting comments on the proposed Great Lakes criteria and methods, EPA also requested comments on possible modifications of the proposed Great Lakes approach for consideration in the development of national wildlife criteria.

3.5.6 Numeric Criteria for Wetlands

Extension of the EPA national 304(a) numeric aquatic life criteria to wetlands is recommended as part of a program to develop standards and criteria for wetlands. Appendices D and E provide an overview of the need for standards and criteria for wetlands. The 304(a) numeric aquatic life criteria are designed to be protective of aquatic life for surface waters and are generally applicable to most wetland types. Appendix E provides a possible approach, based on the site-specific guidelines, for detecting wetland types that might not be protected by direct application of national 304(a) criteria. The evaluation can be simple and inexpensive for those wetland types for which sufficient water chemistry and species assemblage data are available, but will be less useful for wetland types for which these data are not readily available. In Appendix E, the site-specific approach is described and recommended for wetlands for which modification of the 304(a) numeric criteria are considered necessary. The results of this type of evaluation, combined with information on local or regional environmental threats, can be used to prioritize wetland types (and individual criteria) for further site-specific evaluations and/or additional data collection. Close coordination among regulatory agencies, wetland scientists, and criteria experts will be required.

Endnotes

1. Proceedings in production.

Contact: Ecological Risk Assessment Branch (4304)
U.S. Environmental Protection Agency
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Washington, DC 20460
Telephone (202) 260-1940

RESERVED

On October 1, 1993, the Acting Assistant Administrator for Water issuesd the *Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria.*

Since the policy document was signed to late for inclusion in the Handbook, the complete policy document is being sent to the recipients of this Handbook under separate cover. Later this fiscal year, you will receive an update to the Handbook, to be inserted in the following reserved section, reflecting the policy document.

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CHAPTER 4

ANTIDEGRADATION

(40 CFR 131.12)

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CHAPTER 4
ANTIDEGRADATION

This chapter provides guidance on the antidegradation component of water quality standards, its application in conjunction with the other parts of the water quality standards regulation, and its implementation by the States. Antidegradation implementation by the States is based on a set of procedures to be followed when evaluating activities that may impact the quality of the waters of the United States. Antidegradation implementation is an integral component of a comprehensive approach to protecting and enhancing water quality.

4.1 History of Antidegradation

The first antidegradation policy statement was released on February 8, 1968, by the Secretary of the U.S. Department of the Interior. It was included in EPA's first Water Quality Standards Regulation (40 CFR 130.17, 40 F.R. 55340-41, November 28, 1975), and was slightly refined and re-promulgated as part of the current program regulation published on November 8, 1983 (48 F.R. 51400, 40 CFR 131.12). Antidegradation requirements and methods for implementing those requirements are minimum conditions to be included in a State's water quality standards. Antidegradation was originally based on the spirit, intent, and goals of the Act, especially the clause ". . . restore and maintain the chemical, physical and biological integrity of the Nation's waters" (101(a)) and the provision of 303(a) that made water quality standards under prior law the "starting point" for CWA water quality requirements. Antidegradation was explicitly incorporated in the CWA through:

- a 1987 amendment codified in section 303(d)(4)(B) requiring satisfaction of antidegradation requirements before making certain changes in NPDES permits; and
- the 1990 Great Lakes Critical Programs Act codified in CWA section 118(c)(2) requiring EPA to publish Great Lakes water quality guidance including antidegradation policies and implementation procedures.

4.2 Summary of the Antidegradation Policy

Section 131.12(a)(1), or "Tier 1," protecting "existing uses," provides the absolute floor of water quality in all waters of the United States. This paragraph applies a minimum level of protection to all waters.

Section 131.12(a)(2), or "Tier 2," applies to waters whose quality exceeds that necessary to protect the section 101(a)(2) goals of the Act. In this case, water quality may not be lowered to less than the level necessary to fully protect the "fishable/swimmable" uses and other existing uses and may be lowered even to those levels only after following all the provisions described in section 131.12(a)(2).

Section 131.12(a)(3), or "Tier 3," applies to Outstanding National Resource Waters (ONRW) where the ordinary use classifications and supporting criteria may not be sufficient or appropriate. As described in the preamble to the Water Quality Standards Regulation, "States may allow some limited activities which result in temporary and short-term changes in water quality," but such changes in water quality should not impact existing uses or alter the essential character or special use that makes the water an ONRW.

The requirement for potential water quality impairment associated with thermal discharges contained in section 131.12 (a)(4) of the regulation is intended to coordinate the requirements and procedures of the antidegradation policy with those established in the Act for setting thermal discharge limitations. Regulations implementing section 316 may be found at 40 CFR 124.66. The statutory scheme and legislative history indicate that limitations developed under section 316 take precedence over other requirements of the Act.

As the States began to focus more attention on implementing their antidegradation policies, an additional concept was developed by the States, which EPA has accepted even though not directly mentioned in previous EPA guidance or in the regulation. This concept, commonly known as "Tier 2½," is an application of the antidegradation policy that has implementation requirements that are more stringent than for "Tier 2" (high-quality waters), but somewhat less stringent than the prohibition against any lowering of water quality in "Tier 3" (ONRWs). EPA accepts this additional tier in State antidegradation policies because it is clearly a more stringent application of the Tier 2 provisions of the antidegradation policy and, therefore, permissible under section 510 of the CWA.

The supporting rationale that led to the development of the Tier 2½ concept was a concern by the States that the Tier 3 ONRW provision was so stringent that its application would likely prevent States from taking actions in the future that were consistent with important social and economic development on, or upstream of, ONRWs. This concern is a major reason that relatively few water bodies are designated as ONRWs. The Tier 2½ approach allows States to provide a very high level of water quality protection without precluding unforeseen future economic and social development considerations.

4.3 State Antidegradation Requirements

Each State must develop, adopt, and retain a statewide antidegradation policy regarding water quality standards and establish procedures for its implementation through the water quality management process. The State antidegradation policy and implementation procedures must be consistent with the components detailed in 40 CFR 131.12. If not included in the standards regulation of a State, the policy must be specifically referenced in the water quality standards so that the functional relationship between the policy and the standards is clear. Regardless of the location of the policy, it must meet all applicable requirements. States may adopt antidegradation statements more protective than the Federal requirement. The antidegradation implementation procedures specify how the State will determine on a case-by-case basis whether, and to what extent, water quality may be lowered.

State antidegradation polices and implementation procedures are subject to review by the Regional Administrator. EPA has clear authority to review and approve or disapprove and promulgate an antidegradation policy for a State. EPA's review of the implementation procedures is limited to ensuring that procedures are included that describe how the State will implement the required elements of the antidegradation review. EPA may disapprove and federally promulgate all or part of an implementation process for antidegradation if, in the judgment of the Administrator, the State's process (or certain provisions thereof) can be implemented in such a way as to circumvent the intent and purpose of the antidegradation policy. EPA encourages submittal of any amendments to the statement and implementing procedures to the Regional Administrator for pre-adoption review so that the State may take EPA comments into account prior to final action.

If a State's antidegradation policy does not meet the Federal regulatory requirements, either through State action to revise its policy or through revised Federal requirements, the State would be given the opportunity to make its policy consistent with the regulation. If this is not done, EPA has the authority to promulgate the policy for the State pursuant to section 303(c)(4) of the Clean Water Act (see section 6.3, this Handbook).

4.4 Protection of Existing Uses - 40 CFR 131.12(a)(1)

This section requires the protection of existing uses and the level of water quality to protect those uses. An "existing use" can be established by demonstrating that:

- fishing, swimming, or other uses have actually occurred since November 28, 1975; or

- that the water quality is suitable to allow the use to be attained—unless there are physical problems, such as substrate or flow, that prevent the use from being attained.

An example of the latter is an area where shellfish are propagating and surviving in a biologically suitable habitat and are available and suitable for harvesting although, to date, no one has attempted to harvest them. Such facts clearly establish that shellfish harvesting is an "existing" use, not one dependent on improvements in water quality. To argue otherwise would be to say that the only time an aquatic protection use "exists" is if someone succeeds in catching fish.

Full protection of the existing use requires protection of the entire water body with a few limited exceptions such as certain physical modifications that may so alter a water body that species composition cannot be maintained (see section 4.4.3, this Handbook), and mixing zones (see section 4.4.4, this Handbook). For example, an activity that lowers water quality such that a buffer zone must be established within a previous shellfish harvesting area is inconsistent with the antidegradation policy.

Section 131.12(a)(l) provides the absolute floor of water quality in all waters of the United States. This paragraph applies a minimum level of protection to all waters. However, it is most pertinent to waters having beneficial uses that are less than the section 101(a)(2) goals of the Act. If it can be proven, in that situation, that water quality exceeds that necessary to fully protect the existing use(s) and exceeds water quality standards but is not of sufficient quality to cause a better use to be achieved, then that water quality may be lowered to the level required to fully protect the existing use as long as existing water quality standards and downstream water quality standards are not affected. If this does not involve a change in standards, no public hearing would be required under section 303(c). However, public participation would still be provided in connection with the issuance of a NPDES permit or amendment of a section 208 plan or section 319 program. If, however, analysis indicates that the higher water quality does result in a better use, even if not up to the section 101(a)(2) goals, then the water quality standards must be upgraded to reflect the uses presently being attained (131.10(i)).

If a planned activity will foreseeably lower water quality to the extent that it no longer is sufficient to protect and maintain the existing

uses in that water body, such an activity is inconsistent with EPA's antidegradation policy, which requires that existing uses are to be maintained. In such a circumstance, the planned activity must be avoided or adequate mitigation or preventive measures must be taken to ensure that the existing uses and the water quality to protect them will be maintained.

Section 4.4.1, this Handbook, discusses the determination and protection of recreational "existing" uses, and section 4.4.2, this Handbook, discusses aquatic life protection "existing" uses (of course, many other types of existing uses may occur in a water body).

4.4.1 Recreational Uses

Recreational uses traditionally are divided into primary contact and secondary contact recreation (e.g., swimming vs. boating; that is, recreation "in" or "on" the water.) However, these two broad uses can logically be subdivided into a variety of subcategories (e.g., wading, sailing, power boating, rafting). The water quality standards regulation does not establish a level of specificity that each State must apply in determining what recreational "uses" exist. However, the following principles apply.

- The State selects the level of specificity it desires for identifying recreational existing uses (that is, whether to treat secondary contact recreation as a single use or to define subcategories of secondary recreation). The State has two limitations:
  - the State must be at least as specific as the uses listed in sections 101(a) and 303(c) of the Clean Water Act; and
  - the State must be at least as specific as the written description of the designated use classifications adopted by the State.
- If the State designated use classification system is very specific in describing subcategories of a use, then such specifically defined uses, if they exist, must be protected fully under antidegradation. A State with a broadly written use classification system may, as a matter of policy, interpret its classifications more specifically for determining existing uses—as long as it is done consistently. A State may also redefine its use classification system, subject to the constraints in 40 CFR 131.10, to more adequately reflect existing uses.
- If the use classification system in a State is defined in broad terms such as primary contact recreation, secondary contact recreation, or boating, then it is a State determination whether to allow changes in the type of primary or secondary contact recreation or boating activity that would occur on a specific water body as long as the basic use classification is met. For example, if a State defines a use simply as "boating," it is the State's decision whether to allow something to occur that would change the type of boating from canoeing to power boating as long as the resulting water quality allows the "boating" use to be met. (The public record used originally to establish the use may provide a clearer indication of the use intended to be attained and protected by the State.)

The rationale is that the required water quality will allow a boating use to continue and that use meets the goal of the Act. Water quality is the key. This interpretation may allow a State to change activities within a specific use category but it does not create a mechanism to remove use classifications; this latter action is governed solely by the provisions of the standards regulation (CWA section 131.10(g)).

One situation where EPA might conceivably be called upon to decide what constitutes an existing use is where EPA is writing an NPDES

permit. EPA has the responsibility under CWA section 301(b)(1)(C) to determine what is needed to protect existing uses under the State's antidegradation requirement, and accordingly may define "existing uses" or interpret the State's definition to write that permit if the State has not done so. Of course, EPA's determination would be subject to State section 401 certification in such a case.

4.4.2 Aquatic Life/Wildlife Uses

No activity is allowable under the antidegradation policy which would partially or completely eliminate any existing use whether or not that use is designated in a State's water quality standards. The aquatic protection use is a broad category requiring further explanation. Non-aberrational resident species must be protected, even if not prevalent in number or importance. Water quality should be such that it results in no mortality and no significant growth or reproductive impairment of resident species. Any lowering of water quality below this full level of protection is not allowed.

A State may develop subcategories of aquatic protection uses but cannot choose different levels of protection for like uses. The fact that sport or commercial fish are not present does not mean that the water may not be supporting an aquatic life protection function. An existing aquatic community composed entirely of invertebrates and plants, such as may be found in a pristine alpine tributary stream, should still be protected whether or not such a stream supports a fishery.

Even though the shorthand expression "fishable/swimmable" is often used, the actual objective of the Act is to "restore and maintain the chemical, physical, and biological integrity of our Nation's waters" (section 101(a)). The term "aquatic life" would more accurately reflect the protection of the aquatic community that was intended in section 101(a)(2) of the Act.

Section 131.12(a)(1) states, "Existing instream water uses and level of water quality necessary to protect the existing uses shall be maintained and protected." For example, while sustaining a small coldwater fish population, a stream does not support an existing use of a "coldwater fishery." The existing stream temperatures are unsuitable for a thriving coldwater fishery. The small marginal population is an artifact and should not be employed to mandate a more stringent use (true coldwater fishery) where natural conditions are not suitable for that use.

A use attainability analysis or other scientific assessment should be used to determine whether the aquatic life population is in fact an artifact or is a stable population requiring water quality protection. Where species appear in areas not normally expected, some adaptation may have occurred and site-specific criteria may be appropriately developed. Should the coldwater fish population consist of a threatened or endangered species, it may require protection under the Endangered Species Act. Otherwise, the stream need only be protected as a warmwater fishery.

4.4.3 Existing Uses and Physical Modifications

A literal interpretation of 40 CFR 131.12(a)(1) could prevent certain physical modifications to a water body that are clearly allowed by the Clean Water Act, such as wetland fill operations permitted under section 404 of the Clean Water Act. EPA interprets section 131.12(a)(l) 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)(l) Guidelines.

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 polices, just as they may adopt any other requirement more stringent than Federal law requires. For additional information on the linkage between water quality standards and the section 404 program, see Appendix D.

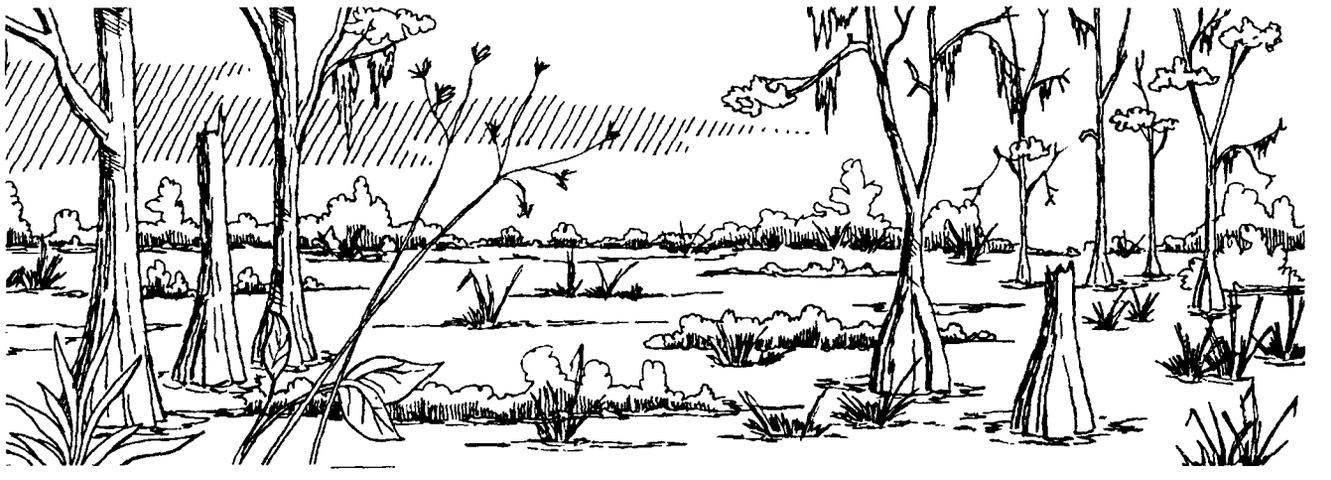
If any wetlands were found to have better water quality than "fishable/swimmable," the State would be allowed to lower water quality to the no significant degradation level as long as the requirements of section 131.12(a)(2) were followed. As for the ONRW provision of antidegradation (131.12(a)(3)), there is no difference in the way it applies to wetlands and other water bodies.

4.4.4 Existing Uses and Mixing Zones

Mixing zones are another instance when the entire extent of the water body is not required to be given full existing use protection. The area within a properly designated mixing zone (see section 5.1) may have altered benthic habitat and a subsequent alteration of the portions of the aquatic community. Any effect on the existing use must be limited to the area of the regulatory mixing zone.

4.5 Protection of Water Quality in High-Quality Waters - 40 CFR 131.12(a)(2)

This section provides general program guidance in the development of procedures for the maintenance and protection of water quality where the quality of the water exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water. Water quality in "high-quality waters" must be maintained and protected as prescribed in section 131.12(a)(2) of the WQS regulation.



High-quality waters are those whose quality exceeds that necessary to protect the section 101(a)(2) goals of the Act, regardless of use designation. All parameters do not need to be better quality than the State's ambient criteria for the water to be deemed a "high-quality water." EPA believes that it is best to apply antidegradation on a parameter-by-parameter basis. Otherwise, there is potential for a large number of waters not to receive antidegradation protection, which is important to attaining the goals of the Clean Water Act to restore and maintain the integrity of the Nation's waters. However, if a State has an official interpretation that differs from this interpretation, EPA will evaluate the State interpretation for conformance with the statutory and regulatory intent of the antidegradation policy. EPA has accepted approaches that do not use a strict pollutant-by-pollutant basis (USEPA, 1989c).

In "high-quality waters," under 131.12(a)(2), before any lowering of water quality occurs, there must be an antidegradation review consisting of:

- a finding that it is necessary to accommodate important economical or social development in the area in which the waters are located (this phrase is intended to convey a general concept regarding what level of social and economic development could be used to justify a change in high-quality waters);

- full satisfaction of all intergovernmental coordination and public participation provisions (the intent here is to ensure that no activity that will cause water quality to decline in existing high-quality waters is undertaken without adequate public review and intergovernmental coordination); and

- assurance that the highest statutory and regulatory requirements for point sources, including new source performance standards, and best management practices for nonpoint source pollutant controls are achieved (this requirement ensures that the limited provision for lowering water quality of high-quality waters down to "fishable/swimmable" levels will not be used to undercut the Clean Water Act requirements for point source and nonpoint source pollution control; furthermore, by ensuring compliance with such statutory and regulatory controls, there is less chance that a lowering of water quality will be sought to accommodate new economic and social development).

In addition, water quality may not be lowered to less than the level necessary to fully protect the "fishable/swimmable" uses and other existing uses. This provision is intended to provide relief only in a few extraordinary circumstances where the economic and social need for the activity clearly outweighs the benefit of maintaining water quality above that required for "fishable/swimmable" water, and both cannot be achieved. The burden of demonstration on the individual proposing such activity will be very high. In any case, moreover, the existing use must be maintained and the activity shall not preclude the maintenance of a "fishable/swimmable" level of water quality protection.

The antidegradation review requirements of this provision of the antidegradation policy are triggered by any action that would result in the lowering of water quality in a high-quality water. Such activities as new discharges or expansion of existing facilities would presumably lower water quality and would not be permissible unless the State conducts a review consistent with the previous paragraph. In addition, no permit may be issued, without an antidegradation review, to a discharger to high-quality waters with effluent limits greater than actual current loadings if such loadings will cause a lowering of water quality (USEPA, 1989c).

Antidegradation is not a "no growth" rule and was never designed or intended to be such. It is a policy that allows public decisions to be made on important environmental actions. Where the State intends to provide for development, it may decide under this section, after satisfying the requirements for intergovernmental coordination and public participation, that some lowering of water quality in "high-quality waters" is necessary to accommodate important economic or social development. Any such lower water quality must protect existing uses fully, and the State must assure that the highest statutory and regulatory requirement for all new and existing point sources and all cost-effective and reasonable BMPs for nonpoint source control are being achieved on the water body.

4.6 Outstanding National Resource Waters (ONRW) - 40 CFR 131.12(a)(3)

Outstanding National Resource Waters (ONRWs) are provided the highest level of protection under the antidegradation policy. The policy provides for protection of water quality in high-quality waters that constitute an ONRW by prohibiting the lowering of water quality. ONRWs are often regarded as highest quality waters of the United States: That is clearly the thrust of 131.12(a)(3). However, ONRW designation also offers special protection for waters of "exceptional ecological significance." These are water bodies that are important, unique, or sensitive ecologically, but whose water quality, as measured by the traditional parameters such as dissolved oxygen or pH, may not be particularly high or whose characteristics cannot be adequately described by these parameters (such as wetlands).

The regulation requires water quality to be maintained and protected in ONRWs. EPA interprets this provision to mean no new or increased discharges to ONRWs and no new or increased discharge to tributaries to ONRWs that would result in lower water quality in the ONRWs. The only exception to this prohibition, as discussed in the preamble to the Water Quality Standards Regulation (48 F.R. 51402), permits States to allow some limited activities that result in temporary and short-term changes in the water quality of ONRW. Such activities must not permanently degrade water quality or result in water quality lower than that necessary to protect the existing uses in the ONRW. It is difficult to give an exact definition of "temporary" and "short-term" because of the variety of activities that might be considered. However, in rather broad terms, EPA's view of temporary is weeks and months, not years. The intent of EPA's provision clearly is to limit water quality degradation to the shortest possible time. If a construction activity is involved, for example, temporary is defined as the length of time necessary to construct the facility and make it operational. During any period of time when, after opportunity for public participation in the decision, the State allows temporary degradation, all practical means of minimizing such degradation shall be implemented. Examples of situations in which flexibility is appropriate are listed in Exhibit 4-1.

OUTSTANDING NATIONAL RESOURCE WATERS

- The highest level of protection under the antidegradation policy's Tier 3.
- High-quality or ecologically unique waters such as those within the jurisdiction of National and State Parks and Wildlife refuges.

Example 1 ***A national park wishes to replace a defective septic tank-drainfield system in a campground. The campground is located immediately adjacent to a small stream with the ONRW use designation.***

Under the regulation, the construction could occur if best management practices were scrupulously followed to minimize any disturbance of water quality or aquatic habitat.

Example 2 ***Same situation except the campground is served by a small sewage treatment plant already discharging to the ONRW. It is desired to enlarge the treatment system and provide higher levels of treatment.***

Under the regulation, this water-quality-enhancing action would be permitted if there was only temporary increase in sediment and, perhaps, in organic loading, which would occur during the actual construction phase.

Example 3 ***A National forest with a mature, second growth of trees which are suitable for harvesting, with associated road repair and re-stabilization. Streams in the area are designated as ONRW and support trout fishing.***

The regulation intends that best management practices for timber harvesting be followed and might include preventive measures more stringent than for similar logging in less environmentally sensitive areas. Of course, if the lands were being considered for designation as wilderness areas or other similar designations, EPA's regulation should not be construed as encouraging or condoning timbering operations. The regulation allows only temporary and short-term water quality degradation while maintaining existing uses or new uses consistent with the purpose of the management of the ONRW area.

Other examples of these types of activities include maintenance and/or repair of existing boat ramps or boat docks, restoration of existing sea walls, repair of existing stormwater pipes, and replacement or repair of existing bridges.

Exhibit 4-1. Examples of Allowable Temporary Lowering of Water Quality in Outstanding National Resource Waters

4.7 Antidegradation Application and Implementation

Any one or a combination of several activities may trigger the antidegradation policy analysis. Such activities include a scheduled water quality standards review, the establishment of new or revised load allocations, waste load allocations, total maximum daily loads, issuance of NPDES permits, and the demonstration of need for advanced treatment or request by private or public agencies or individuals for a special study of the water body.

Nonpoint source activities are not exempt from the provisions of the antidegradation policy. The language of section 131.12 (a)(2) of the regulation: "Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control . . . " reflects statutory provisions of the Clean Water Act. While it is true that the Act does not establish a federally enforceable program for nonpoint sources, it clearly intends that the BMPs developed and approved under sections 205(j), 208, 303(e), and 319 be aggressively implemented by the States.

4.7.1 Antidegradation, Load Allocation, Waste Load Allocation, Total Maximum Daily Load, and Permits

In developing or revising a load allocation (LA), waste load allocation (WLA), or total maximum daily load (TMDL) to reflect new information or to provide for seasonal variation, the antidegradation policy, as an integral part of the State water quality standards, must be applied as discussed in this section.

The TMDL/WLA/LA process distributes the allowable pollutant loadings to a water body. Such allocations also consider the contribution to pollutant loadings from nonpoint sources. This process must reflect applicable State water quality standards including the antidegradation policy. No waste load allocation can be developed or NPDES permit issued that would result in standards being violated. With respect to antidegradation, that means existing uses must be protected, water quality may not be lowered in ONRWs, and in the case of waters whose quality exceeds that necessary for the section 101(a)(2) goals of the Act, an activity cannot result in a lowering of water quality unless the applicable public participation, intergovernmental review, and baseline control requirements of the antidegradation policy have been met. Once the LA, WLA, or TMDL revision is completed, the resulting permits must incorporate discharge limitations based on this revision.

When a pollutant discharge ceases for any reason, the waste load allocations for the other dischargers in the area may be adjusted to reflect the additional loading available consistent with the antidegradation policy under two circumstances:

- In "high-quality waters" where after the full satisfaction of all public participation and intergovernmental review requirements, such adjustments are considered necessary to accommodate important economic or social development, and the "threshold" level requirements (required point and nonpoint source controls) are met.

- In less than "high-quality waters," when the expected improvement in water quality (from the ceased discharge) would not cause a better use to be achieved.

The adjusted loads still must meet water quality standards, and the new waste load allocations must be at least as stringent as technology-based limitations. Of course, all applicable requirements of the section 402 NPDES permit regulations would have to be satisfied before a permittee could increase its discharge.

If a permit is being renewed, reissued or modified to include less stringent limitations

based on the revised LA/WLA/TMDL, the same antidegradation analysis applied during the LA/WLA/TMDL stage would apply during the permitting stage. It would be reasonable to allow the showing made during the LA/WLA/TMDL stage to satisfy the antidegradation showing at the permit stage. Any restrictions to less stringent limits based on antibacksliding would also apply.

If a State issues an NPDES permit that violates the required antidegradation policy, it would be subject to a discretionary EPA veto under section 402(d) or to a citizen challenge. In addition to actions on permits, any waste load allocations and total maximum daily loads violating the antidegradation policy are subject to EPA disapproval and EPA promulgation of a new waste load allocation/total maximum daily load under section 303(d) of the Act. If a significant pattern of violation was evident, EPA could constrain the award of grants or possibly revoke any Federal permitting capability that had been delegated to the State. Where EPA issues an NPDES permit, EPA will, consistent with its NPDES regulations, add any additional or more stringent effluent limitations required to ensure compliance with the State antidegradation policy incorporated into the State water quality standards. If a State fails to require compliance with its antidegradation policy through section 401 certification related to permits issued by other Federal agencies (e.g., a Corps of Engineers section 404 permit), EPA could comment unfavorably upon permit issuance. The public, of course, could bring pressure upon the permit issuing agency.

For example applications of antidegradation in the WLA and permitting process, see Exhibit 4-2.

4.7.2 Antidegradation and the Public Participation Process

Antidegradation, as with other water quality standards activities, requires public participation and intergovernmental coordination to be an effective tool in the water quality management process. 40 CFR 131.12(a)(2) contains explicit requirements for public participation and intergovernmental coordination when determining whether to allow lower water quality in high-quality waters. Nothing in either the water quality standards or the waste load allocation regulations requires the same degree of public participation or intergovernmental coordination for such non-high-quality waters as is required for high-quality waters. However public participation would still be provided in connection with the issuance of a NPDES permit or amendment of a 208 plan. Also, if the action that causes reconsideration of the existing waste loads (such as dischargers withdrawing from the area) will result in an improvement in water quality that makes a better use attainable, even if not up to the "fishable/swimmable" goal, then the water quality standards must be upgraded and full public review is required for any action affecting changes in standards. Although not specifically required by the standards regulation between the triennial reviews, we recommend that the State conduct a use attainability analysis to determine if water quality improvement will result in attaining higher uses than currently designated in situations where significant changes in waste loads are expected.

The antidegradation public participation requirement may be satisfied in several ways. The State may hold a public hearing or hearings. The State may also satisfy the requirement by providing public notice and the opportunity for the public to request a hearing. Activities that may affect several water bodies in a river basin or sub-basin may be considered in a single hearing. To ease the resource burden on both the State and public, standards issues may be combined with hearings on environmental impact statements, water management plans, or permits. However, if this is done, the public must be clearly informed that possible changes in water quality standards are being considered along with other activities.

Example 1

Several facilities on a stream segment discharge phosphorus-containing wastes. Ambient phosphorus concentrations meet the designated class B (non-fishable/swimmable) standards, but barely. Three dischargers achieve elimination by developing land treatment systems. As a result, actual water quality improves (i.e., phosphorus levels decline) but not quite to the level needed to meet class A (fishable/swimmable) standards. Can the remaining dischargers now be allowed to increase their phosphorus discharge without an antidegradation analysis with the result that water quality declines (phosphorus levels increase) to previous levels?

Nothing in the water quality standards regulation explicitly prohibits this. Of course, changes in their NPDES permit limits may be subject to non-water quality constraints, such as BPT, BAT, or the NPDES antibacksliding provisions, which may restrict the increased loads.

Example 2

Suppose, in the above situation, water quality improves to the point that actual water quality now meets class A requirements. Is the answer different?

Yes. The standards must be upgraded (see section 2.8).

Example 3

As an alternative case, suppose phosphorus loadings go down and water quality improves because of a change in farming practices (e.g., initiation of a successful nonpoint source program.) Are the above answers the same?

Yes. Whether the improvement results from a change in point or nonpoint source activity is immaterial to how any aspect of the standards regulation operates. Section 131.10(d) clearly indicates that uses are deemed attainable if they can be achieved by "... cost-effective and reasonable best management practices for nonpoint source control." Section 131.12(a)(2) of the antidegradation policy contains essentially the same wording.

Exhibit 4-2. Examples of the Application of Antidegradation in the Waste Load/Load Allocation and NPDES Permitting Process

It is inconsistent with the water quality standards regulation to "back-door" changes in standards through actions on EIS's, waste load allocations, plans, or permits.

CHAPTER 5

GENERAL POLICIES

(40 CFR 131.13)

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CHAPTER 5
GENERAL POLICIES

States may, at their discretion, adopt certain policies in their standards affecting the application and implementation of standards. For example, policies concerning mixing zones, water quality standards variances, and critical flows for water quality-based permit limits may be adopted. Although these are areas of State discretion, EPA retains authority to review and approve or disapprove such policies (see 40 CFR 131.13).

5.1 Mixing Zones

It is not always necessary to meet all water quality criteria within the discharge pipe to protect the integrity of the water body as a whole. Sometimes it is appropriate to allow for ambient concentrations above the criteria in small areas near outfalls. These areas are called mixing zones. Whether to establish a mixing zone policy is a matter of State discretion, but any State policy allowing for mixing zones must be consistent with the Clean Water Act and is subject to approval of the Regional Administrator.

A series of guidance documents issued by EPA and its predecessor agencies have addressed the concept of a mixing zone as a limited area or volume of water where initial dilution of a discharge takes place. Mixing zones have been applied in the water quality standards program since its inception. The present water quality standards regulation allows States' to adopt mixing zones as a matter of States discretion. Guidance on defining mixing zones previously has been provided in several EPA documents, including FWPCA (1968); NAS/NAE (1972); USEPA (1976); and USEPA (1983a).

EPA's current mixing zone guidance, contained in this Handbook and the *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a), evolved from and supersedes these sources.

Allowable mixing zone characteristics should be established to ensure that:

- mixing zones do not impair the integrity of the water body as a whole,
- there is no lethality to organisms passing through the mixing zone (see section 5.1.2, this Handbook); and
- there are no significant health risks, considering likely pathways of exposure (see section 5.1.3, this Handbook).

EPA recommends that mixing zone characteristics be defined on a case-by-case basis after it has been determined that the assimilative capacity of the receiving system can safely accommodate the discharge. This assessment should take into consideration the physical, chemical, and biological characteristics of the discharge and the receiving system; the life history and behavior of organisms in the receiving system; and the desired uses of the waters. Mixing zones should not be permitted where they may endanger critical areas (e.g., drinking water supplies, recreational areas, breeding grounds, areas with sensitive biota).

EPA has developed a holistic approach to determine whether a mixing zone is tolerable (Brungs, 1986). The method considers all the impacts to the water body and all the impacts that the drop in water quality will have on the surrounding ecosystem and water body uses. It is a multistep data collection and analysis

procedure that is particularly sensitive to overlapping mixing zones. This method includes the identification of all upstream and downstream water bodies and the ecological and cultural data pertaining to them; the collection of data on all present and future discharges to the water body; the assessment of relative environmental value and level of protection needed for the water body; and, finally, the allocation of environmental impact for a discharge applicant. Because of the difficulty in collecting the data necessary for this procedure and the general lack of agreement concerning relative values, this method will be difficult to implement in full. However, the method does serve as a guide on how to proceed in allocating a mixing zone.

Mixing zone allowances will increase the mass loadings of the pollutant to the water body and decrease treatment requirements. They adversely impact immobile species, such as benthic communities, in the immediate vicinity of the outfall. Because of these and other factors, mixing zones must be applied carefully, so as not to impede progress toward the Clean Water Act goals of maintaining and improving water quality. EPA recommendations for allowances for mixing zones, and appropriate cautions about their use, are contained in this section.

MIXING ZONES

A limited area or volume of water where initial dilution of a discharge takes place and where numeric water quality criteria can be exceeded but acutely toxic conditions are prevented.

The *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a, sections 2.2, 4.3, 4.4) discusses mixing zone analyses for situations in which the discharge does not mix completely with the receiving water within a short distance. Included are discussions of outfall designs that maximize initial dilution in the mixing zone, critical design periods for mixing zone analyses, and methods to analyze and model nearfield and farfield mixing.

5.1.1 State Mixing Zone Methodologies

EPA recommends that States have a definitive statement in their standards on whether or not mixing zones are allowed. Where mixing zones provisions are part of the State standards, the State should describe the procedures for defining mixing zones. Since these areas of impact, if disproportionally large, could potentially adversely impact the productivity of the water body and have unanticipated ecological consequences, they should be carefully evaluated and appropriately limited in size. As our understanding of pollutant impacts on ecological systems evolves, cases could be identified where no mixing zone is appropriate.

State water quality standards should describe the State's methodology for determining the location, size, shape, outfall design, and in-zone quality of mixing zones. The methodology should be sufficiently precise to support regulatory actions, issuance of permits, and determination of BMPs for nonpoint sources. EPA recommends the following:

- **Location**

Biologically important areas are to be identified and protected. Where necessary to preserve a zone of passage for migrating fish or other organisms in a water course, the standards should specifically identify the portions of the waters to be kept free from mixing zones.

Where a mixing zone is allowed, water quality standards are met at the edge of that regulatory

mixing zone during design flow conditions and generally provide:

- a continuous zone of passage that meets water quality criteria for free-swimming and drifting organisms; and
- prevention of impairment of critical resource areas.

Individual State mixing zone dimensions are designed to limit the impact of a mixing zone on the water body. Furthermore, EPA's review of State waste load allocations (WLAs) should evaluate whether assumptions of complete or incomplete mixing are appropriate based on available data.

In river systems, reservoirs, lakes, estuaries, and coastal waters, zones of passage are defined as continuous water routes of such volume, area, and quality as to allow passage of free-swimming and drifting organisms so that no significant effects are produced on their populations. Transport of a variety of organisms in river water and by tidal movements in estuaries is biologically important for a number of reasons:

- food is carried to the sessile filter feeders and other nonmotile organisms;
- spatial distribution of organisms and reinforcement of weakened populations are enhanced; and
- embryos and larvae of some fish species develop while drifting.

Anadromous and catadromous species must be able to reach suitable spawning areas. Their young (and in some cases the adults) must be assured a return route to their growing and living areas. Many species make migrations for spawning and other purposes. Barriers or blocks that prevent or interfere with these types of essential transport and movement can be created by water with inadequate chemical or physical quality.

Size

Various methods and techniques for defining the surface area and volume of mixing zones for various types of waters have been formulated. Methods that result in quantitative measures sufficient for permit actions and that protect designated uses of a water body as a whole are acceptable. The area or volume of an individual zone or group of zones must be limited to an area or volume as small as practicable that will not interfere with the designated uses or with the established community of aquatic life in the segment for which the uses are designated.

To ensure that mixing zones do not impair the integrity of the water body, it should be determined that the mixing zone will not cause lethality to passing organisms and that, considering likely pathways of exposure, no significant human health risks exist. One means to achieve these objectives is to limit the size of the area affected by the mixing zones.

In the general case, where a State has both acute and chronic aquatic life criteria, as well as human health criteria, independently established mixing zone specifications may apply to each of the three types of criteria. For application of two-number aquatic life criteria, there may be up to two types of mixing zones (see Figure 5-1). In the zone immediately surrounding the outfall, neither the acute nor the chronic criteria are met. The acute criteria are met at the edge of this zone. In the next mixing zone, the acute, but not the chronic, criteria are met. The chronic criteria are met at the edge of the second mixing zone. The acute mixing zone may be sized to prevent lethality to passing organisms, the chronic mixing zone sized to protect the ecology of the water body as a whole, and the health criteria mixing zone sized to prevent significant human risks. For any particular pollutant from any

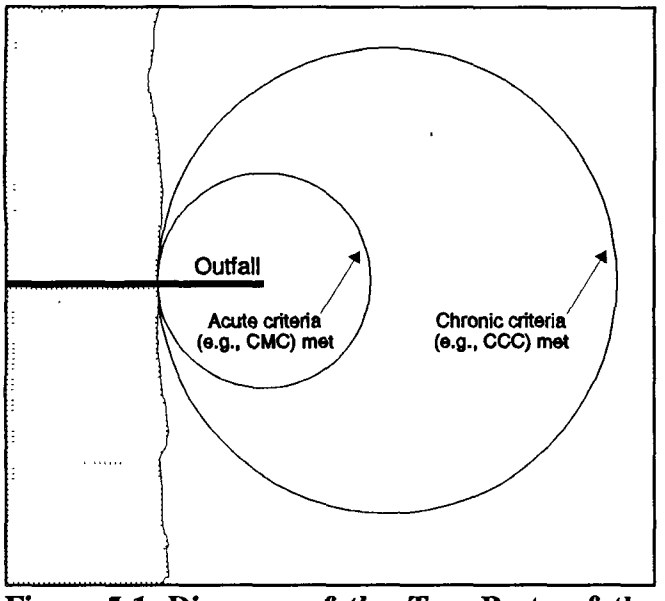


Figure 5-1. Diagram of the Two Parts of the Aquatic Life Mixing Zone

particular discharge, the magnitude, duration, frequency, and mixing zone associated with each of the three types of criteria (acute and chronic aquatic life, and human health) will determine which one most limits the allowable discharge.

Concentrations above the chronic criteria are likely to prevent sensitive taxa from taking up long-term residence in the mixing zone. In this regard, benthic organisms and territorial organisms are likely to be of greatest concern. The higher the concentrations occurring within certain isopleths, the more taxa are likely to be excluded, thereby affecting the structure and function of the ecological community. It is thus important to minimize the overall size of the mixing zone and the size of elevated concentration isopleths within the mixing zone.

To determine that, for aquatic life protection, a mixing zone is appropriately sized, water quality conditions within the mixing zone may be compared to laboratory-measured or predicted toxicity benchmarks as follows:

- It is not necessary to meet chronic criteria within the mixing zone, only at the edge of the mixing zone. Conditions within the mixing zone would thus not be adequate to assure survival, growth, and reproduction of all organisms that might otherwise attempt to reside continuously within the mixing zone.

- If acute criteria (criterion maximum concentration, or CMC, derived from 48- to 96-hour exposure tests) are met throughout the mixing zone, no lethality should result from temporary passage through the mixing zone. If acute criteria are exceeded no more than a few minutes in a parcel of water leaving an outfall (as assumed in deriving the section 5.1.2 options for an outfall velocity of 3 m/sec, and a size of 50 times the discharge length scale), this likewise assures no lethality to passing organisms.

- If a full analysis of concentrations and hydraulic residence times within the mixing zone indicates that organisms drifting through the centerline of the plume along the path of maximum exposure would not be exposed to concentrations exceeding the acute criteria when averaged over the 1-hour (or appropriate site-specific) averaging period for acute criteria, then lethality to swimming or drifting organisms should ordinarily not be expected, even for rather fast-acting toxicants. In many situations, travel time through the acute mixing zone must be less than roughly 15 minutes if a 1-hour average exposure is not to exceed the acute criterion.

  Where mixing zone toxicity is evaluated using the probit approach described in the water quality criteria "Blue Book" (NAS/NAE, 1973), or using models of toxicant accumulation and action in organisms (such as described by Mancini, 1983, or Erickson et al., 1989), the phenomenon of delayed mortality should be

taken into account before judging the mixing zone concentrations to be safe.

The above recommendations assume that the effluent is repulsive, such that free-swimming organisms would avoid the mixing zones. While most toxic effluents are repulsive, caution is necessary in evaluating attractive mixing zones of known effluent toxicity, and denial of such mixing zones may well be appropriate. It is also important to assure that concentration isopleths within any plume will not extend to restrict passage of swimming organisms into tributary streams.

In all cases, the size of the mixing zone and the area within certain concentration isopleths should be evaluated for their effect on the overall biological integrity of the water body. If the total area affected by elevated concentrations within all mixing zones combined is small compared with the total area of a water body (such as a river segment), then mixing zones are likely to have little effect on the integrity of the water body as a whole, provided that they do not impinge on unique or critical habitats. EPA has developed a multistep procedure for evaluating the overall acceptability of mixing zones (Brungs, 1986).

Shape

The shape of a mixing zone should be a simple configuration that is easy to locate in a body of water and that avoids impingement on biologically important areas. In lakes, a circle with a specified radius is generally preferable, but other shapes may be specified in the case of unusual site requirements. Most States allow mixing zones as a policy issue but provide spatial dimensions to limit the areal extent of the mixing zones. The mixing zones are then allowed (or not allowed) after case-by-case determinations. State regulations dealing with streams and rivers generally limit mixing zone widths, cross-sectional areas, and flow volumes, and allow lengths to be determined on a case-by-case basis. For lakes, estuaries, and coastal waters, dimensions are usually specified by surface area, width, cross-sectional area, and volume. "Shore-hugging" plumes should be avoided in all water bodies.

Outfall Design

Before designating any mixing zone, the State should ensure that the best practicable engineering design is used and that the location of the existing or proposed outfall will avoid significant adverse aquatic resource and water quality impacts of the wastewater discharge.

In-Zone Quality

Mixing zones are areas where an effluent discharge undergoes initial dilution and are extended to cover the secondary mixing in the ambient water body. A mixing zone is an allocated impact zone where acute and chronic water quality criteria can be exceeded as long as a number of protections are maintained, including freedom from the following:

(1) materials in concentrations that will cause acutely toxic conditions to aquatic life;

(2) materials in concentrations that settle to form objectionable deposits;

(3) floating debris, oil, scum, and other material in concentrations that form nuisances;

(4) substances in concentrations that produce objectionable color, odor, taste, or turbidity; and

(5) substances in concentrations that produce undesirable aquatic life or result in a dominance of nuisance species.

Acutely toxic conditions are defined as those lethal to aquatic organisms that may pass through the mixing zone. As discussed in section 5.1.2 below, the underlying assumption for allowing a mixing zone is that a small area of concentrations in excess of acute and chronic criteria but below acutely toxic releases can exist without causing adverse effects to the overall water body. The State regulatory agency can decide to allow or deny a mixing zone on a site-specific basis. For a mixing zone to be permitted, the discharger should prove to the State regulatory agency that all State requirements for a mixing zone are met.

5.1.2 Prevention of Lethality to Passing Organisms

Lethality is a function of the magnitude of pollutant concentrations and the duration an organism is exposed to those concentrations. Requirements for wastewater plumes that tend to attract aquatic life should incorporate measures to reduce the toxicity (e.g., via pretreatment, dilution) to minimize lethality or any irreversible toxic effects on aquatic life.

EPA's water quality criteria provide guidance on the magnitude and duration of pollutant concentrations causing lethality. The CMC is used as a means to prevent lethality or other acute effects. As explained in Appendix D to the *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a), the CMC is a toxicity level and should not be confused with an LC_{50} level. The CMC is defined as one-half of the final acute value (FAV) for specific toxicants and 0.3 acute toxicity unit (TU_a) for effluent toxicity (USEPA, 1991a, chap. 2). The CMC describes the condition under which lethality will not occur if the duration of the exposure to the CMC level is less than 1 hour. The CMC for whole-effluent toxicity is intended to prevent lethality or acute effects in the aquatic biota. The CMC for individual toxicants prevents acute effects in all but a small percentage of the tested species. Thus, the areal extent and concentration isopleths of the mixing zone must be such that the 1-hour average exposure of organisms passing through the mixing zone is less than the CMC. The organism must be able to pass through quickly or flee the high-concentration area. The objective of mixing zone water quality recommendations is to provide time-exposure histories that produce negligible or no measurable effects on populations of critical species in the receiving system.

Lethality to passing organisms can be prevented in the mixing zone in one of four ways. The first method is to prohibit concentrations in excess of the CMC in the pipe itself, as measured directly at the end of the pipe. As an example, the CMC should be met in the pipe whenever a continuous discharge is made to an intermittent stream. The second approach is to require that the CMC be met within a very short distance from the outfall during chronic design flow conditions for receiving waters (see section 5.2, this Handbook).

If the second alternative is selected, hydraulic investigations and calculations indicate that the use of a high-velocity discharge with an initial velocity of 3 m/sec, or greater, together with a mixing zone spatial limitation of 50 times the discharge length scale in any direction, should ensure that the CMC is met within a few minutes under practically all conditions.

The discharge length scale is defined as the square root of the cross-sectional area of any discharge pipe.

A third alternative (applicable to any water body) is not to use a high-velocity discharge.

Rather the discharger should provide data to the State regulatory agency showing that the most restrictive of the following conditions are met for each outfall:

- The CMC should be met within 10 percent of the distance from the edge of the outfall structure to the edge of the regulatory mixing zone in any spatial direction.

- The CMC should be met within a distance of 50 times the discharge length scale in any spatial direction. In the case of a multiport diffuser, this requirement must be met for each port using the appropriate discharge length scale of that port. This restriction will ensure a dilution factor of at least 10 within this distance under all possible circumstances, including situations of severe bottom interaction, surface interaction, or lateral merging.

- The CMC should be met within a distance of 5 times the local water depth in any horizontal direction from any discharge outlet. The local water depth is defined as the natural water depth (existing prior to the installation of the discharge outlet) prevailing under mixing-zone design conditions (e.g., low-flow for rivers). This restriction will prevent locating the discharge in very shallow environments or very close to shore, which would result in significant surface and bottom concentrations.

A fourth alternative (applicable to any water body) is for the discharger to provide data to the State regulatory agency showing that a drifting organism would not be exposed to 1-hour average concentrations exceeding the CMC, or would not receive harmful exposure when evaluated by other valid toxicological analysis (USEPA, 1991a, chap. 2). Such data should be collected during environmental conditions that replicate critical conditions.

For the third and fourth alternatives, examples of such data include monitoring studies, except for those situations where collecting chemical samples to develop monitoring data would be impractical, such as at deep outfalls in oceans, lakes, or embayments. Other types of data could include field tracer studies using dye, current meters, other tracer materials, or detailed analytical calculations, such as modeling estimations of concentration or dilution isopleths.

The following outlines a method, applicable to the fourth alternative, to determine whether a mixing zone is tolerable for a free-swimming or drifting organism. The method incorporates mortality rates (based on toxicity studies for the pollutant of concern and a representative organism) along with the concentration isopleths of the mixing zone and the length of time the organism may spend in each isopleth. The intent of the method is to prevent the actual time of exposure from exceeding the exposure time required to elicit an effect:

$$\sum \left(\frac{T(n)}{ET(X) \text{ at } C_{(n)}} \right) \leq 1$$

where T(n) is the exposure time an organism is in isopleth n, and ET(X) is the "effect time." That is, ET(X) is the exposure time required to produce an effect (including a delayed effect) in X percent of organisms exposed to a concentration equal to $C_{(n)}$, the concentration in isopleth n. ET(X) is experimentally determined; the effect is usually mortality. If the summation of ratios of exposure time to effect time is less than 1, then the percent effect will not occur.

5.1.3 Human Health Protection

For protection of human health, the presence of mixing zones should not result in significant health risks when evaluated using reasonable assumptions about exposure pathways. Thus, where drinking water contaminants are a concern, mixing zones should not encroach on

drinking water intakes. Where fish tissue residues are a concern (either because of measured or predicted residues), mixing zones should not be projected to result in significant health risks to average consumers of fish and shellfish, after considering exposure duration of the affected aquatic organisms in the mixing zone and the patterns of fisheries use in the area.

While fish tissue contamination tends to be a far-field problem affecting entire water bodies rather than a narrow-scale problem confined to mixing zones, restricting or eliminating mixing zones for bioaccumulative pollutants may be appropriate under conditions such as the following:

- Mixing zones should be restricted such that they do not encroach on areas often used for fish harvesting particularly of stationary species such as shellfish.

- Mixing zones might be denied (see section 5.1.4) where such denial is used as a device to compensate for uncertainties in the protectiveness of the water quality criteria or uncertainties in the assimilative capacity of the water body.

5.1.4 Where Mixing Zones Are Not Appropriate

States are not required to allow mixing zones and, if mixing zones are allowed, a State regulatory agency may decide to deny a mixing zone in a site-specific case. Careful consideration must be given to the appropriateness of a mixing zone where a substance discharged is bioaccumulative, persistent, carcinogenic, mutagenic, or teratogenic.

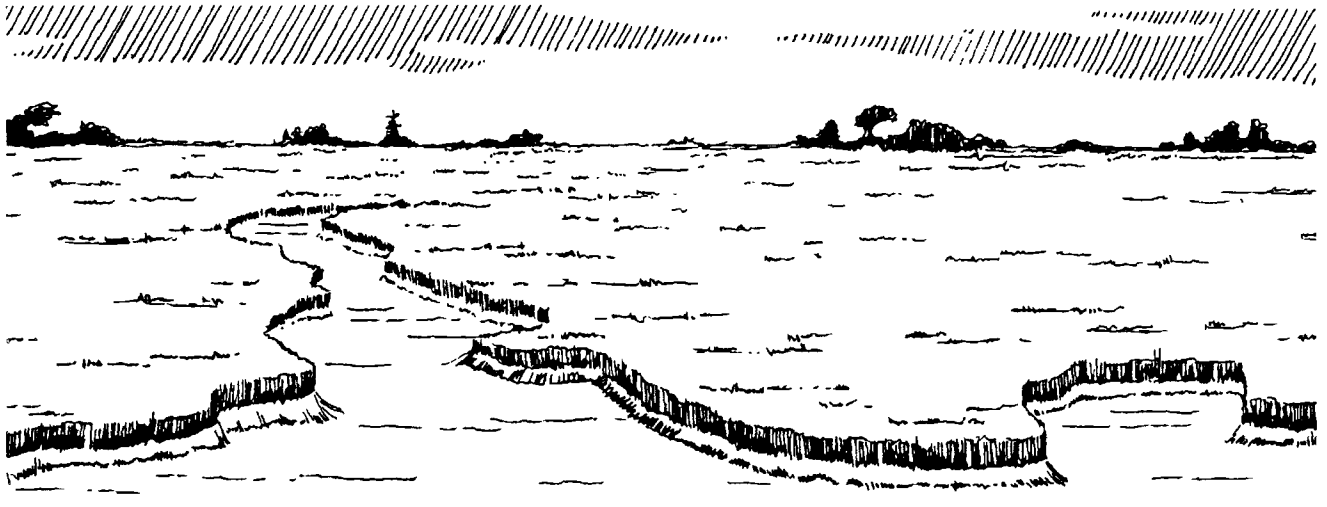
Denial should be considered when bioaccumulative pollutants are in the discharge. The potential for a pollutant to bioaccumulate in living organisms is measured by:

- the bioconcentration factor (BCF), which is chemical-specific and describes the degree to which an organism or tissue can acquire a higher contaminant concentration than its environment (e.g., surface water);

- the duration of exposure; and

- the concentration of the chemical of interest.

While any BCF value greater than 1 indicates that bioaccumulation potential exists, bioaccumulation potential is generally not considered to be significant unless the BCF exceeds 100 or more. Thus, a chemical that is discharged to a receiving stream resulting in



low concentrations and has a low BCF value will not result in a bioaccumulation hazard. Conversely, a chemical that is discharged to a receiving stream resulting in a low concentration but having a high BCF value may result in a bioaccumulation hazard. Also, some chemicals of relatively low toxicity, such as zinc, will bioconcentrate in fish without harmful effects resulting from human consumption.

Factors such as size of zone, concentration gradient within the zone, physical habitat, and attraction of aquatic life are important in this evaluation. Where unsafe fish tissue levels or other evidence indicates a lack of assimilative capacity in a particular water body for a bioaccumulative pollutant, care should be taken in calculating discharge limits for this pollutant or the additivity of multiple pollutants. In such instances, the ecological or human health effects may be so adverse that a mixing zone is not appropriate.

Another example of when a regulator should consider prohibiting a mixing zone is in situations where an effluent is known to attract biota. In such cases, provision of a continuous zone of passage around the mixing area will not serve the purpose of protecting aquatic life. A review of the technical literature on avoidance/attraction behavior revealed that the majority of toxicants elicited an avoidance or neutral response at low concentrations (Versar, 1984). However, some chemicals did elicit an attractive response, but the data were not sufficient to support any predictive methods. Temperature can be an attractive force and may counter an avoidance response to a pollutant, resulting in attraction to the toxicant discharge. Innate behavior such as migration may also supersede an avoidance response and cause a fish to incur a significant exposure.

5.1.5 Mixing Zones for the Discharge of Dredged or Fill Material

EPA, in conjunction with the Department of the Army, has developed guidelines to be applied in evaluating the discharge of dredged or fill material in navigable waters (see 40 CFR 230). The guidelines include provisions for determining the acceptability of mixing discharge zones (section 230.11(f)). The particular pollutant involved should be evaluated carefully in establishing dredging mixing zones. Dredged spoil discharges generally result in temporary short-term disruption and do not represent continuous discharge that will affect beneficial uses over a long term. Disruption of beneficial uses should be the primary consideration in establishing mixing zones for dredge and fill activities. State water quality standards should reflect these principles if mixing zones for dredging activities are referenced.

5.1.6 Mixing Zones for Aquaculture Projects

The Administrator is authorized, after public hearings, to permit certain discharges associated with approved aquaculture projects (section 318 of the Act). The regulations relating to aquaculture (40 CFR 122.56 and 125.11) provide that the aquaculture project area and project approval must not result in the enlargement of any previously approved mixing zone. In addition, aquaculture regulations provide that designated project areas must not include so large a portion of the body of water that a substantial portion of the indigenous biota will be exposed to conditions within the designated projects area (section 125.11(d)). Areas designated for approved aquaculture projects should be treated in the same manner as other mixing zones. Special allowances should not be made for these areas.

5.2 Critical Low-Flows

Water quality standards should protect water quality for designated uses in critical low-flow situations. In establishing water quality standards, States may designate a critical low-flow below which numerical water quality criteria do not apply. At all times, waters shall

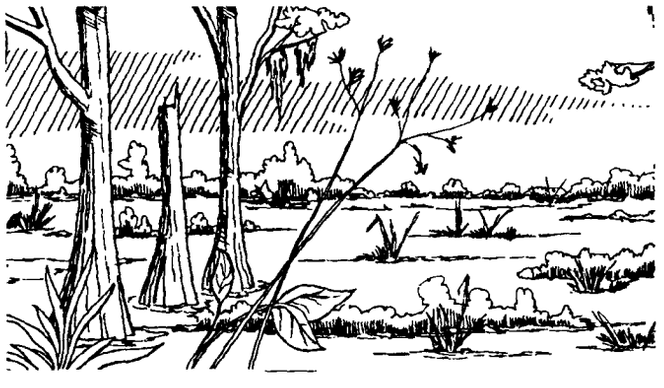
be free from substances that settle to form objectionable deposits; float as debris, scum, oil, or other matter; produce objectionable color, odor, taste, or turbidity; cause acutely toxic conditions; or produce undesirable or nuisance aquatic life.

To do steady-state waste load allocation analyses, these low-flow values become design flows for sizing treatment plants, developing waste load allocations, and developing water quality-based effluent limits. Historically, these so-called "design" flows were selected for the purposes of waste load allocation analyses that focused on instream dissolved oxygen concentrations and protection of aquatic life. EPA introduced hydrologically and biologically based analyses for the protection of aquatic life and human health with the publication of the *Technical Support Document for Water Quality-based Toxics Control.* These concepts have been expanded subsequently in guidance entitled *Technical Guidance Manual for Performing Wasteload Allocations, Book 6, Design Conditions*, (USEPA, 1986c). These new developments are included in Appendix D of the 1991 *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a). The discussion here is greatly simplified; it is provided to support EPA's recommendation for baseline application values for instream flows and thereby maintain the intended stringency of the criteria for priority toxic pollutants. EPA recommended either of two methods for calculating acceptable low-flows, the traditional hydrologic method developed by the U.S. Geological Survey and a biologically based method developed by EPA.

Most States have adopted specific low-flow requirements for streams and rivers to protect designated uses against the effects of toxics. Generally, these have followed the guidance in the TSD. EPA believes it is essential that States adopt design flows for steady-state analyses so that criteria are implemented appropriately. The TSD also recommends the use of three dynamic models to perform waste load allocations. Because dynamic waste load models do not generally use specific steady-state design flows but accomplish the same effect by factoring in the probability of occurrence of stream flows based on the historical flow record, only steady-state conditions will be discussed here. Clearly, if the criteria are implemented using inadequate design flows, the resulting toxics controls would not be fully effective because the resulting ambient concentrations would exceed EPA's criteria.

In the case of aquatic life, more frequent violations than the assumed exceedences once in 3 years would result in diminished vitality of stream ecosystems characteristics by the loss of desired species such as sport fish. Numeric water quality criteria should apply at all flows that are equal to or greater than flows specified in Exhibit 5-1.

EPA is recommending the harmonic mean flow to be applied with human health criteria for carcinogens. The concept of a harmonic mean is a standard statistical data analysis technique. EPA's model for human health effects assumes that such effects occur because of a long-term exposure to low concentration of a toxic pollutant (for example, 2 liters of water per day for 70 years). To estimate the concentrations of the toxic pollutant in those 2 liters per day by withdrawal from streams with a high daily variation in flow, EPA believes the harmonic mean flow is the correct statistic to use in computing such design flows rather than other averaging techniques. For a description of harmonic means, refer to Rossman (1990).



AQUATIC LIFE

Acute criteria (CMC)	**1Q10 or 1B3**
Chronic criteria (CCC)	**7Q10 or 4B3**

HUMAN HEALTH

Non-carcinogens	**30Q5**
Carcinogens	**Harmonic mean flow**

Where:

1Q10 is the lowest one day flow with an average recurrence frequency of once in 10 years determined hydrologically;

1B3 is biologically based and indicates an allowable exceedence of once every 3 years. It is determined by EPA's computerized method (DFLOW model);

7Q10 is the lowest average 7 consecutive day low flow with an average recurrence frequency of once in 10 years determined hydrologically;

4B3 is biologically based and indicates an allowable exceedence for 4 consecutive days once every 3 years. It is determined by EPA's computerized method (DFLOW model);

30Q5 is the lowest average 30 consecutive day low flow with an average recurrence frequency of once in 5 years determined hydrologically; and

harmonic mean flow is a long term mean flow value calculated by dividing the number of daily flows analyzed by the sum of the reciprocals of those daily flows.

Exhibit 5-1. EPA recommendations for design flows

EPA has produced guidance on flow considerations (USEPA, 1986d) which calculates design flows based on steady-state modeling. Two design flows are calculated, one for the criterion continuous concentration (CCC) and one for the criterion maximum concentration (CMC). The CCC is the 4-day average concentration of a pollutant in ambient water that should not be exceeded more than once every 3 years on average. The CCC is therefore, a chronic concentration. The CMC is a 1-hour average concentration in ambient waters that should not be exceeded more than once every 3 years on average. The CMC is an acute concentration. Note that when a criterion specifies a 4-day average concentration that should not be exceeded more than once every 3 years, this should not be interpreted as implying that a 4Q3 low-flow is appropriate for use as the design flow.

EPA had recommended interim use of the 1Q5 and 1Q10 low-flow as the CMC design flow and the 7Q5 and 7Q10 low-flows as the CCC design flow for unstressed and stressed systems, respectively. Further consideration of stress placed on aquatic ecosystems resulting from exceedences of water quality criteria indicates that there is little justification for different design flows for unstressed and stressed systems. All ecosystems have been changed and, therefore, stressed as a result of human activities. Therefore, the recommended design flow for CMC is 1Q10 and for CCC is 7Q10. States may designate other design or low-flows but such flows, must be scientifically justified. That many streams within a State have no flow at 7Q10 is not adequate justification for designating alternative flows.

5.3 Variances From Water Quality Standards

EPA first formally indicated allowability of State WQS variance provisions in Decision of the General Counsel No. 44, dated June 22, 1976, which specifically considered an Illinois variance provision, and expanded upon the acceptability of State WQS variance procedures in Decision of the General Counsel No. 58 (OGC No. 58) dated March 29, 1977 (published, in part, at 44 F.R. 39508 (July 6, 1979)). Subsequent guidance has elaborated on or clarified the policy over the years. For example, the Director of EPA's Criteria and Standards Division transmitted EPA's definition of a WQS variance to the Regional WQS Coordinators on July 3, 1979, and on March 15, 1985, the Director of the Office of Water Regulations and Standards, responding to questions raised on WQS variances, issued a reinterpretation of the factors that could be considered when granting variances.

Variance procedures involve the same substantive and procedural requirements as removing a designated use (see section 2.7, this Handbook), but unlike use removal, variances are both discharger and pollutant specific, are time-limited, and do not forego the currently designated use.

A variance should be used instead of removal of a use where the State believes the standard can ultimately be attained. By maintaining the standard rather than changing it, the State will assure that further progress is made in improving water quality and attaining the standard. With a variance, NPDES permits may be written such that reasonable progress is made toward attaining the standards without violating section 402(a)(1) of the Act, which requires that NPDES permits must meet the applicable water quality standards.

State variance procedures, as part of State water quality standards, must be consistent with the substantive requirements of 40 CFR 131. EPA has approved State-adopted variances in the past and will continue to do so if:

- each individual variance is included as part of the water quality standard;
- the State demonstrates that meeting the standard is unattainable based on one or more of the grounds outlined in 40 CFR 131.10(g) for removing a designated use;
- the justification submitted by the State includes documentation that treatment more advanced than that required by sections 303(c)(2)(A) and (B) has been carefully considered, and that alternative effluent control strategies have been evaluated;
- the more stringent State criterion is maintained and is binding upon all other dischargers on the stream or stream segment;
- the discharger who is given a variance for one particular constituent is required to meet the applicable criteria for other constituents;
- the variance is granted for a specific period of time and must be rejustified upon expiration but at least every 3 years (Note: the 3-year limit is derived from the triennial review requirements of section 303(c) of the Act.);
- the discharger either must meet the standard upon the expiration of this time period or must make a new demonstration of "unattainability";
- reasonable progress is being made toward meeting the standards; and
- the variance was subjected to public notice, opportunity for comment, and public hearing. (See section 303(c)(1) and 40 CFR 131.20.) The public notice should contain a clear description of the impact of the variance upon achieving water quality standards in the affected stream segment.

CHAPTER 6

PROCEDURES FOR REVIEW AND REVISION OF WATER QUALITY STANDARDS

(40 CFR 131 - Subpart C)

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CHAPTER 6
PROCEDURES FOR REVIEW AND REVISION OF WATER QUALITY STANDARDS

State review and revision of water quality standards are discussed in section 6.1. of this chapter. Guidance is provided on the administrative and regulatory requirements and procedures that should be followed in the State review and submittal process as well as the implication of a State's failure to submit standards. EPA review and approval procedures are discussed in section 6.2, and the procedures for promulgation of Federal standards are described in section 6.3.

6.1 State Review and Revision

Section 303(c)(1) of the Clean Water Act requires that a State shall, from time to time, but at least once every 3 years, hold public hearings to review applicable water quality standards and, as appropriate, to modify and adopt standards. The 3-year period is measured from the date of the letter in which the State informs EPA that revised or new standards have been adopted for the affected waters and are being submitted for EPA review or, if no changes were made in the standards for those waters, from the date of the letter in which the State informs EPA that the standards were reviewed and no changes were made.

States identify additions or revisions necessary to existing standards based on their 305(b) reports, other available water quality monitoring data, previous water quality standards reviews, or requests from industry, environmental groups, or the public. Water quality standards reviews and revisions may take many forms, including additions to and modifications in uses, in criteria, in the antidegradation policy, in the antidegradation implementation procedures, or in other general policies.

6.1.1 Consultation with EPA

State consultation with EPA regional offices should occur when States begin activities to revise or adopt new water quality standards and long before the State standards are formally submitted for EPA review. Reasons for early consultation with EPA include the following:

- States will benefit from early identification of potential areas of disagreement between EPA and the States, and EPA can determine where assistance may be provided;
- EPA must be in a position to respond to litigation and to congressional and other inquiries relating to actions on the revised State water quality standards;
- Headquarters must be ready to support promulgation actions when State standards have been disapproved;
- early consultation with EPA allows issues to be discussed well before a formal review request is received from the State; and
- EPA actions related to State standards should receive as comprehensive a review as possible.

6.1.2 Public Notice Soliciting Suggestions for Additions or Revisions to Standards

An important component of the water quality standards setting and review process is a

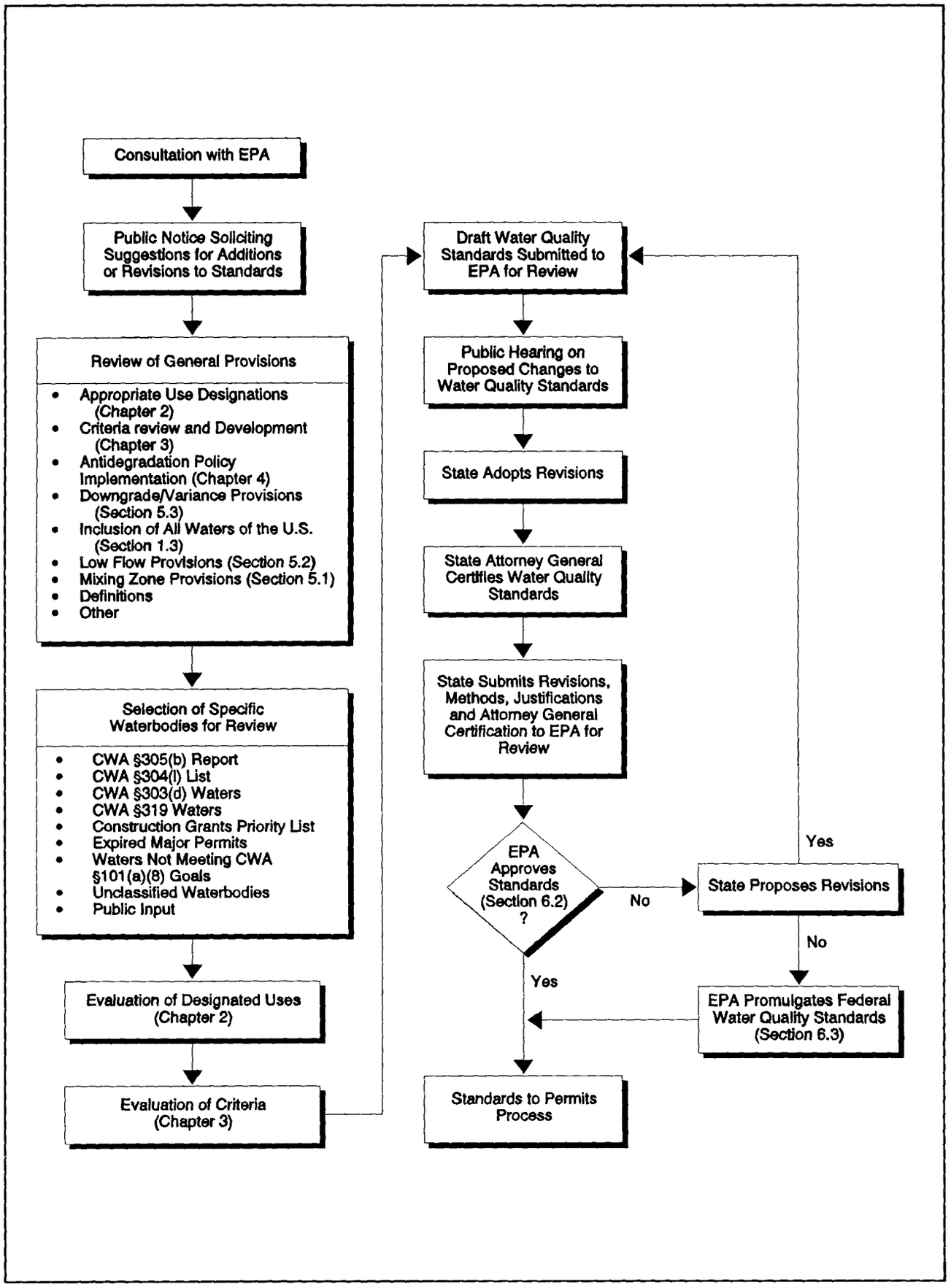


Figure 6-1. Simplified Flow Chart of a Typical State Water Quality Standards Review Process

meaningful involvement of those affected by the standards decisions. At a minimum, section 303(c) of the Clean Water Act requires States to hold a public hearing in reviewing and revising water quality standards. (State law may require more than one hearing.) However, States are urged to involve the public more actively in the review process. Involvement of the public includes the involvement of citizens affected by standards decisions, the regulated community (municipalities and industry), and inter-governmental coordination with local, State, and Federal agencies, and Indian Tribes with an interest in water quality issues. This partnership will ensure the sharing of ideas, data, and information, which will increase the effectiveness of the total water quality management process.

Public involvement is beneficial at several points in the water quality standards decision making process. Enlisting the support of municipalities, industries, environmentalists, universities, other agencies, and the affected public in collecting and evaluating information for the decision making process should assist the State in improving the scientific basis for, and in building support for, standards decisions. The more that people and groups are involved early in the process of setting appropriate standards, the more support the State will have in implementing the standards.

6.1.3 Review of General Provisions

In each 3-year water quality standards review cycle, States review the general provisions of the standards for adequacy taking into consideration:

- new Federal or State statutes, regulations, or guidance;
- legal decisions involving application of standards; or
- other necessary clarifications or revisions.

Inclusion of All Waters of the United States

Water quality standards are needed for all "waters of the United States," defined in the National Pollution Discharge Elimination System Regulations at 40 CFR 122.2 to include all interstate waters, including wetlands, and all intrastate lakes, rivers, streams (including intermittent streams), wetlands, natural ponds, etc., the use, degradation or destruction of which would affect or could affect interstate or foreign commerce. The term "waters of the United States" should be read broadly during the standards review process. States should ensure that all waters under this definition are included in the States' water quality standards, are assigned designated uses, and have protective criteria.

Definitions

Terms used in the Water Quality Standards Regulation are defined in 40 CFR 131.3. The glossary of this document contains these and other water quality standards-related terms defined by the Clean Water Act, EPA regulation, or guidance. States, when reviewing their water quality standards, should at a minimum define those terms included in the Definitions section of the regulation to be synonymous with the EPA definitions.

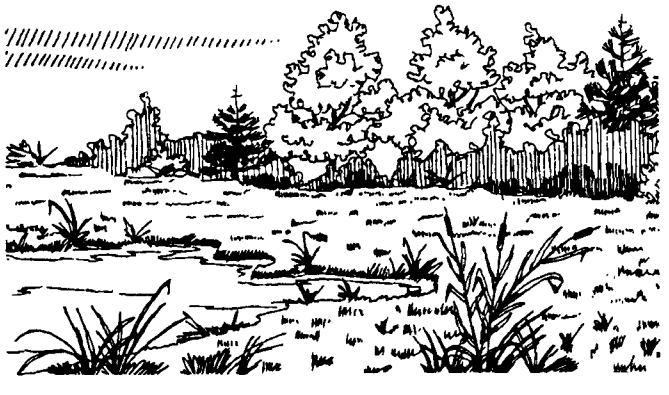
6.1.4 Selection of Specific Water Bodies for Review

The Water Quality Standards Regulation allows States to establish procedures for identifying and reviewing the standards on specific water bodies in detail. Any procedures States establish to revise standards should be articulated in the continuing planning process consistent with the water quality management regulation. Water bodies receiving a detailed standards review are most likely to be those where:

- combined sewer overflow (CSO) funding decisions are pending;
- water quality-based permits are scheduled to be issued or reissued;
- CWA goal uses are not being met;
- toxics have been identified and are suspected of precluding a use or may be posing an unreasonable risk to human health; or
- there may be potential impacts on threatened or endangered species.

States may have other reasons for wishing to examine a water body in detail, such as human health problems, court orders, or costs or economic and social impacts of implementing the existing water quality standards. States must reexamine any water body with standards not consistent with the section 101(a)(2) goals of the Act every 3 years, and if new information indicates that section 101(a)(2) goal uses are attainable, revise its standards to reflect those uses.

States are encouraged to review standards for a large enough area to consider the interaction between both point and nonpoint source discharges. In carrying out standards reviews, the States and EPA should ensure proper coordination of all water quality programs.



6.1.5 Evaluation of Designated Uses

Once priority water bodies have been selected for review, the designated uses must be evaluated. This may involve some level of data collection up to and including a full water body survey and assessment; however, an intensive survey of the water body is not necessary if adequate data are available. The purpose of the evaluation is to pinpoint problems and to characterize present uses, attainable uses (uses that could exist in the absence of anthropogenic effects), uses impaired or precluded, and the reasons why uses are impaired or precluded. Information generated in the survey also can be used to establish the basis for seasonal uses and subcategories of uses.

Included in section 2.9 of this Handbook are examples of a range of physical, chemical, and biological characteristics of the water body that may be surveyed when evaluating aquatic protection uses. This information is then used in determining the existing species in the water body and the health of those species, as well as what species could be in the water body given the physical characteristics of the water body, or what species might be in the water if the quality of the water were improved.

Review of the Cause of Uses Not Being Met

If the survey indicates that designated uses are impaired, the next step is to determine the cause. In many situations, physical conditions and/or the presence of pollutants prevent the water body from meeting its designated use. Physical limitations refer to such factors as depth, flow, habitat, turbulence, or structures such as dams that might make a use unsuitable or impossible to achieve regardless of water quality.

If uses are precluded because of physical limitations of the water body, the State may wish to examine modifications that might allow a habitat suitable for a species to thrive where it could not before. Some of the techniques

which have been used include bank stabilization, current deflectors, construction of oxbows, or installation of spawning beds. A State also might wish to consider improving the access to the water body, improving facilities nearby so that it can be used for recreational purposes, or establishing seasonal uses or subcategories of a use.

If uses are not being met because of water pollution problems, the first step in the process is to determine the cause. If the standards review process is well coordinated with the total maximum daily load (TMDL) determination and the permit process, permitees may be required to conduct some of the analyses necessary to determine why uses are not attained (For more information on the TMDL process, see chapter 7, this Handbook.) When background levels of pollutants are irreversible and criteria cannot be met, States should evaluate other more appropriate uses and revise the water quality standards appropriately.

Determination of Attainable Uses

Consideration of the suitability of the water body to attain a use is an integral part of the water quality standards review and revision process. The data and information collected from the water body survey provide a firm basis for evaluating whether the water body is suitable for the particular use. Suitability depends on the physical, chemical, and biological characteristics of the water body, its geographic setting and scenic qualities, and the socioeconomic and cultural characteristics of the surrounding area. Suitability must be assessed through the professional judgment of the evaluators. It is their task to provide sufficient information to the public and the State decision makers.

In some instances, physical factors may preclude the attainment of uses regardless of improvements in the chemistry of the receiving water. This is particularly true for fish and wildlife protection uses where the lack of a proper substrate may preclude certain forms of aquatic life from using the stream for propagation, or the lack of cover, depth, flow, pools, riffles, or impacts from channelization, dams, or diversions may preclude particular forms of aquatic life from the stream altogether. While physical factors may influence a State's decision regarding designation of uses for a water body, States need to give consideration to the incidental uses that may be made of the water body notwithstanding the use designation. For example, even though it may not make sense to encourage use of a stream for swimming because of the flow, depth, or velocity of the water, the States and EPA must recognize that swimming and/or wading may, in fact, occur. To protect public health, States must set criteria to reflect swimming if it appears that primary contact recreation will, in fact, occur in the stream.

While physical factors are important in evaluating whether a use is attainable, physical limitations of the stream may not be an overriding factor. Common sense and good judgment play an important role in setting appropriate uses and criteria. In setting criteria and uses, States must assure the attainment of downstream standards. The downstream uses may not be affected by the same physical limitations as the upstream uses.

If a change in the designated use is warranted based on a use attainability analysis, States may modify the uses currently assigned. In doing so, the State should designate uses that can be supported given the physical, chemical, or biological limitations of the water body. Or, a State may designate uses on a seasonal basis. Seasonal use designations may be appropriate for streams that lack adequate water volume to support aquatic life year round, but can be used for fish spawning, etc., during higher flow periods. In setting seasonal uses, care must be taken not to allow the creation of conditions instream that preclude uses in another season. EPA encourages the designation of seasonal

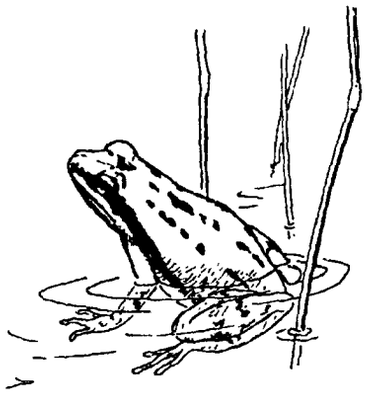
uses as an alternative to completely downgrading the use of a water body.

Economic Impact Assessment

The Water Quality Standards Regulation allows States to establish uses that are inconsistent with the section 101(a)(2) goals of the Act if the more stringent technology required to meet the goals will cause substantial and widespread economic and social impact. These are impacts resulting specifically from imposition of the pollution controls and reflect such factors as unemployment, plant closures, and changes in the governmental fiscal base. The analysis should address the incremental effects of water quality standards beyond technology-based or other State requirements. If the requirements are not demonstrated to have an incremental, substantial, and widespread impact on the affected community, the standard must be maintained or made compatible with the goals of the Act.

6.1.6 Evaluation of Criteria

Changes in use designations also must be accompanied by consideration of the need for a change in criteria. If a use is removed, the criteria to protect that use may be deleted or revised to assure protection of the remaining uses. If a use is added, there must be adequate water quality criteria to protect the use. Regardless of whether changes or modifications in uses are made, criteria protective of the use must be adopted. Certain criteria are deemed essential for inclusion in all State standards, and criteria for section 307(a) toxic pollutants must be addressed consistent with section 303(c)(2)(B) (see chapter 3, this Handbook). All State standards should contain the "free froms" narrative statements (see section 3.5.2) in addition to numerical limits that can be used as a basis for regulating discharges into surface waters. Also, water quality parameters such as temperature, dissolved oxygen, pH, and bacteriological requirements are basic to all State standards.



EPA's laboratory-derived criteria may not always accurately reflect the bioavailability and/or toxicity of a pollutant because of the effect of local physical and chemical characteristics or varying sensitivities of local aquatic communities. Similarly, certain compounds may be more or less toxic in some waters because of differences in temperature, hardness, or other conditions. Setting site-specific criteria is appropriate where:

- background water quality parameters, such as pH, hardness, temperature, color, appear to differ significantly from the laboratory water used in developing the section 304(a) criteria; or

- the types of local aquatic organisms differ significantly from those actually tested in developing the section 304(a) criteria.

Developing site-specific criteria is a method of taking local conditions into account so that criteria are adequate to protect the designated use without being more or less stringent than needed. A three-phase testing program that includes water quality sampling and analysis, a biological survey, and acute bioassays provides an approach for developing site-specific criteria. Much of the data and information for the water quality sampling and analysis and the biological survey can be obtained while conducting the assessment of the water body. Included in section 3.10 of this Handbook are scientifically acceptable procedures for setting site-specific pollutant concentrations that will protect

designated uses. EPA believes that setting site-specific criteria will occur on only a limited number of stream segments because of the resources required to conduct the analyses and the basic soundness of the section 304(a) recommendations.

6.1.7 Draft Water Quality Standards Submitted to EPA for Review

While not a regulatory requirement, prudence dictates that draft State water quality standards be submitted to EPA for review. The EPA regional office and Headquarters will conduct concurrent reviews of draft standards and make comments on proposed revisions to assist the State in producing standards that are approvable by the Regional Administrator. Continuing cooperation between the State and EPA is essential to timely approval of State standards.

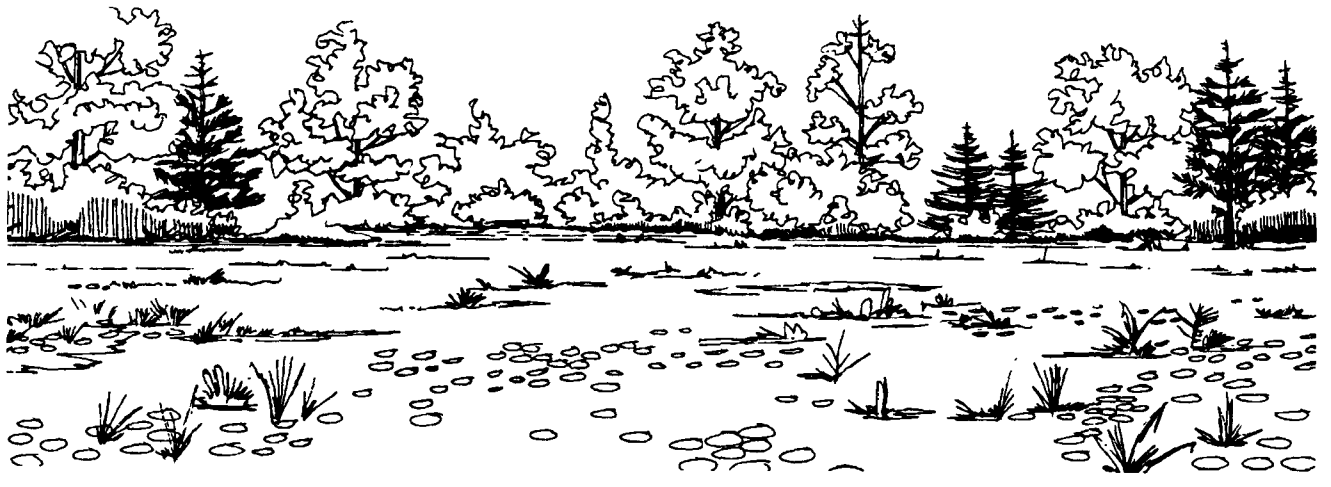
6.1.8 Public Hearing on Proposed Changes to Standards

Before removing or modifying any use or changing criteria, the Clean Water Act requires the State to hold a public hearing. More than one hearing may be required depending on State regulations. It may be appropriate to have EPA review the adequacy of justifications including the data and the suitability and appropriateness of the analyses and how the analyses were applied prior to the public hearing. In cases where the analyses are judged to be inadequate, EPA will identify how the analyses could be improved and suggest the additional types of evaluations or data needed. By consulting with EPA frequently throughout the review process, States can be better assured that EPA will be able to expeditiously review State submissions and make the determination that the standards meet the requirements of the Act.

The analyses and supporting documentation prepared in conjunction with the proposed water quality standards revision should be made available to the interested public prior to the hearing. Open discussion of the scientific evidence and analysis supporting proposed revisions in the water quality standards will assist the State in making its decision.

6.1.9 State Adopts Revisions; Submits Standards Package to EPA for Review

Within 30 days of their final administrative action, States submit to EPA water quality standards revisions, supporting analyses, and State Attorney General certification that the standards were duly adopted pursuant to State law. Final administrative action is meant to be the last action a State must take before its revision becomes a rule under State law and it can officially transmit State-adopted standards to EPA for review. This last action might be a signature, a review by a legislative committee or



State Board, or a delay mandated by a State administrative procedures act.

In reviewing changes in uses that are inconsistent with the section 101(a)(2) goals of the Act or changes in criteria, EPA will carefully consider the adequacy of the analyses and the public comments received during the hearing process. Standards are to meet the goals of the Act unless the State can clearly demonstrate that the uses reflected in the goals are unattainable.

6.2 EPA Review and Approval

When States adopt new or revised water quality standards, the State is required under CWA Section 303(c) to submit such standards to EPA for review and approval/disapproval. Section 131.20(c) of the Water Quality Standards Regulation requires the submittal to EPA to occur within 30 days of the final State action. Figure 6.2 outlines EPA's review process. EPA reviews and approves/disapproves the standards based on whether the standards meet the requirements of the CWA and the Water Quality Standards Regulation. States are encouraged to provide early drafts to the EPA Regional Office so that issues can be resolved during the water quality standards review process, prior to formal State proposal or adoption of revised or new standards.

When reviewing State water quality standards, EPA ensures that the standards meet the minimum requirements of the Act and Water Quality Standards Regulation. Pursuant to section 510 of the Act, State water quality standards may be more stringent than EPA's minimum requirements.

The general elements of an EPA review include, but are not limited to, the following:

- EPA determines whether "fishable/ swimmable" designated uses have been assigned to all State waters or a use attainability analysis (UAA) is available to support the designation of other uses. Other uses may satisfy the CWA section 101(a)(2) goal if properly supported by a UAA. EPA reviews the adequacy of the analyses.

- EPA determines whether the State's water quality criteria are sufficient to protect the designated uses by ensuring that all numeric criteria are based on CWA Section 304(a) guidance, 304(a) guidance modified to reflect site-specific conditions, or other scientifically defensible methods. EPA's decision to accept criteria based on site-specific calculations or alternative scientific procedures is based on a determination of the validity and adequacy of the supporting scientific procedures and assumptions and not on whether the resulting criterion is more or less stringent than the EPA guideline.

- EPA ensures that uses and/or criteria are consistent throughout the water body and that downstream standards are protected. A review to determine compliance with downstream standards is most likely to involve bodies of water on, or crossing, interstate and international boundaries.

- Where the analyses supporting any changes in the standards are inadequate, EPA identifies how the analyses need to be improved and suggests the type of information or analyses needed.

- For waters where uses have not been designated in support of the fishable/ swimmable goal of the CWA, EPA determines whether the alternative uses are based on an acceptable UAA and whether such UAAs have been reviewed every 3 years as required by 40 CFR 131.20(a).

- EPA ensures that general "free from" narrative criteria are included that protect all waters at all flows from substances that

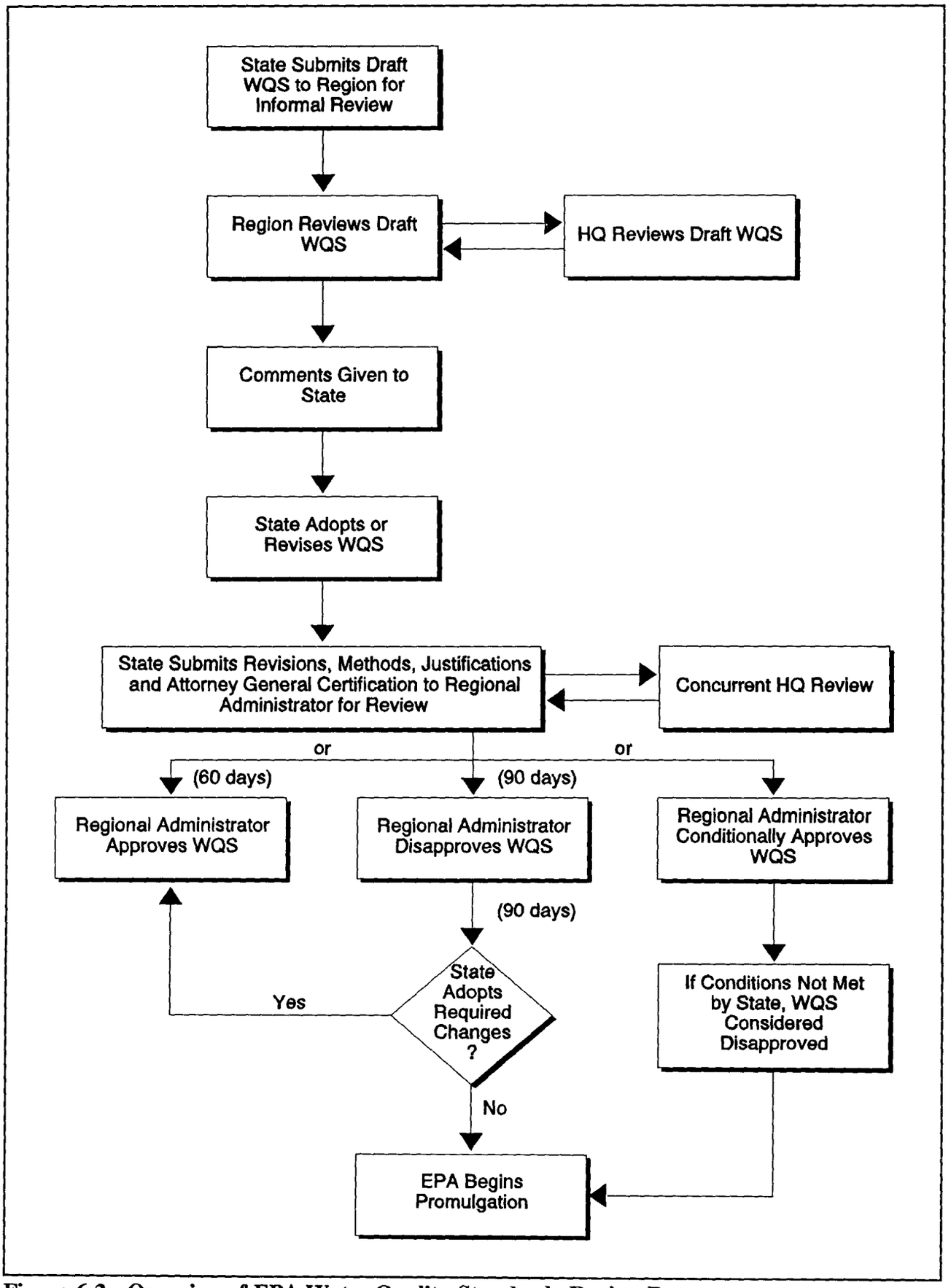


Figure 6-2. Overview of EPA Water Quality Standards Review Process

settle to form objectionable deposits; float as debris, scum, oil, or other matter; produce objectionable color, odor, taste, or turbidity; are acutely toxic; or produce undesirable or nuisance aquatic life.

- EPA determines whether the State has included criteria for CWA section 307(a) "priority" pollutants sufficient to satisfy the requirements of CWA section 303(c)(2)(B).

- For toxic pollutants where EPA has not issued guidance or it is not known which toxicant or toxicants are causing the problem, EPA ensures that the State standards include or reference a method for implementing the narrative toxics "free from" criterion.

- EPA ensures that the State's antidegradation policy meets the requirements of section 131.12 of the Water Quality Standards Regulation.

- EPA reviews whether the State has provided or referenced a procedure for implementing the antidegradation policy.

- Where (optional) general policies are included in the State water quality standards (e.g., mixing zone provisions, variance policies, low-flow exemption policies), EPA reviews whether the policies are consistent with the latest EPA guidance.

- EPA reviews comments and suggestions on previous State water quality standards to ensure that any areas for improvement or conditions attached to previous approvals have been acted upon satisfactorily.

- EPA reviews whether the policies are consistent with the latest EPA guidance and regulatory requirements.

- EPA ensures that the State has met the minimum requirements for a standards submission as outlined in section 131.6 of the Water Quality Standards Regulation.

- EPA reviews whether the State has complied with the procedural requirements (e.g., public participation) for conducting water quality standards reviews.

Since 1972, EPA review and approval/ disapproval includes concurrent reviews by the Regions and Headquarters. However, because the EPA regional Administrator has the responsibility for approving/disapproving water quality standards and because of the decentralized structure of EPA, the regional offices are the primary point of contact with the States. The EPA regional offices, not the States, are responsible for providing copies of State water quality standards to EPA Headquarters for review and for acting as liaison between States and EPA Headquarters on most matters affecting the water quality standards program. The basic internal EPA review procedures have been described in various guidance documents over the years; the most was a memorandum dated December 17, 1984. This memorandum also made one minor change to the process. It required that Headquarters be consulted immediately for possible advice and assistance when the Regional Office learns that a State:

- is proposing to lower designated water uses below the section 101(a)(2) goals of the Act;

- is not raising water uses to meet the section 101(a)(2) goals of the Act; or

- is considering adopting a water quality criterion less stringent than currently included in a State's standard.

To expedite Headquarters review, copies of State water quality standards revisions (draft and final) must be provided to the Director, Standards and Applied Science Division, at the time they are received by the Region. The Standards and Applied Science Division will

involve other EPA offices in the review as appropriate, and provide comments and suggestions, if any, to regional offices for consideration in State-EPA negotiations and final standards decisions. Their review will be expeditiously accomplished so as not to slow regional approval/disapproval. Neither the regional nor Headquarters review need be limited only to revisions to existing standards or to new standards.

In general, three outcomes are possible:

- EPA approval, in whole or in part, of the submitted State water quality standards;
- EPA disapproval, in whole or in part, of the submitted State water quality standards; and
- EPA conditional approval, in whole or in part, of the submitted State water quality standards.

Unconditional approval or disapproval of State-adopted water quality standards within the statutory time limits is the preferred approach. Conditional approvals should be used only as a limited exception to this general policy for correcting minor deficiencies in State standards and only if a State provides assurance that it will submit corrections on a specified, written schedule. Failure of a State to respond in a timely manner to the conditions expressed in the letter means that the standards are disapproved and the Region must promptly request Headquarters to initiate a promulgation action. Where this occurs, the Region should formally notify the State in writing that their failure to meet the conditions previously specified results in the standards now being disapproved as of the original date of the conditional approval letter.

6.2.1 Policies and Procedures Related to Approvals

Authority to approve or disapprove State water quality standards is delegated by the Administrator to each Regional Administrator. The Administrator retains the authority to promulgate standards. Revisions to State water quality standards that meet the requirements of the Act and the Water Quality Standards Regulation are approved by the appropriate EPA Regional Administrator. The Regional Administrator must, within 60 days, notify the Governor or his designee by letter of the approval and forward a copy of the letter to the appropriate State agency. The letter should contain any information that might be helpful in understanding the scope of the approval action. If particular events (e.g., State implementation decisions, pending Federal legislation pertaining to water quality standards requirements) could result in a failure of the approved standards to continue to meet the requirements of the Act, these events should be identified in the approval letter. Such events should be identified for the record to guide future review and revision activities.

When only a portion of the revisions submitted meet the requirements of the Act and the Water Quality Standards Regulation, the Regional Administrator may approve only that portion. If only a partial approval is made, the Region must, in notifying the State, be as specific as possible in identifying what is disapproved and why. The Regional Administrator must also clearly indicate what action the State could take to make the disapproved item acceptable.

6.2.2 Policies and Procedures Related to Disapprovals

If the Regional Administrator determines that the revisions submitted are not consistent with or do not meet the requirements of the Act or the Water Quality Standards Regulation, the Regional Administrator must disapprove such standards within 90 days. Such disapproval must be via written notification to the Governor of the State or his designee. The letter must state why the revisions are not consistent with the Act or the Water Quality Standards

Regulation and specify the revisions that must be adopted to obtain full approval. The letter must also notify the Governor that the Administrator will initiate promulgation proceedings if the State fails to adopt and submit the necessary revisions within 90 days after notification.

A State water quality standard remains in effect, even though disapproved by EPA, until the State revises it or EPA promulgates a rule that supersedes the State water quality standard. This is because water quality standards are State laws, not Federal laws, and once the law is amended by the State, the previously adopted and EPA-approved standards no longer legally exist.

6.2.3 Policies and Procedures Related to Conditional Approvals

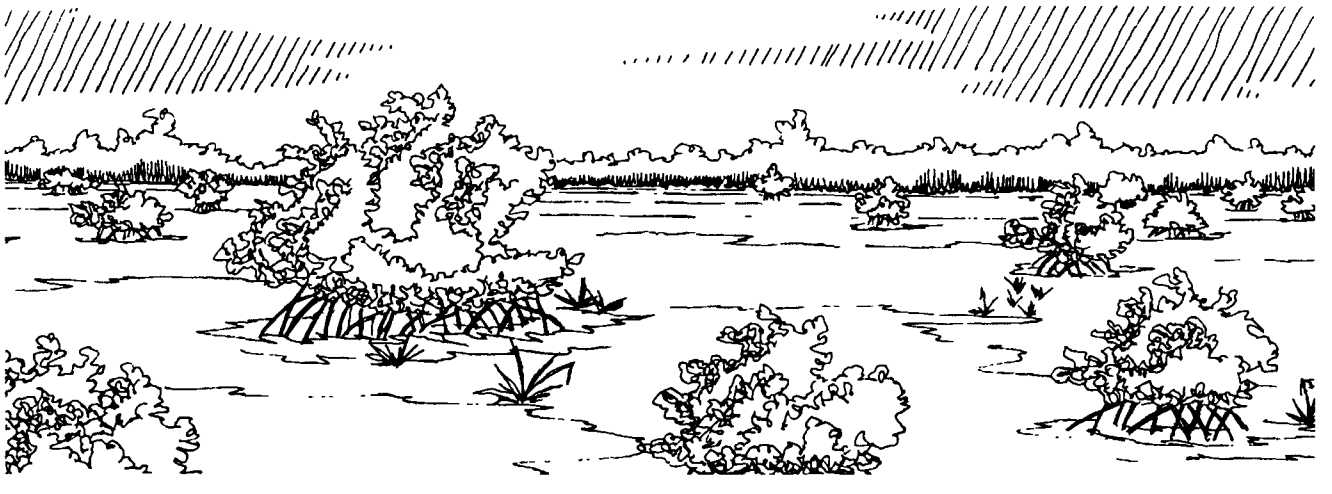
Conditional approvals are EPA approvals contingent on the performance of specified actions on the part of a State in a timely manner. There is an implicit or explicit statement in the letter to the State that failure to satisfy the identified conditions will nullify the conditional approval and lead to Federal promulgation action. Problems have arisen with inconsistent use of conditional approvals among the regions and with followup actions to ensure that a State is responding to the conditions in a timely manner.

Because promulgation of Federal standards is inherently a lengthy process, the use of conditional approvals evolved over the years as another mechanism to maintain the State-Federal relationship in establishing standards. When used properly, conditional approvals can result in standards that fully meet the requirements of the Act without undue Federal intervention and promote smooth operation of the national program.

If used improperly, conditional approvals can be an unacceptable delaying tactic to establishing standards and can be construed as EPA failing to properly exercise its duty to review and either approve or disapprove and promptly initiate promulgation action after the allotted 90-day period for State action. This improper use of conditional approvals must be avoided.

It is incumbent on a Region that uses a conditional approval to ensure that State action is timely. When a State fails to meet the agreed-upon schedule, EPA should initiate promulgation action. Conditional approvals are to be used only to correct minor deficiencies and should be the exception, not the rule, governing regional responses to State standards. Note that requests for clarification or additional information are not approval actions of any type.

This policy is modeled after that applied to EPA approval of State implementation plans



(SIPs) in the air program. (See 44 F.R. 38583, July 2, 1979. See also *Mississippi Commission on Natural Resources* v. *Costle*, 625 F. 2d 1269 (5th Cir.) 1980.)

Necessary Elements of Conditional Approvals

First, conditional approvals are appropriate only for "minor deficiencies." Blatant disregard of Federal statutory or regulatory requirements or changes that will affect major permit issuance or reissuance are not minor deficiencies. In addition, the State's standards submission as a whole must be in substantial compliance with EPA's regulation. Major deficiencies must be disapproved to allow prompt Federal promulgation action.

Second, the State must commit, in writing, to a mutually satisfactory, negotiated schedule to correct the identified regulatory deficiencies in as short a time period as possible. The time allowed should bear a reasonable relationship to the required action. However, in consideration of the first element above, it is expected that the time period for compliance will be limited to a few months. It is definitely not expected that a year or more will be required. If that is the case, disapproval would be more appropriate. Headquarters concurrence in the schedule is required if it extends for more than 3 months.

6.3 EPA Promulgation

As a matter of policy, EPA prefers that States adopt their own standards. However, under section 303(c)(4) of the Act, EPA may promulgate Federal standards:

- if a revised or new water quality standard submitted by a State is determined by the Administrator not to be consistent with the requirements of the Clean Water Act, or
- in any case where the Administrator determines that a new or revised standard is necessary to meet the requirements of the Act.

Under the latter provision of the statute, EPA would be able to promulgate standards for a State, or States, that failed to conduct a triennial review and submit new or revised standards to EPA for review so long as the Administrator determined new standards were necessary. Where one of these conditions is met, the Administrator has the authority to publish proposed revisions to the State(s) standards in the *Federal Register*. Generally, a public hearing will be held on the proposed standards. Final standards are promulgated after giving due consideration to written comments received and statements made at any public hearings on the proposed revisions.

Although only the Administrator may promulgate State standards, the Regional Office has a major role in the promulgation process. The Regional Office provides the necessary background information and conducts the public hearings. The Regional Office prepares drafts of the rationale supporting EPA's action included in the proposed and final rulemakings. The rationale should clearly state the reason for the disapproval of the State standard.

If conditions warrant (e.g., a State remedies the deficiencies in its water quality standards prior to promulgation), the Administrator may terminate the rulemaking proceeding at any time. However, if a proposed rulemaking has been published in the *Federal Register*, then the Regional Administrator must not approve the State's changes without obtaining concurrence from Headquarters.

Whenever promulgation proceedings are terminated, a notice of withdrawal of the proposed rulemaking will be published in the *Federal Register*. The Regional Offices are responsible for initiating such action and

furnishing a rationale for use in preparing the notice for the Administrator's signature.

An EPA-promulgated standard will be withdrawn when revisions to State water quality standards are made that meet the requirements of the Act. In such a situation, the Regional Office should initiate the withdrawal action by notifying the Standards and Applied Science Division (WH-585) that it is requesting the withdrawal, specifying the rationale for the withdrawal, and obtaining Headquarters concurrence on the acceptability of the State's water quality standards. EPA's action to withdraw a federally promulgated standard requires both a proposed and final rulemaking if the State-adopted standards are less stringent than federally promulgated standards but, in the Agency's judgment, fully meet the requirements of the Act. EPA will withdraw the Federal rule without a notice and comment rulemaking when the State standards are no less stringent than the Federal rule (i.e., standards that provide, at least, equivalent environmental and human health protection).

Withdrawal of a Federal promulgation is based on a determination that State-adopted water quality standards meet the requirements of the Clean Water Act. Such State-adopted standards may be the same as, more stringent than, or less stringent than the Federal rule.

CHAPTER 7

THE WATER QUALITY-BASED APPROACH TO POLLUTION CONTROL

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CHAPTER 7
THE WATER QUALITY-BASED APPROACH TO POLLUTION CONTROL

This chapter briefly describes the overall water quality-based approach and its relationship to the water quality standards program. The water quality-based approach emphasizes the overall quality of water within a water body and provides a mechanism through which the amount of pollution entering a water body is controlled based on the intrinsic conditions of that body of water and the standards set to protect it.

As shown in Figure 7.1, the water quality-based approach contains eight stages. These stages each represent a major Clean Water Act program with specific regulatory requirements and guidance. The presentations in this chapter summarize how the different programs fit into the overall water quality control scheme and are not intended as implementation guidance. Implementation of these programs should be consistent with the specific programmatic regulations and guidance documents provided by the appropriate program office, many of which are cited herein.

The first stage, "Determining Protection Level," involves State development of water quality standards, the subject of the preceding chapters of this Handbook.

In the second stage, "Monitoring and Assessing Water Quality," States identify impaired waters, determine if water quality standards are being met, and detect pollution trends. Sections of the Clean Water Act require States to compile data, assess, and report on the status of their water bodies. States generally use existing information and new data collected from ongoing monitoring programs to assess their waters. This stage is discussed in section 7.2. of this Handbook.

In the third stage, "Establishing Priorities," States rank water bodies according to the severity of the pollution, the uses to be made of the waters, and other social-economic considerations, and determine how best to utilize available resources to solve problems. Section 7.3 of this Handbook discusses the ranking and targeting of water bodies.

In the fourth stage, "Evaluating WQS for Targeted Waters," the appropriateness of the water quality standards for specific waters is evaluated. States may revise or reaffirm their water quality standards. A State may choose, for example, to develop site-specific criteria for a particular stream because a particular species needs to be protected. This stage is discussed in section 7.4 of this Handbook.

In the fifth stage "Defining and Allocating Control Responsibilities," the level of control needed to meet water quality standards is established, and control responsibilities are defined and allocated. States use mathematical models and/or monitoring to determine total maximum daily loads (TMDLs) for water bodies; the TMDLs include waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and a margin of safety. The TMDL is the amount of a pollutant that may be discharged into a water body and still maintain water quality standards. Pollutant loadings above this amount generally will result in waters exceeding the standards. Allocations for pollution limits for point and nonpoint sources are calculated to ensure that water quality standards are not exceeded. Section 7.5 discusses the TMDL process in greater detail.

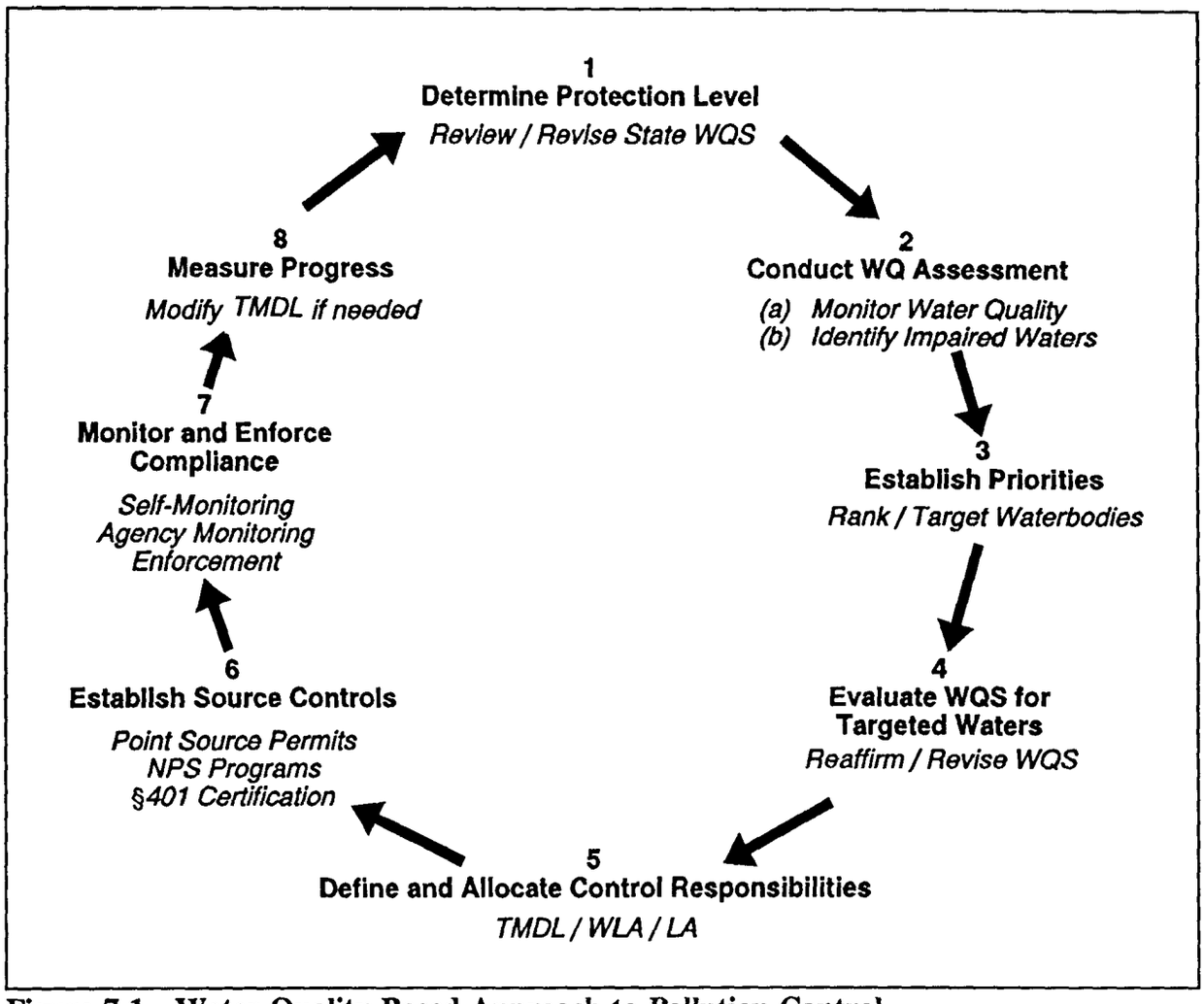


Figure 7-1. Water Quality-Based Approach to Pollution Control

In the sixth stage, "Establishing Source Control," States and EPA implement point source controls through NPDES permits, State and local governments implement nonpoint source management programs through State laws and local ordinances, and States assure attainment of water quality standards through the CWA section 401 certification process. Control actions are discussed in Section 7.6.

In the seventh stage, "Monitoring and Enforcing Compliance," States (or EPA) evaluate self-monitoring data reported by dischargers to see that the conditions of the NPDES permit are being met and take actions against any violators. Dischargers are monitored to determine whether or not they meet permit conditions and to ensure that expected water quality improvements are achieved. State nonpoint source programs are monitored and enforced under State law and to the extent provided by State law.

In the final stage, "Measuring Progress," the States (and EPA) assess the effectiveness of the controls and determine whether water quality standards have been attained, water quality standards need to be revised, or more stringent controls should be applied.

7.1 Determine Protection Level

The water quality-based approach to pollution control begins with the identification of problem water bodies. State water quality standards form the basis and "yardstick" by which States can assess the water body status

and implement needed pollution controls. A water quality standard defines the water quality goals of a water body, or portion thereof, by designating the use or uses to be made of the water, by setting criteria necessary to protect the uses, and by preventing degradation of water quality through antidegradation provisions. States adopt water quality standards to protect public health or welfare, enhance the quality of water, and serve the purposes of the Clean Water Act. "Serve the purposes of the Act" (as defined in sections 101(a), 101(a)(2), and 303(d) of the Act) means that water quality standards should (1) include provisions for restoring and maintaining chemical, physical, and biological integrity of State waters; (2) provide, wherever attainable, water quality for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water ("fishable/swimmable"); and (3) consider the use and value of State waters for public water supplies, propagation of fish and wildlife, recreation, agricultural and industrial purposes, and navigation. The preceding chapters of this Handbook provide EPA's guidance on the water quality standards program.

7.2 Conduct Water Quality Assessment

Once State water quality standards have determined the appropriate levels of protection to be afforded to State water bodies, States conduct water quality monitoring and identify those waters that are "water quality limited," or not meeting the standards.

7.2.1 Monitor Water Quality

Monitoring is an important element throughout the water quality-based decision making process. In this step, monitoring provides data for identifying impaired waters. The Clean Water Act specifies that States and Interstate Agencies, in cooperation with EPA, establish water quality monitoring systems necessary to review and revise water quality standards, assess designated use attainment, calculate TMDLs, assess compliance with permits, and report on conditions and trends in ambient waters. EPA issued guidance in 1985 for *State Water Monitoring and Waste load Allocation* (USEPA, 1985d). Guidance for preparing CWA section 305(b) reports is contained in the *Guidelines for the Preparation of the 1994 State Water Quality Assessments (305(b) Reports)* (USEPA, 1993a). Both of these documents discuss monitoring as an information collection tool for many program needs. The Intergovernmental Task Force on Monitoring Water Quality report (ITFM, 1992) proposes actions to improve ambient water quality monitoring in the United States to allow better management of water resources.

Sections 208(b)(2)(F) through (K) of the CWA require the development of a State process to identify, if appropriate, agricultural, silvicultural, and other nonpoint sources of pollution. NPS monitoring concerns are discussed in several NPS guidance documents along with methods to monitor and evaluate nonpoint sources (*Watershed Monitoring and Reporting Requirements for Section 319 National Monitoring Program Projects* (USEPA, 1991g) and *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (USEPA, 1993b).

7.2.2 Identify Impaired (Water Quality-Limited) Waters

EPA's Water Quality Planning and Management Regulation (40 CFR Part 130) establishes the process for identifying water quality-limited water still requiring total maximum daily loads (TMDLs). Waters require TMDLs when certain pollution control requirements (see Exhibit 7.1) are not stringent enough to maintain water quality standards for such waters.

The most widely applied water pollution controls are the technology-based effluent limitations required by sections 301(b) and 306 of the Clean Water Act. In some cases, a State

(b)(1) Each State shall identify those water quality segments still requiring WLAs/LAs and TMDLs within its boundaries for which:

> **(i) Technology-based effluent limitations required by sections 301(b), 306, 307, or other section of the Act;**
>
> **(ii) More stringent effluent limitations (including prohibitions) required by either State or local authority preserved by section 510 of the Act, of Federal authority (*e.g.*, law, regulation, or treaty); and**
>
> **(iii) Other pollution control requirements (*e.g.*, best management practices) required by local, State, or Federal authority**

are not stringent enough to implement any water quality standard applicable to such waters.

Exhibit 7-1. Identifying Waters Still Requiring TMDLs: 40 CFR 130.7(b)

or local authority may establish enforceable requirements beyond technology-based controls. Examples of such requirements may be those that (1) provide more stringent NPDES permit limitations to protect a valuable water resource, or (2) provide for the management of certain types of nonpoint source pollution.

Identification of good quality waters that are threatened is an important part of this approach. Adequate control of new discharges from either point or nonpoint sources should be a high priority for States to maintain the existing use or uses of these water bodies. In the identification of threatened waters, it is important that the 303(d) process consider all parts of the State water quality standards program to ensure that a State's antidegradation policy and narrative provisions, as well as parameter-specific criteria, are maintained.

Section 303(d) requires States to identify those water quality-limited waters needing TMDLs. States must regularly update their lists of waters as assessments are made and report these lists to EPA once every 2 years. In their biennial submission, States should identify the water quality-limited waters targeted for TMDL development in the next 2 years, and the pollutants or stressors for which the water is water quality-limited.

Each State may have different methods for identifying and compiling information on the status of its water bodies, depending on its specific programmatic or cross-programmatic needs and organizational arrangements. Typically, States utilize both existing information and new data collected from ongoing monitoring programs to assess whether water quality standards are being met, and to detect trends.

States assess their waters for a variety of purposes, including targeting cleanup activities, assessing the extent of contamination at potential Superfund sites, and meeting federally mandated reporting requirements. While the identification of water quality-limited waters may appear to be a major task for the States, a significant amount of this work has already begun or has been completed under sections 305(b), 304(l), 314(a), and 319(a) of the Clean Water Act as amended in 1987.

Section 305(b) requires States to prepare a water quality inventory every 2 years to document the status of water bodies that have been assessed. Under section 304(l), States identified all surface waters adversely affected by toxic (65 classes of compounds), conventional (such as BOD, total suspended solids, fecal coliform, and oil and grease), and nonconventional (such as ammonia, chlorine, and iron) pollutants from both point and nonpoint sources. Under section 314(a), States identify publicly owned lakes for which uses are known to be impaired by point and nonpoint sources, and report those identified in their

305(b) reports. Section 319 of the CWA requires each State to develop an NPS assessment report. Guidance on the submission and approval process for Section 319 reports is contained in *Nonpoint Source Guidance* (USEPA, 1987c).

Lists prepared to satisfy requirements under section 305(b), 304(l), 314(a) and 319 should be very useful in preparing 303(d) lists. Appendix B of *Guidance for Water Quality-based Decisions: The TMDL Process* (USEPA, 1991c) provides a summary of these supporting CWA programs.

7.3 Establish Priorities

Once waters needing additional controls have been identified, a State prioritizes its list of waters using established ranking processes that should consider all water pollution control activities within the State. Priority ranking has traditionally been a process defined by the State and may vary in complexity and design. A priority ranking should enable the State to make efficient use of its available resources and meet the objectives of the Clean Water Act.

The Clean Water Act states that the priority ranking for such waters must take into account the severity of the pollution and the uses to be made of such waters. Several documents (USEPA, 1987e, 1988c,d, 1989d, 1990c, 1993c) are available from EPA to assist States in priority setting.

According to EPA's State Clean Water Strategy document: "Where all water quality problems cannot be addressed immediately, EPA and the States will, using multi-year approaches, set priorities and direct efforts and resources to maximize environmental benefits by dealing with the most serious water quality problems and the most valuable and threatened resources first."

Targeting high-priority waters for TMDL development should reflect an evaluation of the relative value and benefit of water bodies within the State and take into consideration the following:

- risk to human health, aquatic life, and wildlife;
- degree of public interest and support;
- recreational, economic, and aesthetic importance of a particular water body;
- vulnerability or fragility of a particular water body as an aquatic habitat;
- immediate programmatic needs such as waste load allocations needed for permits that are coming up for revisions or for new or expanding discharges, or load allocations for needed BMPs;
- waters and pollution problems identified during the development of the section 304(l) "long list";
- court orders and decisions relating to water quality; and
- national policies and priorities such as those identified in EPA's Annual Operating Guidance.

States are required to submit their priority rankings to EPA for review. EPA expects all waters needing TMDLs to be ranked, with "high" priority waters — targeted for initiation

of TMDL development within 2 years following the listing process — identified. (See USEPA (1991c) for further details on submission of priorities to EPA.)

To effectively develop and implement TMDLs for all waters identified, States should establish multi-year schedules that take into consideration the immediate TMDL development for targeted water bodies and the long-range planning for addressing all water quality-limited waters still requiring TMDLs.

While the CWA section 319 NPS assessment report identifies the overall dimensions of the State's NPS water quality problems and States are to develop statewide program approaches for specific categories of pollution to address NPS problems, States are also encouraged to target subsets of waters for concerted action on a watershed-by-watershed basis. EPA has issued guidance on NPS targeting (USEPA, 1987e).

7.4 Evaluate Water Quality Standards for Targeted Waters

At this point in the water quality management process, States have identified and targeted priority water quality-limited water bodies. It is often appropriate, to re-evaluate the appropriateness of the water quality standards for the targeted waters for several reasons including, but not limited to, the following.

First, many States have not conducted in-depth analyses of appropriate uses and criteria for all water bodies but have designated general fishable/swimmable use classifications and statewide criteria on a "best professional judgment" basis to many waters. In addition, many States make general assumptions about the antidegradation status of State waters (e.g., all waters not specifically assigned to an antidegradation category will be considered tier 2 or high-quality waters). It is possible that these generally applied standards, although meeting the minimum requirements of the CWA and WQS regulation, may be inappropriate (either over- or under-protective) for a specific water body that has not had an in-depth standards analysis. For example, if a water body was classified as a coldwater fishery based solely on its proximity to other coldwater fisheries, a water body-specific analysis may show that only a warmwater fishery use is existing or attainable. If the listing of the water body was based on exceedences of criteria that are more stringent for coldwater fish (such as ammonia or dissolved oxygen), changing the designated use through a use attainability analysis and applying appropriate criteria may allow standards to be met without further water quality controls.

Second, even if an in-depth analysis has been done in the past, changes in the uses of the water body since that time may have made different standards more appropriate or generated an additional "existing use" which must be protected. For example, a water body designated for fish, aquatic life, and recreation in the past may now be used as a public water supply, without that use and protective criteria ever being formally adopted in the standards. Another example might be a designated warmwater fishery that, due to the removal of a thermal discharge, now supports a coldwater fishery as the existing use.

Third, monitoring data used to identify the water body as impaired may be historical, and subsequent water quality improvements have allowed standards to be met. And fourth, site-specific criteria may be appropriate because of specific local environmental conditions. For example, the species capable of living at the site are more or less sensitive than those included in the national criteria data set, or physical and/or chemical characteristics of the site alter the biological availability and/or toxicity of the chemical.

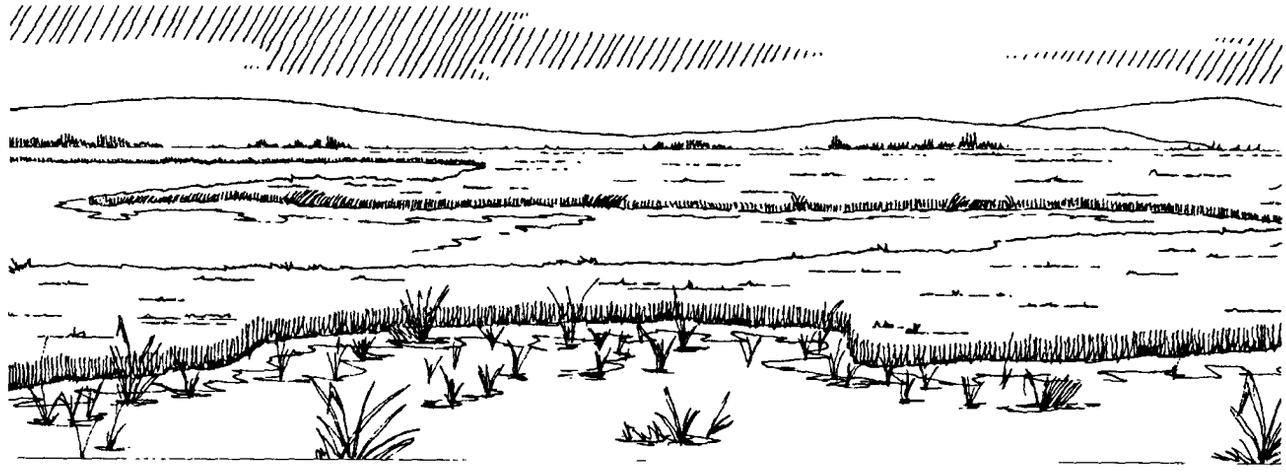
7.5 Define and Allocate Control Responsibilities

For a water quality-limited water that still requires a TMDL, a State must establish a TMDL that quantifies pollutant sources, and a margin of safety, and allocates allowable loads to the contributing point and nonpoint source discharges so that the water quality standards are attained. The development of TMDLs should be accomplished by setting priorities, considering the geographic area impacted by the pollution problem, and in some cases where there are uncertainties from lack of adequate data, using a phased approach to establishing control measures based on the TMDL.

Many water pollution concerns are areawide phenomena caused by multiple dischargers, multiple pollutants (with potential synergistic and additive effects), or nonpoint sources. Atmospheric deposition and ground water discharge may also result in significant pollutant loadings to surface waters. As a result, EPA recommends that States develop TMDLs on a watershed basis to efficiently and effectively manage the quality of surface waters.

The TMDL process is a rational method for weighing the competing pollution concerns and developing an integrated pollution reduction strategy for point and nonpoint sources. The TMDL process allows States to take a holistic view of their water quality problems from the perspective of instream conditions. Although States may define a water body to correspond with their current programs, it is expected that States will consider the extent of pollution problems and sources when defining the geographic area for developing TMDLs. In general, the geographical approach for TMDL development supports sound environmental management and efficient use of limited water quality program resources. In cases where TMDLs are developed on watershed levels, States should consider organizing permitting cycles so that all permits in a given watershed expire at the same time.

For traditional water pollution problems, such as dissolved oxygen depletion and nutrient enrichment, there are well-validated models that can predict effects with known levels of uncertainty. This is not true for such nontraditional pollution problems as urban stormwater runoff and pollutants that involve sediment and bioaccumulative pathways. Predictive modeling for these problems therefore uses conservative assumptions, but in many cases the degree of uncertainty cannot be well quantified until more data become available to develop sensitivity analyses and model comparisons. For TMDLs involving these nontraditional problems, the margins of safety may be increased and additional monitoring required to verify attainment of water quality standards and provide data needed to recalculate the TMDL, if necessary (the phased approach).



EPA regulations provide that load allocations for nonpoint sources and natural background "are best estimates of the loading which may range from reasonably accurate estimates to gross allotments . . ." (40 CFR 130.2(g)). A phased approach to developing TMDLs may be appropriate where nonpoint sources are involved and where estimates are based on limited information. Under the phased approach, TMDL includes monitoring requirements and a schedule for reassessing TMDL allocations to ensure attainment of water quality standards. Uncertainties that cannot be quantified may also exist for certain pollutants discharged primarily by point sources. In such situations a large margin of safety and followup monitoring are appropriate.

By pursuing the phased approach where applicable, a State can move forward to implement water quality-based control measures and adopt an explicit schedule for implementation and assessment. States can also use the phased approach to address a greater number of water bodies including threatened waters or watersheds that would otherwise not be managed. Specific requirements relating to the phased approach are discussed in *Guidance for Water Quality-based Decisions: The TMDL Process* (USEPA 1991c).

7.6 Establish Source Controls

Once a TMDL has been established for a water body (or watershed) and the appropriate source loads developed, implementation of control actions should proceed. The State or EPA is responsible for implementation, the first step being to update the water quality management plan. Next, point and nonpoint source controls should be implemented to meet waste load allocations and load allocations, respectively. Various pollution allocation schemes (i.e., determination of allowable loading from different pollution sources in the same water body) can be employed by States to optimize alternative point and nonpoint source management strategies.

The NPDES permitting process is used to limit effluent from point sources. Section 7.6.1 provides a more complete description of the NPDES process and how it fits into the water quality-based approach to permitting. Construction decisions regarding publicly owned treatment works (POTWs), including advanced treatment facilities, must also be based on the more stringent of technology-based or water quality-based limitations. These decisions should be coordinated so that the facility plan for the discharge is consistent with the limitations in the permit.

In the case of nonpoint sources, both State and local laws may authorize the implementation of nonpoint source controls such as the installation of best management practices (BMPs) or other management measures. CWA section 319 and Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) section 6217 State management programs may also be utilized to implement nonpoint source control measures and practices to ensure improved water quality. Many BMPs may be implemented through section 319 programs even where State regulatory programs do not exist. In such cases, a State needs to document the coordination that may be necessary among State and local agencies, landowners, operators, and managers and then evaluate BMP implementation, maintenance, and overall effectiveness to ensure that load allocations are achieved. Section 7.6.2 discusses some of the programs associated with implementation of nonpoint source control measures.

States may also grant, condition, or deny "certification" for a federally permitted or licensed activity that may result in a discharge to the waters of the United States, if it is the State where the discharge will originate. The State decision is based on a State's determination of whether the proposed activity will comply with the requirements of certain

sections of the Clean Water Act, including water quality standards under section 303. Section 7.6.3 of this Handbook contains further discussion of section 401 certification.

7.6.1 Point Source Control - the NPDES Process

Both technology-based and water quality-based controls are implemented through the National Pollutant Discharge Elimination System (NPDES) permitting process. Permit limits based on TMDLs are called water quality-based limits.

Waste load allocations establish the level of effluent quality necessary to protect water quality in the receiving water and to ensure attainment of water quality standards. Once allowable loadings have been developed through WLAs for specific pollution sources, limits are incorporated into NPDES permits. It is important to ensure that the WLA accounts for the fact that effluent quality is often highly variable. The WLA and permit limit should be calculated to prevent water quality standards impairment at all times. The reader is referred to the *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a) for additional information on deriving permit limits.

As a result of the 1987 Amendments to the Act, Individual Control Strategies (ICSs) were established under section 304(l)(1) for certain point source discharges of priority toxic pollutants. ICSs consist of NPDES permit limits and schedules for achieving such limits, along with documentation showing that the control measures selected are appropriate and adequate (e.g.,fact sheets including information on how water quality-based limits were developed, such as total maximum daily loads and waste load allocations). Point sources with approved ICSs are to be in compliance with those ICSs as soon as possible or in no case later than 3 years from the establishment of the ICS (typically by 1992 or 1993).

When establishing WLAs for point sources in a watershed, the TMDL record should show that, in the case of any credit for future nonpoint source reductions (1) there is reasonable assurance that nonpoint source controls will be implemented and maintained, or (2) that nonpoint source reductions are demonstrated through an effective monitoring program. Assurances may include the application or utilization of local ordinances, grant conditions, or other enforcement authorities. For example, it may be appropriate to provide that a permit may be reopened when a WLA requiring more stringent limits is necessary because attainment of a nonpoint source load allocation was not demonstrated.

7.6.2 Nonpoint Source Controls

In addition to permits for point sources, nonpoint sources controls such as management measures or best management practices (BMPs) are also to be implemented so that surface water quality objectives are met. To fully address water bodies impaired or threatened by nonpoint source pollution, States should implement their nonpoint source management programs and ensure adoption of control measures or practices by all contributors of nonpoint source pollution to the targeted watersheds.

Best management practices are the primary mechanism in section 319 of the CWA to enable achievement of water quality standards. Section 319 requires each State, in addition to developing the assessment reports discussed in section 7.2.1 of this Handbook, to adopt NPS

management programs to control NPS pollution.

Sections 208(b)(2)(F) through (K) of the CWA also require States to set forth procedures and methods including land use requirements, to control to the extent feasible nonpoint sources of pollution reports.

Section 6217 of the Coastal Zone Reauthorization Amendments of 1990 (CZARA) requires that States with federally approved coastal zone management programs develop Coastal Nonpoint Pollution Control Programs to be approved by EPA and NOAA. EPA and NOAA have issued *Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance* (NOAA/EPA, 1993), which describes the program development and approval process and requirements. State programs are to employ an initial technology-based approach generally throughout the coastal management area, to be followed by a more stringent water quality-based approach to address known water quality problems. The Management Measures generally implemented throughout the coastal management area are described in *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (USEPA, 1993b).

7.6.3 CWA Section 401 Certification

States may grant, condition, or deny "certification" for a federally permitted or licensed activity that may result in a discharge to the waters of the United States, if it is the State where the discharge will originate. The language of section 401(a)(1) is very broad with respect to the activities it covers:

> [A]ny activity, including, but not limited to, the construction or operation of facilities, which <u>may</u> result in <u>any discharge</u> . . .

requires water quality certification.

EPA has identified five Federal permits and/or licenses that authorize activities that may result in a discharge to the waters: permits for point source discharge under section 402 and discharge of dredged and fill material under section 404 of the Clean Water Act; permits for activities in navigable waters that may affect navigation under sections 9 and 10 of the Rivers and Harbors Act (RHA); and licenses required for hydroelectric projects issued under the Federal Power Act. There are likely other Federal permits and licenses, such as permits for activities on public lands, and Nuclear Regulatory Commission licenses, which may result in a discharge and thus require 401 certification. Each State should work with EPA and the Federal agencies active in its State to determine whether 401 certification is in fact applicable.

Congress intended for the States to use the water quality certification process to ensure that no Federal license or permits would be issued that would violate State standards or become a source of pollution in the future. Also, because the States' certification of a construction permit or license also operates as certification for an operating permit (except in certain instances specified in section 401(a)(3)), it is imperative for a State review to consider all potential water quality impacts of the project, both direct and indirect, over the life of the project.

In addition, when an activity requiring 401 certification in one State (i.e. the State in which the discharge originates) will have an impact on the water quality of another State, the statute provides that after receiving notice of application from a Federal permitting or licensing agency, EPA will notify any States whose water quality may be affected. Such States have the right to submit their objections and request a hearing. EPA may also submit its evaluation and recommendations. If the use of conditions cannot ensure compliance with the affected State's water quality requirements,

the Federal permitting or licensing agency shall not issue such permit or license.

The decision to grant, condition, or deny certification is based on a State's determination from data submitted by an applicant (and any other information available to the State) whether the proposed activity will comply with the requirements of certain sections of the Clean Water Act enumerated in section 401(a)(1). These requirements address effluent limitations for conventional and nonconventional pollutants, water quality standards, new source performance standards, and toxic pollutants (sections 301, 302, 303, 306, and 307). Also included are requirements of State law or regulation more stringent than those sections or their Federal implementing regulations.

States adopt surface water quality standards pursuant to section 303 of the Clean Water Act and have broad authority to base those standards on the waters' use and value for "... public water supplies, propagation of fish and wildlife, recreational purposes, and . . . other purposes" (33 U.S.C. section 1313 (c)(2)(A)). All permits must include effluent limitations at least as stringent as needed to maintain established beneficial uses and to attain the quality of water designated by States for their waters. Thus, the States' water quality standards are a critical concern of the 401 certification process.

If a State grants water quality certification to an applicant for a Federal license or permit, it is in effect saying that the proposed activity will comply with State water quality standards (and the other CWA and State law provisions enumerated above). The State may thus deny certification because the applicant has not demonstrated that the project will comply with those requirements. Or it may place whatever limitations or conditions on the certification it determines are necessary to ensure compliance with those provisions, and with any other "appropriate" requirements of State law.

If a State denies certification, the Federal permitting or licensing agency is prohibited from issuing a permit or license. While the procedure varies from State to State, a State's decision to grant or deny certification is ordinarily subject to an administrative appeal, with review in the State courts designated for appeals of agency decisions. Court review is typically limited to the question of whether the State agency's decision is supported by the record and is not arbitrary or capricious. The courts generally presume regularity in agency procedures and defer to agency expertise in their review. (If the applicant is a Federal agency, however, at least one Federal court has ruled that the State's certification decision may be reviewed by the Federal courts.)

States may also waive water quality certification, either affirmatively or involuntarily. Under section 401(a)(1), if the State fails to act on a certification request "within a reasonable time (which shall not exceed one year)" after the receipt of an application, it forfeits its authority to grant conditionally or to deny certification.

The most important regulatory tools for the implementation of 401 certification are the States' water quality standards regulations and their 401 certification implementing regulations and guidelines. Most Tribes do not yet have water quality standards, and developing them would be a first step prior to having the authority to conduct water quality certification. Also, many States have not adopted regulations implementing their authority to grant, deny, and condition water quality certification. *Wetland and 401 Certification: Opportunities and Guidelines for States and Eligible Indian Tribes* (USEPA, 1989a) discusses specific approaches, and elements of water quality standards and 401 certification regulations that EPA views as effective to implement the States' water quality certification authority.

7.7 Monitor and Enforce Compliance

As noted throughout the previous sections, monitoring is a crucial element of water quality-based decision making. Monitoring provides data for assessing compliance with water quality-based controls and for evaluating whether the TMDL and control actions that are based on the TMDL protect water quality standards.

With point sources, dischargers are required to provide reports on compliance with NPDES permit limits. Their discharge monitoring reports (DMR) provide a key source of effluent quality data. In some instances, dischargers may also be required in the permit to assess the impact of their discharge on the receiving water. A monitoring requirement can be put into the permit as a special condition as long as the information is collected for purposes of writing a permit limit.

States should also ensure that effective monitoring programs are in place for evaluating nonpoint source control measures. EPA recognizes monitoring as a high-priority activity in a State's nonpoint source management program (55 F.R. 35262, August 28, 1990). To facilitate the implementation and evaluation of NPS controls, States should consult current guidance (USEPA, 1991g); (USEPA, 1993b). States are also encouraged to use innovative monitoring programs (e.g.,rapid bioassessments (USEPA, 1989e), and volunteer monitoring (USEPA, 1990b) to provide for adequate point and nonpoint source monitoring coverage.

Dischargers are monitored to determine whether or not they are meeting their permit conditions and to ensure that expected water quality improvements are achieved. If a State has not been delegated authority for the NPDES permit program, compliance reviews of all permittees in that State are the responsibility of EPA. EPA retains oversight responsibility for State compliance programs in NPDES-delegated States. NPDES permits also contain self-monitoring requirements that are the responsibility of the individual discharger. Data obtained through self-monitoring are reported to the appropriate regulatory agency.

Based on a review of data, EPA or a State regulatory agency determines whether or not a NPDES permittee has complied with the requirements of the NPDES permit. If a facility has been identified as having apparent violations, EPA or the State will review the facility's compliance history. This review focuses on the magnitude, frequency, and duration of violations. A determination of the appropriate enforcement response is then made. EPA and States are authorized to bring civil or criminal action against facilities that violate their NPDES permits. State nonpoint source programs are enforced under State law and to the extent provided by State law.

Once control measures have been implemented, the impaired waters should be assessed to determine if water quality standards have been attained or are no longer threatened. The monitoring program used to gather the data for this assessment should be designed based on the specific pollution problems or sources. For example, it is difficult to ensure, *a priori*, that implementing nonpoint source controls will achieve expected load reductions due to inadequate selection of practices or measures, inadequate design or implementation, or lack of full participation by all contributing nonpoint sources (USEPA, 1987e). As a result, long-

term monitoring efforts must be consistent over time to develop a data base adequate for analysis of control actions.

7.8 Measure Progress

If the water body achieves the applicable State water quality standards, the water body may be removed from the 303(d) list of waters still needing TMDLs. If the water quality standards are not met, the TMDL and allocations of load and waste loads must be modified. This modification should be based on the additional data and information gathered as required by the phased approach for developing a TMDL, where appropriate; as part of routine monitoring activities; and when assessing the water body for water quality standards attainment.

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APPENDIX A

Water Quality Standards Regulation

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

Water Quality Standards Regulation

(40 CFR 131; 48 FR 51405, Nov. 8, 1983; Revised through July 1, 1991; amended at 56 FR 64893, Dec. 12, 1991; 57 FR 60910, Dec. 22, 1992)

TITLE 40—PROTECTION OF ENVIRONMENT

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

SUBCHAPTER D—WATER PROGRAMS

PART 131—WATER QUALITY STANDARDS

Authority: 33 U.S.C. 1251 *et seq.*

[Amended at 56 FR 64893, Dec. 12, 1991; 57 FR 60910, Dec. 22, 1992]

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Subpart A—General Provisions

§131.1 Scope.

This part describes the requirements and procedures for developing, reviewing, revising and approving water quality standards by the States as authorized by section 303(c) of the Clean Water Act. The reporting or recordkeeping (information) provisions in this rule were approved by the Office of Management and Budget under 3504(b) of the Paperwork Reduction Act of 1980, U.S.C. 3501 *et seq.* (Approval number 2040-0049).

§131.2 Purpose.

A water quality standard defines the water quality goals of a water body, or portion thereof, by designating the use or uses to be made of the water and by setting criteria necessary to protect the uses. States adopt water quality standards to protect public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act (the Act). "Serve the purposes of the Act" (as defined in sections 101(a)(2) and 303(c) of the Act) means that water quality standards should, wherever attainable, provide water quality for the protection and propagation of fish, shellfish and wildlife and for recreation in and on the water and take into consideration their use and value of public water supplies, propagation of fish, shellfish, and wildlife, recreation in and on the water, and agricultural, industrial, and other purposes including navigation.

Such standards serve the dual purposes of establishing the water quality goals for a specific water body and serve as the regulatory basis for the establishment of water-quality-based treatment controls and strategies beyond the technology-based levels of treatment required by sections 301(b) and 306 of the Act.

§131.3 Definitions.

(a) *The Act* means the Clean Water Act (Pub. L. 92-500 , as amended, (33 U.S.C. 1251 *et seq.*)).

(b) *Criteria* are elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated use.

(c) *Section 304(a) criteria* are developed by EPA under authority of section 304(a) of the Act based on the latest scientific information on the relationship that the effect of a constituent concentration has on particular aquatic species and/or human health. This information is issued periodically to the States as guidance for use in developing criteria.

(d) *Toxic pollutants* are those pollutants listed by the Administrator under section 307(a) of the Act.

(e) *Existing uses* are those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards.

(f) *Designated uses* are those uses specified in water quality standards for each

water body or segment whether or not they are being attained.

(g) *Use attainability analysis* is a structured scientific assessment of the factors affecting the attainment of the use which may include physical, chemical, biological, and economic factors as described in §131.10(g).

(h) *Water quality limited segment* means any segment where it is known that water quality does not meet applicable water quality standards, and/or is not expected to meet applicable water quality standards, even after the application of the technology-bases effluent limitations required by sections 301(b) and 306 of the Act.

(i) *Water quality standards* are provisions of State or Federal law which consist of a designated use or uses for the waters of the United States and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the Act.

[§131.3(j)--(l) added at 56 FR 64893, Dec. 12, 1991]

(j) *States* include: The 50 States, the District of Columbia, Guam, the Commonwealth of Puerto Rico, Virgin Islands, American Samoa, the Trust Territory of the Pacific Islands, the Commonwealth of the Northern Mariana Islands, and Indian Tribes that EPA determines qualify for treatment as States for purposes of water quality standards.

(k) *Federal Indian Reservation, Indian Reservation,* or *Reservation* means all land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, and including rights-of-way running through the reservation."

(l) *Indian Tribe* or *Tribe* means any Indian Tribe, band, group, or community recognized by the Secretary of the Interior and exercising governmental authority over a Federal Indian reservation.

§131.4 State authority.

(a) States (as defined in §131.3) are responsible for reviewing, establishing, and revising water quality standards. As recognized by section 510 of the Clean Water Act, States may develop water quality standards more stringent than required by this regulation. Consistent with section 101(g) and 518(a) of the Clean Water Act, water quality standards shall not be construed to superseder or abrogate rights to quantities of water.

(b) States (as defined in §131.3) may issue certifications pursuant to the requirements of Clean Water Act section 401. Revisions adopted by States shall be applicable for use in issuing State certifications consistent with the provisions of §131.21(c).

(c) Where EPA determines that a Tribe qualifies for treatment as a State for purposes of water quality standards, the Tribe likewise qualifies for treatment as a State for purposes of certifications conducted under Clean Water Act section 401.

[§131.4 revised at 56 FR 64893, Dec. 12, 1991]

§131.5 EPA authority.

[§131.5 former paragraphs (a)—(e) redesignated as new (a) and (a)(1)—(a)(5) at 56 FR 64893, Dec. 12, 1991]

(a) Under section 303(c) of the Act, EPA is to review and to approve or disapprove State-adopted water quality standards. The review involves a determination of:

(1) Whether the State has adopted water uses which are consistent with the requirements of the Clean Water Act;

(2) Whether the state has adopted criteria that protect the designated water uses;

(3) Whether the State has followed its legal procedures for revising or adopting standards;

(4) Whether the State standards which do not include the uses specified in section 101(a)(2) of the Act are based upon appropriate technical and scientific data and analyses, and

(5) Whether the State submission meets the requirements included in §131.6 of this part. If EPA determines that State water quality standards are consistent with the factors listed in paragraphs (a) through (e) of this section, EPA approves the standards. EPA must disapprove the State water quality standards under section 303(c)(4) of the Act, if State adopted standards are not consistent with the factors listed in paragraphs (a) through (e) of this section. EPA may also promulgate a new or revised standard where necessary to meet the requirements of the Act.

(b) Section 401 of the Clean Water Act authorizes EPA to issue certifications pursuant to the requirements of section 401 in any case where a State or interstate agency has no authority for issuing such certifications.

[§131.5(b) added at 56 FR 64893, Dec. 12, 1991]

§131.6 Minimum requirements for water quality standards submission.

The following elements must be included in each State's water quality standards submitted to EPA for review:

(a) Use designations consistent with the provisions of sections 101(a)(2) and 303(c)(2) of the Act.

(b) Methods used and analyses conducted to support water quality standards revisions.

(c) Water quality criteria sufficient to protect the designated uses.

(d) An antidegradation policy consistent with §131.12.

(e) Certification by the State Attorney General or other appropriate legal authority within the State that the water quality standards were duly adopted pursuant to State law.

(f) General information which will aid the Agency in determining the adequacy of the scientific basis of the standards which do not include the uses specified in section 101(a)(2) of the Act as well as information on general policies applicable to State standards which may affect their application and implementation.

§131.7 Dispute resolution mechanism.

(a) Where disputes between States and Indian Tribes arise as a result of differing water quality standards on common bodies of water, the lead EPA Regional Administrator, as determined based upon OMB circular A-105, shall be responsible for acting in accordance with the provisions of this section.

(b) The Regional Administrator shall attempt to resolve such disputes where:

(1) The difference in water quality standards results in unreasonable consequences;

(2) The dispute is between a State (as defined in §131.3(j) but exclusive of all Indian Tribes) and a Tribe which EPA has determined qualifies to be treated as a State for purposes of water quality standards;

(3) A reasonable effort to resolve the dispute without EPA involvement has been made;

(4) The requested relief is consistent with the provisions of the Clean Water Act and other relevant law;

(5) The differing State and Tribal water quality standards have been adopted pursuant to State and Tribal law and approved by EPA: and

(6) A valid written request has been submitted by either the Tribe or the State.

(c) Either a State or a Tribe may request EPA to resolve any dispute which satisfies the criteria of paragraph (b) of this section. Written requests for EPA involvement should be submitted to the lead Regional Administrator and must include:

(1) A concise statement of the unreasonable consequences that are alleged to have arisen because of differing water quality standards;

(2) A concise description of the actions which have been taken to resolve the dispute without EPA involvement;

(3) A concise indication of the water quality standards provision which has resulted in the alleged unreasonable consequences;

(4) Factual data to support the alleged unreasonable consequences; and

(5) A statement of the relief sought from the alleged unreasonable consequences.

(d) Where, in the Regional Administrator's judgment, EPA involvement is appropriate based on the factors of paragraph (b) of this section, the Regional Administrator shall, within 30 days, notify the parties in writing that he/she is initiating an EPA dispute resolution action and solicit their written response. The Regional Administrator shall also make reasonable efforts to ensure that other interested individuals or groups have notice of this action. Such efforts shall include but not be limited to the following:

(1) Written notice to responsible Tribal and State Agencies, and other affected Federal Agencies,

(2) Notice to the specific individual or entity that is alleging that an unreasonable consequence is resulting from differing standards having been adopted on a common body of water,

(3) Public notice in local newspapers, radio, and television, as appropriate,

(4) Publication in trade journal newsletters, and

(5) Other means as appropriate.

(e) If in accordance with applicable State and Tribal law an Indian Tribe and State have entered into an agreement that resolves the dispute or establishes a mechanism for resolving a dispute, EPA shall defer to this agreement where it is consistent with the Clean Water Act and where it has been approved by EPA.

(f) EPA dispute resolution actions shall be consistent with one or a combination of the following options:

(1) *Mediation.* The Regional Administrator may appoint a mediator to mediate the dispute. Mediators shall be EPA employees, employees from other Federal agencies, or other individuals with appropriate qualifications.

(i) Where the State and Tribe agree to participate in the dispute resolution process, mediation with the intent to establish Tribal-State agreements, consistent with Clean Water Act section 518(d) shall normally be pursued as a first effort.

(ii) Mediators shall act as neutral facilitators whose function is to encourage communication and negotiation between all parties to the dispute.

(iii) Mediators may establish advisory panels, to consist in part of representatives from the affected parties, to study the problem and recommend an appropriate solution.

(iv) The procedure and schedule for mediation of individual disputes shall be determined by the mediator in consultation with the parties.

(v) If formal public hearings are held in connection with the actions taken under this paragraph, Agency requirements at 40 CFR 25.5 shall be followed.

(2) *Arbitration.* Where the parties to the dispute agree to participate in the dispute resolution process, the Regional Administrator may appoint an arbitrator or arbitration panel to arbitrate the dispute. Arbitrators and panel members shall be EPA employees, employees from other Federal agencies, or other individuals with appropriate qualifications. The Regional administrator shall select as arbitrators and arbitration panel members individuals who are agreeable to all parties, are knowledgeable concerning the requirements of the water quality standards program, have a basic understanding of the political and economic interests of Tribes and States involved, and are expected to fulfill the duties fairly and impartially.

(i) The arbitrator or arbitration panel shall conduct one or more private or public meetings with the parties and actively solicit information pertaining to the effects of differing water quality permit requirements on upstream and downstream dischargers, comparative risks to public health and the environment, economic impacts, present and historical water uses, the quality of the waters subject to such standards, and other factors relevant to the dispute such as whether proposed water quality criteria are more stringent than necessary to support designated uses, more stringent than natural background water quality or whether designated uses are reasonable given natural background water quality.

(ii) Following consideration of relevant factors as defined in paragraph (f)(2)(i) of this section, the arbitrator or arbitration panel shall have the authority and responsibility to provide all parties and the Regional Administrator with a written recommendation for resolution of the dispute. Arbitration panel recommendations shall, in general, be reached by majority vote. However, where the parties agree to binding arbitration, or where required by the Regional Administrator, recommendations of such arbitration panels may be unanimous decisions. Where binding or non-binding arbitration panels cannot reach a unanimous recommendation after a reasonable period of time, the Regional Administrator may direct the panel to issue a non-binding decision by majority vote.

(iii) The arbitrator or arbitration panel members may consult with EPA's Office of General Counsel on legal issues, but otherwise shall have no *ex parte* communications pertaining to the dispute. Federal employees who are arbitrators or arbitration panel members shall be neutral and shall not be predisposed for or against the position of any disputing party based on any Federal Trust responsibilities which their employers may have with respect to the Tribe. In addition, arbitrators or arbitration panel members who are Federal employees shall act independently from the normal hierarchy within their agency.

(iv) The parties are not obligated to abide by the arbitrator's or arbitration

panel's recommendation unless they voluntarily entered into a binding agreement to do so.

(v) If a party to the dispute believes that the arbitrator or arbitration panel has recommended an action contrary to or inconsistent with the Clean Water Act, the party may appeal the arbitrator's recommendation to the Regional Administrator. The request for appeal must be in writing and must include a description of the statutory basis for altering the arbitrator's recommendation.

(vi) The procedure and schedule for arbitration of individual disputes shall be determined by the arbitrator or arbitration panel in consultation with parties.

(vii) If formal public hearings are held in connection with the actions taken under this paragraph. Agency requirements at 40 CFR 25.5 shall be followed.

(3) *Dispute Resolution Default Procedure.* Where one or more parties (as defined in paragraph (g) of this section) refuse to participate in either the mediation or arbitration dispute resolution processes, the Regional Administrator may appoint a single official or panel to review available information pertaining to the dispute and to issue a written recommendation for resolving the dispute. Review officials shall be EPA employees, employees from other Federal agencies, or other individuals with appropriate qualifications. Review panels shall include appropriate members to be selected by the Regional Administrator in consultation with the participating parties. Recommendations of such review officials or panels shall, to the extent possible given the lack of participation by one or more parties, be reached in a manner identical to that for arbitration of disputes specified in paragraphs (f)(2)(i) through (f)(2)(vii) of this section.

(g) *Definitions.* For the purposes of this section:

(1) *Dispute Resolution Mechanism* means the EPA mechanism established pursuant to the requirements of Clean Water Act section 518(e) for resolving unreasonable consequences that arise as a result of differing water quality standards that may be set by States and Indian Tribes located on common bodies of water.

(2) *Parties* to a State-Tribal dispute include the State and the Tribe and may, at the discretion of the Regional Administrator, include an NPDES permittee, citizen, citizen group, or other affected entity.

[§131.7 added at 56 FR 64893, Dec. 12, 1991]

§131.8 Requirements for Indian Tribes to be treated as States for purposes of water quality standards.

(a) The Regional Administrator, as determined based on OMB Circular A105, may treat an Indian Tribe as a State for purposes of the water quality standards program if the Tribe meets the following criteria:

(1) The Indian Tribe is recognized by the Secretary of the Interior and meets the definitions in §131.3(k) and (l),

(2) The Indian Tribe has a governing body carrying out substantial governmental duties and powers,

(3) The water quality standards program to be administered by the Indian Tribe pertains to the management and protection of water resources which are within the borders of the Indian reservation and held by the Indian Tribe, within the borders of the Indian reservation and held by the United States in trust for Indians, within the borders of the Indian reservation and held by a member of the Indian Tribe if such property interest is subject to a trust restriction on alienation, or otherwise within the borders of the Indian reservation, and

(4) The Indian Tribe is reasonably expected to be capable, in the Regional Administrator's judgment, of carrying out the functions of an effective water quality standards program in a manner consistent with the terms and purposes of the Act and applicable regulations.

(b) Requests by Indian Tribes for treatment as States for purposes of water quality standards should be submitted to the lead EPA Regional Administrator. The application shall include the following information:

(1) A statement that the Tribe is recognized by the Secretary of the Interior.

(2) A descriptive statement demonstrating that the Tribal governing body is currently carrying out substantial governmental duties and powers over a defined area. The statement shall:

(i) Describe the form of the Tribal government;

(ii) Describe the types of governmental functions currently performed by the Tribal governing body such as, but not limited to, the exercise of police powers affecting (or relating to) the health, safety, and welfare of the affected population, taxation, and the exercise of the power of eminent domain; and

(iii) Identify the source of the Tribal government's authority to carry out the governmental functions currently being performed.

(3) A descriptive statement of the Indian Tribe's authority to regulate water quality. The statement shall include:

(i) A map or legal description of the area over which the Indian Tribe asserts authority to regulate surface water quality;

(ii) A statement by the Tribe's legal counsel (or equivalent official) which describes the basis for the Tribes assertion of authority;

(iii) A copy of all documents such as Tribal constitutions, by-laws, charters, executive orders, codes, ordinances, and/or resolutions which support the Tribe's assertion of authority; and

(iv) an identification of the surface water for which the Tribe proposes to establish water quality standards.

(4) A narrative statement describing the capability of the Indian Tribe to administer an effective water quality standards program. The narrative statement shall include:

(i) A description of the Indian Tribe's previous management experience including, but not limited to, the administration of programs and services authorized by the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450 *et seq.*), the Indian Mineral Development Act (25 U.S.C. 2101 *et seq.*), or the Indian Sanitation Facility Construction Activity Act (42 U.S.C. 2004a);

(ii) A list of existing environmental or public health programs administered by the Tribal governing body and copies of related Tribal laws, policies, and regulations;

(iii) A description of the entity (or entities) which exercise the executive, legislative, and judicial functions of the Tribal government;

(iv) A description of the existing or proposed, agency of the Indian Tribe which will assume primary responsibility for establishing, reviewing, implementing and revising water quality standards;

(v) A description of the technical and administrative capabilities of the staff to

administer and manage an effective water quality standards program or a plan which proposes how the Tribe will acquire additional administrative and technical expertise. The plan must address how the Tribe will obtain the funds to acquire the administrative and technical expertise.

(5) Additional documentation required by the Regional Administrator which, in the judgment of the Regional Administrator, is necessary to support a Tribal request for treatment as a State.

(6) Where the Tribe has previously qualified for treatment as a State under a Clean Water Act or Safe Drinking Water Act program, the Tribe need only provide the required information which has not been submitted in a previous treatment as a State application.

(c) Procedure for processing an Indian Tribe's application for treatment as a State.

(1) The Regional Administrator shall process an application of an Indian Tribe for treatment as a State submitted pursuant to 131.8(b) in a timely manner. He shall promptly notify the Indian Tribe of receipt of the application.

(2) Within 30 days after receipt of the Indian Tribe's application for treatment as a State, the Regional Administrator shall provide appropriate notice. Notice shall:

(i) Include information on the substance and basis of the Tribe's assertion of authority to regulate the quality of reservation waters; and

(ii) Be provided to all appropriate governmental entities.

(3) The Regional Administrator shall provide 30 days for comments to be submitted on the Tribal application. Comments shall be limited to the Tribe's assertion of authority.

(4) If a Tribe's asserted authority is subject to a competing or conflicting claim, the Regional Administrator, after consultation with the Secretary of the Interior, or his designee, and in consideration of other comments received, shall determine whether the Tribe has adequately demonstrated that it meets the requirements of 131.8(a)(3).

(5) Where the Regional Administrator determines that a Tribe meets the requirements of this section, he shall promptly provide written notification to the Indian Tribe that the Tribe has qualified to be treated as a State for purposes of water quality standards and that the Tribe may initiate the formulation and adoption of water quality standards approvable under this part.

[§131.8 added at 56 FR 64893, Dec. 12, 1991]

Subpart B—Establishment of Water Quality Standards

§131.10 Designation of uses.

(a) Each State must specify appropriate water uses to be achieved and protected. The classification of the waters of the State must take into consideration the use and value of water for public water supplies, protection and propagation of fish, shellfish and wildlife, recreation in and on the water, agricultural, industrial, and other purposes including navigation. In no case shall a State adopt waste transport or waste assimilation as a designated use for any waters of the United States.

(b) In designating uses of a water body and the appropriate criteria for those uses, the State shall take into consideration the water quality standards of downstream waters and shall ensure that its water quality standards provide for the attainment and maintenance of the water quality standards of downstream waters.

(c) States may adopt sub-categories of a use and set the appropriate criteria to reflect varying needs of such sub-categories of uses, for instance, to differentiate between cold water and warm water fisheries.

(d) At a minimum, uses are deemed attainable if they can be achieved by the imposition of effluent limits required under sections 301(b) and 306 of the Act and cost-effective and reasonable best management practices for nonpoint source control.

(e) Prior to adding or removing any use, or establishing sub-categories of a use, the State shall provide notice and an opportunity for a public hearing under §131.20(b) of this regulation.

(f) States may adopt seasonal uses as an alternative to reclassifying a water body or segment thereof to uses requiring less stringent water quality criteria. If seasonal uses are adopted, water quality criteria should be adjusted to reflect the seasonal uses, however, such criteria shall not preclude the attainment and maintenance of a more protective use in another season.

(g) States may remove a designated use which is *not* an existing use, as defined in §131.3, or establish sub-categories of a use if the State can demonstrate that attaining the designated use is not feasible because:

(1) Naturally occurring pollutant concentrations prevent the attainment of the use; or

(2) Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or

(3) Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or

(4) Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or

(5) Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or

(6) Controls more stringent than those required by sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact.

(h) States may not remove designated uses if:

(1) They are existing uses, as defined in §131.3, unless a use requiring more stringent criteria is added; or

(2) Such uses will be attained by implementing effluent limits required under sections 301(b) and 306 of the Act and by implementing cost-effective and reasonable best management practices for nonpoint source control.

(i) Where existing water quality standards specify designated uses less than those which are presently being attained, the State shall revise its standards to reflect the uses actually being attained.

(j) A State must conduct a use attainability analysis as described in §131.3(g) whenever:

(1) The State designates or has designated uses that do not include the uses specified in section 101(a)(2) of the Act, or

(2) The State wishes to remove a designated use that is specified in section 101(a)(2) of the Act or to adopt subcategories of uses specified in section 101(a)(2) of the Act which require less stringent criteria.

(k) A State is not required to conduct a use attainability analysis under this regulation whenever designating uses which include those specified in section 101(a)(2) of the Act.

§131.11 Criteria.

(a) *Inclusion of pollutants:*

(1) States must adopt those water quality criteria that protect the designated use. Such criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use. For waters with multiple use designations, the criteria shall support the most sensitive use.

(2) *Toxic pollutants.* States must review water quality data and information on discharges to identify specific water bodies where toxic pollutants may be adversely affecting water quality or the attainment of the designated water use or where the levels of toxic pollutants are at a level to warrant concern and must adopt criteria for such toxic pollutants applicable to the water body sufficient to protect the designated use. Where a State adopts narrative criteria for toxic pollutants to protect designated uses, the State must provide information identifying the method by which the State intends to regulate point source discharges of toxic pollutants on water quality limited segments based on such narrative criteria. Such information may be included as part of the standards or may be included in documents generated by the State in response to the Water Quality Planning and Management Regulations (40 CFR part 35).

(b) Form of criteria: In establishing criteria, States should:

(1) Establish numerical values based on:

(i) 304(a) Guidance; or

(ii) 304(a) Guidance modified to reflect site-specific conditions; or

(iii) Other scientifically defensible methods;

(2) Establish narrative criteria or criteria based upon biomonitoring methods where numerical criteria cannot be established or to supplement numerical criteria.

§131.12 Antidegradation policy.

(a) The State shall develop and adopt a statewide antidegradation policy and identify the methods for implementing such policy pursuant to this subpart. The antidegradation policy and implementation methods shall, at a minimum, be consistent with the following:

(1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

(2) Where the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control.

(3) Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.

(4) In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with section 316 of the Act.

§131.13 General policies.

States may, at their discretion, include in their State standards, policies generally affecting their application and implementation, such as mixing zones, low flows and variances. Such policies are subject to EPA review and approval.

Subpart C—Procedures for Review and Revision of Water Quality Standards

§131.20 State review and revision of water quality standards.

(a) *State review.* The State shall from time to time, but at least once every three years, hold public hearings for the purpose of reviewing applicable water quality standards and, as appropriate, modifying and adopting standards. Any water body segment with water quality standards that do not include the uses specified in section 101(a)(2) of the Act shall be re-examined every three years to determine if any new information has become available. If such new information indicates that the uses specified in section 101(a)(2) of the Act are attainable, the State shall revise its standards accordingly. Procedures States establish for identifying and reviewing water bodies for review should be incorporated into their Continuing Planning Process.

(b) *Public participation.* The State shall hold a public hearing for the purpose of reviewing water quality standards, in accordance with provisions of State law, EPA's water quality management regulation (40 CFR 130.3(b)(6)) and public participation regulation (40 CFR part 25). The proposed water quality standards revision and supporting analyses shall be made available to the public prior to the hearing.

(c) *Submittal to EPA.* The State shall submit the results of the review, any supporting analysis for the use attainability analysis, the methodologies used for site-specific criteria development, any general policies applicable to water quality standards and any revisions of the standards to the Regional Administrator for review and approval, within 30 days of the final State action to adopt and certify the revised standard, or if no revisions are made as a result of the review, within 30 days of the completion of the review.

§131.21 EPA review and approval of water quality standards.

(a) After the State submits its officially adopted revisions, the Regional Administrator shall either:

(1) Notify the State within 60 days that the revisions are approved, or

(2) Notify the State within 90 days that the revisions are disapproved. Such

notification of disapproval shall specify the changes needed to assure compliance with the requirements of the Act and this regulation, and shall explain why the State standard is not in compliance with such requirements. Any new or revised State standard must be accompanied by some type of supporting analysis.

(b) The Regional Administrator's approval or disapproval of a State water quality standard shall be based on the requirements of the Act as described in §§131.5, and 131.6.

(c) A State water quality standard remains in effect, even though disapproved by EPA, until the State revises it or EPA promulgates a rule that supersedes the State water quality standard.

(d) EPA shall, at least annually, publish in the FEDERAL REGISTER a notice of approvals under this section.

§131.22 EPA promulgation of water quality standards.

(a) If the State does not adopt the changes specified by the Regional Administrator within 90 days after notification of the Regional Administrator's disapproval, the Administrator shall promptly propose and promulgate such standard.

(b) The Administrator may also propose and promulgate a regulation, applicable to one or more States, setting forth a new or revised standard upon determining such a standard is necessary to meet the requirements of the Act.

(c) In promulgating water quality standards, the Administrator is subject to the same policies, procedures, analyses, and public participation requirements established for States in these regulations.

Subpart D—Federally Promulgated Water Quality Standards

§131.31 Arizona.

(a) Article 6, Part 2 is amended as follows:

(1) Reg. 6-2-6.11 shall read:

Reg. 6-2-6.11 Nutrient Standards A. The mean annual total phosphate and mean annual total nitrate concentrations of the following waters shall not exceed the values given below nor shall the total phosphate or total nitrate concentrations of more than 10 percent of the samples in any year exceed the 90 percent values given below. Unless otherwise specified, indicated values also apply to tributaries to the named waters.

	Mean 90 pct annual value	
	Total phosphates as PO_4 mg/l	Total nitrates as NO_3 mg/l
1 Colorado River from Utah border to Willow Beach (main stem)	0 04-0 06	4-7
2 Colorado River from Willow Beach to Parker Dam (main stem)	0 06-0 10	5
3 Colorado River from Parker Dam to Imperial Dam (main stem)	0 08-0 12	5-7
4 Colorado River from Imperial Dam to Morelos Dam (main stem)	0.10-0.10	5-7
5 Gila River from New Mexico border to San Carlos Reservoir (excluding San Carlos Reservoir)	0 50-0 80	
6 Gila River from San Carlos Reservoir to Ashurst Hayden Dam (including San Carlos Reservoir).	0 30-0 50	
7 San Pedro River	0 30-0 50	
8 Verde River (except Granite Creek)	0 20-0 30	
9 Salt River above Roosevelt Lake	0 20-0 30	
10 Santa Cruz River from international boundary near Nogales to Sahuarita	0 50-0 80	
11 Little Colorado River above Lyman Reservoir	0 30-0 50	

B The above standards are intended to protect the beneficial uses of the named waters. Because regulation of nitrates and phosphates alone may not be adequate to protect waters from eutrophication, no substance shall be added to any surface water which produces aquatic growth to the extent that such growths create a public nuisance or interference with beneficial uses of the water defined and designated in Reg 6-2-6 5

(2) Reg. 6-2-6.10 Subparts A and B are amended to include Reg. 6-2-6.11 in series with Regs. 6-2-6.6, 6-2-6.7 and 6-2-6.8.

§131.33 [Reserved]

§131.34 [Reserved]

§131.35 Colville Confederated Tribes Indian Reservation.

The water quality standards applicable to the waters within the Colville Indian Reservation, located in the State of Washington.

(a) *Background.*

(1) It is the purpose of these Federal water quality standards to prescribe minimum water quality requirements for the surface waters located within the exterior boundaries of the Colville Indian Reservation to ensure compliance with section 303(c) of the Clean Water Act.

(2) The Colville Confederated Tribes have a primary interest in the protection, control, conservation, and utilization of the water resources of the Colville Indian Reservation. Water quality standards have been enacted into tribal law by the Colville Business Council of the Confederated Tribes of the Colville Reservation, as the Colville Water Quality Standards Act, CTC Title 33 (Resolution No. 1984-526 (August 6, 1984) as amended by Resolution No. 1985-20 (January 18, 1985)).

(b) *Territory Covered.* The provisions of these water quality standards shall apply to all surface waters within the exterior boundaries of the Colville Indian Reservation.

(c) *Applicability, Administration and Amendment.*

(1) The water quality standards in this section shall be used by the Regional Administrator for establishing any water quality based National Pollutant Discharge Elimination System Permit (NPDES) for point sources on the Colville Confederated Tribes Reservation.

(2) In conjunction with the issuance of section 402 or section 404 permits, the Regional Administrator may designate mixing zones in the waters of the United States on the reservation on a case-by-case basis. The size of such mixing zones and the in-zone water quality in such mixing zones shall be consistent with the applicable procedures and guidelines in EPA's Water Quality Standards Handbook and the Technical Support Document for Water Quality Based Toxics Control.

(3) Amendments to the section at the request of the Tribe shall proceed in the following manner.

(i) The requested amendment shall first be duly approved by the Confederated Tribes of the Colville Reservation (and so certified by the Tribes Legal Counsel) and submitted to the Regional Administrator.

(ii) The requested amendment shall be reviewed by EPA (and by the State of Washington, if the action would affect a boundary water).

(iii) If deemed in compliance with the Clean Water Act, EPA will propose and promulgate an appropriate change to this section.

(4) Amendment of this section at EPA's initiative will follow consultation with the Tribe and other appropriate entities. Such amendments will then follow normal EPA rulemaking procedures.

(5) All other applicable provisions of this part 131 shall apply on the Colville Confederated Tribes Reservation. Special attention should be paid to §§131.6, 131.10, 131.11 and 131.20 for any amendment to these standards to be initiated by the Tribe.

(6) All numeric criteria contained in this section apply at all in-stream flow rates greater than or equal to the flow rate calculated as the minimum 7-consecutive day average flow with a recurrence frequency of once in ten years (7Q10); narrative criteria (§131.35(e)(3)) apply regardless of flow. The 7Q10 low flow shall be calculated using methods recommended by the U.S. Geological Survey.

(d) *Definitions.*

(1) "Acute toxicity" means a deleterious response (e.g., mortality, disorientation, immobilization) to a stimulus observed in 96 hours or less.

(2) "Background conditions" means the biological, chemical, and physical conditions of a water body, upstream from the point or non-point source discharge under consideration. Background sampling location in an enforcement action will be upstream from the point of discharge, but not upstream from other inflows. If several discharges to any water body exist, and an enforcement action is being taken for possible violations to the standards, background sampling will be undertaken immediately upstream from each discharge.

(3) "Ceremonial and Religious water use" means activities involving traditional Native American spiritual practices which involve, among other things, primary (direct) contact with water.

(4) "Chronic Toxicity" means the lowest concentration of a constituent causing observable effects (i.e., considering lethality, growth, reduced reproduction, etc.) over a relatively long period of time, usually a 28-day test period for small fish test species.

(5) "Council" or "Tribal Council" means the Colville Business Council of the Colville Confederated Tribes.

(6) "Geometric mean" means the "nth" root of a product of "n" factors.

(7) "Mean retention time" means the time obtained by dividing a reservoir's mean annual minimum total storage by the non-zero 30-day, ten-year low-flow from the reservoir.

(8) "Mixing Zone" or "dilution zone" means a limited area or volume of water where initial dilution of a discharge takes place; and where numeric water quality criteria can be exceeded but acutely toxic conditions are prevented from occurring.

(9) "pH" means the negative logarithm of the hydrogen ion concentration.

(10) "Primary contact recreation" means activities where a person would have direct contact with water to the point of complete submergence, including but not limited to skin diving, swimming, and water skiing.

(11) "Regional Administrator" means the Administrator of EPA's Region X.

(12) "Reservation" means all land within the limits of the Colville Indian Reservation, established on July 2, 1872 by Executive Order, presently containing 1,389,000 acres more or less, and under the jurisdiction of the United States government, notwithstanding the issuance of any patent, and including rights-of-way running through the reservation.

(13) "Secondary contact recreation" means activities where a person's water contact would be limited to the extent that bacterial infections of eyes, ears, respiratory, or digestive systems or urogenital areas would normally be avoided (such as wading or fishing).

(14) "Surface water" means all water above the surface of the ground within the exterior boundaries of the Colville Indian Reservation including but not limited to lakes, ponds, reservoirs, artificial impoundments, streams, rivers, springs, seeps and wetlands.

(15) "Temperature" means water temperature expressed in Centigrade degrees (C).

(16) "Total dissolved solids" (TDS) means the total filterable residue that passes through a standard glass fiber filter disk and remains after evaporation and drying to a constant weight at 180 degrees C. it is considered to be a measure of the dissolved salt content of the water.

(17) "Toxicity" means acute and/or chronic toxicity.

(18) "Tribe" or "Tribes" means the Colville Confederated Tribes.

(19) "Turbidity" means the clarity of water expressed as nephelometric turbidity units (NTU) and measured with a calibrated turbidimeter.

(20) "Wildlife habitat" means the waters and surrounding land areas of the Reservation used by fish, other aquatic life and wildlife at any stage of their life history or activity.

(e) *General considerations.* The following general guidelines shall apply to the water quality standards and classifications set forth in the use designation Sections.

(1) *Classification Boundaries.* At the boundary between waters of different classifications, the water quality standards for the higher classification shall prevail.

(2) *Antidegradation Policy.* This antidegradation policy shall be applicable to all surface waters of the Reservation.

(i) Existing in-stream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

(ii) Where the quality of the waters exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the Regional Administrator finds, after full satisfaction of the inter-governmental coordination and public participation provisions of the Tribes' continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the Regional Administrator shall assure water quality adequate to protect existing uses fully. Further, the Regional Administrator shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control.

(iii) Where high quality waters are identified as constituting an outstanding national or reservation resource, such as waters within areas designated as unique water quality management areas and waters otherwise of exceptional recreational or ecological significance, and are designated as special resource waters, that water quality shall be maintained and protected.

(iv) In those cases where potential water quality impairment associated with a thermal discharge is involved, this antidegradation policy's implementing method shall be consistent with section 316 of the Clean Water Act.

(3) *Aesthetic Qualities.* All waters within the Reservation, including those within mixing zones, shall be free from substances, attributable to wastewater discharges or other pollutant sources, that:

(i) Settle to form objectionable deposits;

(ii) Float as debris, scum, oil, or other matter forming nuisances;

(iii) Produce objectionable color, odor, taste, or turbidity;

(iv) Cause injury to, are toxic to, or produce adverse physiological responses in humans, animals, or plants; or

(v) Produce undesirable or nuisance aquatic life.

(4) *Analytical Methods.*

(i) The analytical testing methods used to measure or otherwise evaluate compliance with water quality standards shall to the extent practicable, be in accordance with the "Guidelines Establishing Test Procedures for the Analysis of Pollutants" (40 CFR part 136). When a testing method is not available for a particular substance, the most recent edition of "Standard Methods for the Examination of Water and Wastewater" (published by the American Public Health Association, American Water Works Association, and the Water Pollution Control Federation) and other or superseding methods published and/or approved by EPA shall be used.

(f) *General Water Use and Criteria Classes.* The following criteria shall apply to the various classes of surface waters on the Colville Indian Reservation:

(1) *Class I (Extraordinary)—*

(i) *Designated uses.* The designated uses include, but are not limited to, the following:

(A) Water supply (domestic, industrial, agricultural).

(B) Stock watering.

(C) Fish and shellfish: Salmonid migration, rearing, spawning, and harvesting; other fish migration, rearing, spawning, and harvesting.

(D) Wildlife habitat.

(E) Ceremonial and religious water use.

(F) Recreation (primary contact recreation, sport fishing, boating and aesthetic enjoyment).

(G) Commerce and navigation.

(ii) *Water quality criteria.*

(A) Bacteriological Criteria—The geometric mean of the enterococci bacteria densities in samples taken over a 30 day period shall not exceed 8 per 100 milliliters, nor shall any single sample exceed an enterococci density of 35 per 100 milliliters. These limits are calculated as the geometric mean of the collected samples approximately equally spaced over a thirty day period.

(B) Dissolved oxygen—The dissolved oxygen shall exceed 9.5 mg/l.

(C) Total dissolved gas—concentrations shall not exceed 110 percent of the saturation value for gases at the existing atmospheric and hydrostatic pressures at any point of sample collection.

(D) Temperature—shall not exceed 16.0 degrees C due to human activities. Temperature increases shall not, at any time, exceed $t=23/(T+5)$.

(*1*) When natural conditions exceed 16.0 degrees C, no temperature increase will be allowed which will raise the receiving water by greater than 0.3 degrees C.

(*2*) For purposes hereof, "t" represents the permissive temperature change across the dilution zone; and "T" represents the highest existing temperature in this water classification outside of any dilution zone.

(*3*) Provided that temperature increase resulting from nonpoint source activities shall not exceed 2.8 degrees C, and the maximum water temperature shall not exceed 10.3 degrees C.

(E) pH shall be within the range of 6.5 to 8.5 with a human-caused variation of less than 0.2 units.

(F) Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

(G) Toxic, radioactive, nonconventional, or deleterious material concentrations shall be less than those of public health significance, or which may cause acute or chronic toxic conditions to the aquatic biota, or which may adversely affect designated water uses.

(2) *Class II (Excellent).—*

(i) *Designated uses.* The designated uses include but are not limited to, the following:

(A) Water supply (domestic, industrial, agricultural).

(B) Stock watering.

(C) Fish and shellfish: Salmonid migration, rearing, spawning, and harvesting; other fish migration, rearing, spawning, and harvesting; crayfish rearing, spawning, and harvesting.

(D) Wildlife habitat.

(E) Ceremonial and religious water use.

(F) Recreation (primary contact recreation, sport fishing, boating and aesthetic enjoyment).

(G) Commerce and navigation.

(ii) *Water quality criteria.*

(A) Bacteriological Criteria—The geometric mean of the enterococci bacteria densities in samples taken over a 30 day period shall not exceed 16/100 ml, nor shall any single sample exceed an enterococci density of 75 per 100 milliliters. These limits are calculated as the geometric mean of the collected samples approximately equally spaced over a thirty day period.

(B) Dissolved oxygen—The dissolved oxygen shall exceed 8.0 mg/l.

(C) Total dissolved gas—concentrations shall not exceed 110 percent of the saturation value for gases at the existing atmospheric and hydrostatic pressures at any point of sample collection.

(D) Temperature—shall not exceed 18.0 degrees C due to human activities. Temperature increases shall not, at any time, exceed $t=28/(T+7)$.

(*1*) When natural conditions exceed 18 degrees C no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3 degrees C.

(*2*) For purposes hereof, "t" represents the permissive temperature change across the dilution zone; and "T" represents the highest existing temperature in this water classification outside of any dilution zone.

(*3*) Provided that temperature increase resulting from non-point source activities shall not exceed 2.8 degrees C, and the maximum water temperature shall not exceed 18.3 degrees C.

(E) pH shall be within the range of 6.5 to 8.5 with a human-caused variation of less than 0.5 units.

(F) Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

(G) Toxic, radioactive, nonconventional, or deleterious material concentrations shall be less than those of public health significance, or which may cause acute or chronic toxic conditions to the aquatic biota, or which may adversely affect designated water uses.

(3) *Class III (Good).*—

(i) *Designated uses.* The designated uses include but are not limited to, the following:

(A) Water supply (industrial, agricultural).

(B) Stock watering.

(C) Fish and shellfish: Salmonid migration, rearing, spawning, and harvesting; other fish migration, rearing, spawning, and harvesting; crayfish rearing, spawning, and harvesting.

(D) Wildlife habitat.

(E) Recreation (secondary contact recreation, sport fishing, boating and aesthetic enjoyment).

(F) Commerce and navigation.

(ii) *Water quality criteria.*

(A) Bacteriological Criteria—The geometric mean of the enterococci bacteria densities in samples taken over a 30 day period shall not exceed 33/100 ml, nor shall any single sample exceed an enterococci density of 150 per 100 milliliters. These limits are calculated as the geometric mean of the collected samples approximately equally spaced over a thirty day period.

(B) Dissolved oxygen.

	Early life stages[1,2]	Other life stages
7 day mean	9 5 (6.5)	[3]NA
1 day minimum[4]	8.0 (5.0)	6.5

[1] These are water column concentrations recommended to achieve the required intergravel dissolved oxygen concentrations shown in parentheses. The 3 mg/L differential is discussed in the dissolved oxygen criteria document (EPA 440/5-86-003, April 1986). For species that have early life stages exposed directly to the water column, the figures in parentheses apply

[2] Includes all embryonic and larval stages and all juvenile forms to 30-days following hatching

[3] NA (not applicable)

[4] All minima should be considered as instantaneous concentrations to be achieved at all times

(C) Total dissolved gas concentrations shall not exceed 110 percent of the saturation value for gases at the existing atmospheric and hydrostatic pressures at any point of sample collection.

(D) Temperature shall not exceed 21.0 degrees C due to human activities. Temperature increases shall not, at any time, exceed t=34/(T+9).

(*1*) When natural conditions exceed 21.0 degrees C no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3 degrees C.

(*2*) For purposes hereof, "t" represents the permissive temperature change across the dilution zone; and "T" represents the highest existing temperature in this water classification outside of any dilution zone.

(*3*) Provided that temperature increase resulting from nonpoint source activities shall not exceed 2.8 degrees C, and the maximum water temperature shall not exceed 21.3 degrees C.

(E) pH shall be within the range of 6.5 to 8.5 with a human-caused variation of less than 0.5 units.

(F) Turbidity shall not exceed 10 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 20 percent increase in turbidity when the background turbidity is more than 50 NTU.

(G) Toxic, radioactive, nonconventional, or deleterious material concentrations shall be less than those of public health significance, or which may cause acute or chronic toxic conditions to the aquatic biota, or which may adversely affect designated water uses.

(4) *Class IV (Fair)*—

(i) *Designated uses.* The designated uses include but are not limited to, the following:

(A) Water supply (industrial).

(B) Stock watering.

(C) Fish (salmonid and other fish migration).

(D) Recreation (secondary contact recreation, sport fishing, boating and aesthetic enjoyment).

(E) Commerce and navigation.

(ii) *Water quality criteria.*

(A) Dissolved oxygen.

	During periods of salmonid and other fish migration	During all other time periods
30 day mean	6.5	5.5
7 day mean	[1]NA	[1]NA
7 day mean minimum	5 0	4 0
1 day minimum[2]	4.0	3.0

[1] NA (not applicable).

[2] All minima should be considered as instantaneous concentrations to be achieved at all times.

(B) Total dissolved gas—concentrations shall not exceed 110 percent of the saturation value for gases at the existing atmospheric and hydrostatic pressures at any point of sample collection.

(C) Temperature shall not exceed 22.0 degrees C due to human activities. Temperature increases shall not, at any time, exceed t=20/(T+2).

(*1*) When natural conditions exceed 22.0 degrees C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3 degrees C.

(*2*) For purposes hereof, "t" represents the permissive temperature change across the dilution zone; and "T" represents the highest existing temperature in this water classification outside of any dilution zone.

(D) pH shall be within the range of 6.5 to 9.0 with a human-caused variation of less than 0.5 units.

(E) Turbidity shall not exceed 10 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 20 percent increase in turbidity when the background turbidity is more than 50 NTU.

(F) Toxic, radioactive, nonconventional, or deleterious material concentrations shall be less than those of public health significance, or which may cause acute or chronic toxic conditions to the aquatic biota, or which may adversely affect designated water uses.

(5) *Lake Class*—

(i) *Designated uses.* The designated uses include but are not limited to, the following:

(A) Water supply (domestic, industrial, agricultural).

(B) Stock watering.

(C) Fish and shellfish: Salmonid migration, rearing, spawning, and harvesting; other fish migration, rearing, spawning, and harvesting; crayfish rearing, spawning, and harvesting.

(D) Wildlife habitat.

(E) Ceremonial and religious water use.

(F) Recreation (primary contact recreation, sport fishing, boating and aesthetic enjoyment).

(G) Commerce and navigation.

(ii) *Water quality criteria.*

(A) Bacteriological Criteria. The geometric mean of the enterococci bacteria densities in samples taken over a 30 day period shall not exceed 33/100 ml, nor shall any single sample exceed an enterococci density of 150 per 100 milliliters. These limits are calculated as the geometric mean of the collected samples approximately equally spaced over a thirty day period.

(B) Dissolved oxygen—no measurable decrease from natural conditions.

(C) Total dissolved gas concentrations shall not exceed 110 percent of the saturation value for gases at the existing atmospheric and hydrostatic pressures at any point of sample collection.

(D) Temperature—no measurable change from natural conditions.

(E) pH—no measurable change from natural conditions.

(F) Turbidity shall not exceed 5 NTU over natural conditions.

(G) Toxic, radioactive, nonconventional, or deleterious material concentrations shall be less than those which may affect public health, the natural aquatic environment, or the desirability of the water for any use.

(6) *Special Resource Water Class (SRW)—*

(i) *General characteristics.* These are fresh or saline waters which comprise a special and unique resource to the Reservation. Water quality of this class will be varied and unique as determined by the Regional Administrator in cooperation with the Tribes.

(ii) *Designated uses.* The designated uses include, but are not limited to, the following:

(A) Wildlife habitat.

(B) Natural foodchain maintenance.

(iii) Water quality criteria.

(A) Enterococci bacteria densities shall not exceed natural conditions.

(B) Dissolved oxygen—shall not show any measurable decrease from natural conditions.

(C) Total dissolved gas shall not vary from natural conditions.

(D) Temperature—shall not show any measurable change from natural conditions.

(E) pH shall not show any measurable change from natural conditions.

(F) Settleable solids shall not show any change from natural conditions.

(G) Turbidity shall not exceed 5 NTU over natural conditions.

(H) Toxic, radioactive, or deleterious material concentrations shall not exceed those found under natural conditions.

(g) *General Classifications.* General classifications applying to various surface waterbodies not specifically classified under §131.35(h) are as follows:

(1) All surface waters that are tributaries to Class I waters are classified Class I, unless otherwise classified.

(2) Except for those specifically classified otherwise, all lakes with existing average concentrations less than 2000 mg/L TDS and their feeder streams on the Colville Indian Reservation are classified as Lake Class and Class I, respectively.

(3) All lakes on the Colville Indian Reservation with existing average concentrations of TDS equal to or exceeding 2000 mg/L and their feeder streams are classified as Lake Class and Class I respectively unless specifically classified otherwise.

(4) All reservoirs with a mean detention time of greater than 15 days are classified Lake Class.

(5) All reservoirs with a mean detention time of 15 days or less are classified the same as the river section in which they are located.

(6) All reservoirs established on pre-existing lakes are classified as Lake Class.

(7) All wetlands are assigned to the Special Resource Water Class.

(8) All other waters not specifically assigned to a classification of the reservation are classified as Class II.

(h) *Specific Classifications.* Specific classifications for surface waters of the Colville Indian Reservation are as follows:

(1) Streams:

Alice Creek	Class III
Anderson Creek	Class III
Armstrong Creek	Class III
Barnaby Creek	Class II
Bear Creek	Class III
Beaver Dam Creek	Class II
Bridge Creek	Class II
Brush Creek	Class III
Buckhorn Creek	Class III
Cache Creek	Class III
Canteen Creek	Class I
Capoose Creek	Class III
Cobbs Creek	Class III
Columbia River from Chief Joseph Dam to Wells Dam	
Columbia River from northern Reservation boundary to Grand Coulee Dam (Roosevelt Lake)	
Columbia River from Grand Coulee Dam to Chief Joseph Dam	
Cook Creek	Class I
Cooper Creek	Class III
Cornstalk Creek	Class III
Cougar Creek	Class I
Coyote Creek	Class II
Deerhorn Creek	Class III
Dick Creek	Class III
Dry Creek	Class I
Empire Creek	Class III
Faye Creek	Class I
Forty Mile Creek	Class III
Gibson Creek	Class I
Gold Creek	Class II
Granite Creek	Class II
Grizzly Creek	Class III
Haley Creek	Class III
Hall Creek	Class II
Hall Creek, West Fork	Class I
Iron Creek	Class III
Jack Creek	Class III
Jerred Creek	Class I
Joe Moses Creek	Class III
John Tom Creek	Class III
Jones Creek	Class I
Kartar Creek	Class III
Kincaid Creek	Class III
King Creek	Class III
Klondyke Creek	Class I
Lime Creek	Class III
Little Jim Creek	Class III
Little Nespelem	Class II
Louie Creek	Class III
Lynx Creek	Class II
Manila Creek	Class III
McAllister Creek	Class III
Meadow Creek	Class III
Mill Creek	Class II
Mission Creek	Class III
Nespelem River	Class II
Nez Perce Creek	Class III
Nine Mile Creek	Class II
Nineteen Mile Creek	Class III
No Name Creek	Class II
North Nanamkin Creek	Class III
North Star Creek	Class III
Okanogan River from Reservation north boundary to Columbia River	Class II
Olds Creek	Class I
Omak Creek	Class II
Onion Creek	Class II
Parmenter Creek	Class III
Peel Creek	Class III
Peter Dan Creek	Class III
Rock Creek	Class I
San Poil River	Class I
Sanpoil, River West Fork	Class II
Seventeen Mile Creek	Class III
Silver Creek	Class III
Sitdown Creek	Class III
Six Mile Creek	Class III
South Nanamkin Creek	Class III
Spring Creek	Class III
Stapaloop Creek	Class III
Stepstone Creek	Class III
Stranger Creek	Class II
Strawberry Creek	Class III
Swimptkin Creek	Class III
Three Forks Creek	Class I
Three Mile Creek	Class III
Thirteen Mile Creek	Class II
Thirty Mile Creek	Class II
Trail Creek	Class III
Twentyfive Mile Creek	Class III
Twentyone Mile Creek	Class III
Twentythree Mile Creek	Class III
Wannacot Creek	Class III

Wells Creek	Class I
Whitelaw Creek	Class III
Wilmont Creek	Class II
(2) Lakes.	
Apex Lake	LC
Big Goose Lake	LC
Bourgeau Lake	LC
Buffalo Lake	LC
Cody Lake	LC
Crawfish Lakes	LC
Camille Lake	LC
Elbow Lake	LC
Fish Lake	LC
Gold Lake	LC
Great Western Lake	LC
Johnson Lake	LC
LaFleur Lake	LC
Little Goose Lake	LC
Little Owhi Lake	LC
McGinnis Lake	LC
Nicholas Lake	LC
Omak Lake	SRW
Owhi Lake	SRW
Penley Lake	SRW
Rebecca Lake	LC
Round Lake	LC
Simpson Lake	LC
Soap Lake	LC
Sugar Lake	LC
Summit Lake	LC
Twin Lakes	SRW

§131.36 Toxics criteria for those states not complying with Clean Water Act section 303(c)(2)(B).

(a) *Scope.* This section is not a general promulgation of the section 304(a) criteria for priority toxic pollutants but is restricted to specific pollutants in specific States.

(b) (1) *EPA's Section 304(a) Criteria for Priority Toxic Pollutants.*

(#)	A COMPOUND	CAS Number	B FRESHWATER Criterion Maximum Conc. d (ug/L) B1	 Criterion Continuous Conc. d (ug/L) B2	C SALTWATER Criterion Maximum Conc. d (ug/L) C1	 Criterion Continuous Conc. d (ug/L) C2	D HUMAN HEALTH (10^{-6} risk for carcinogens) For Consumption of: Water & Organisms (ug/L) D1	 Organisms Only (ug/L) D2
1	Antimony	7440360					14 a	4300 a
2	Arsenic	7440382	360 m	190 m	69 m	36 m	0.018 a,b,c	0.14 a,b,c
3	Beryllium	7440417					n	n
4	Cadmium	7440439	3.9 e,m	1.1 e,m	43 m	9.3 m	n	n
5a	Chromium (III)	16065831	1700 e,m	210 e,m			n	n
b	Chromium (VI)	18540299	16 m	11 m	1100 m	50 m	n	n
6	Copper	7440508	18 e,m	12 e,m	2.9 m	2.9 m		
7	Lead	7439921	82 e,m	3.2 e,m	220 m	8.5 m	n	n
8	Mercury	7439976	2.4 m	0.012 i	2.1 m	0.025 i	0.14	0.15
9	Nickel	7440020	1400 e,m	160 e,m	75 m	8.3 m	610 a	4600 a
10	Selenium	7782492	20	5	300 m	71 m	n	n
11	Silver	7440224	4.1 e,m		2.3 m			
12	Thallium	7440280					1.7 a	6.3 a
13	Zinc	7440666	120 e,m	110 e,m	95 m	86 m		
14	Cyanide	57125	22	5.2	1	1	700 a	220000 a,j
15	Asbestos	1332214					7,000,000 fibers/L k	
16	2,3,7,8-TCDD (Dioxin)	1746016					0.000000013 c	0.000000014 c
17	Acrolein	107028					320	780
18	Acrylonitrile	107131					0.059 a,c	0.66 a,c
19	Benzene	71432					1.2 a,c	71 a,c
20	Bromoform	75252					4.3 a,c	360 a,c
21	Carbon Tetrachloride	56235					0.25 a,c	4.4 a,c
22	Chlorobenzene	108907					680 a	21000 a,j
23	Chlorodibromomethane	124481					0.41 a,c	34 a,c
24	Chloroethane	75003						
25	2-Chloroethylvinyl Ether	110758						
26	Chloroform	67663					5.7 a,c	470 a,c
27	Dichlorobromomethane	75274					0.27 a,c	22 a,c

(#)	A COMPOUND	CAS Number	B FRESHWATER Criterion Maximum Conc. d (ug/L) B1	 Criterion Continuous Conc. d (ug/L) B2	C SALTWATER Criterion Maximum Conc. d (ug/L) C1	 Criterion Continuous Conc. d (ug/L) C2	D HUMAN HEALTH (10^{-6} risk for carcinogens) For Consumption of: Water & Organisms (ug/L) D1	 Organisms Only (ug/L) D2
28	1,1-Dichloroethane	75343						
29	1,2-Dichloroethane	107062					0.38 a,c	99 a,c
30	1,1-Dichloroethylene	75354					0.057 a,c	3.2 a,c
31	1,2-Dichloropropane	78875						
32	1,3-Dichloropropylene	542756					10 a	1700 a
33	Ethylbenzene	100414					3100 a	29000 a
34	Methyl Bromide	74839					48 a	4000 a
35	Methyl Chloride	74873					n	n
36	Methylene Chloride	75092					4.7 a,c	1600 a,c
37	1,1,2,2-Tetrachloroethane	79345					0.17 a,c	11 a,c
38	Tetrachloroethylene	127184					0.8 c	8.85 c
39	Toluene	108883					6800 a	200000 a
40	1,2-Trans-Dichloroethylene	156605						
41	1,1,1-Trichloroethane	71556					n	n
42	1,1,2-Trichloroethane	79005					0.60 a,c	42 a,c
43	Trichloroethylene	79016					2.7 c	81 c
44	Vinyl Chloride	75014					2 c	525 c
45	2-Chlorophenol	95578						
46	2,4-Dichlorophenol	120832					93 a	790 a,j
47	2,4-Dimethylphenol	105679						
48	2-Methyl-4,6-Dinitrophenol	534521					13.4	765
49	2,4-Dinitrophenol	51285					70 a	14000 a
50	2-Nitrophenol	88755						
51	4-Nitrophenol	100027						
52	3-Methyl-4-Chlorophenol	59507						
53	Pentachlorophenol	87865	20 f	13 f	13	7.9	0.28 a,c	8.2 a,c,j
54	Phenol	108952					21000 a	4600000 a,j
55	2,4,6-Trichlorophenol	88062					2.1 a,c	6.5 a,c
56	Acenaphthene	83329						

(#)	A COMPOUND	CAS Number	B FRESHWATER Criterion Maximum Conc. d (ug/L) B1	B FRESHWATER Criterion Continuous Conc. d (ug/L) B2	C SALTWATER Criterion Maximum Conc. d (ug/L) C1	C SALTWATER Criterion Continuous Conc. d (ug/L) C2	D HUMAN HEALTH (10^{-6} risk for carcinogens) For Consumption of: Water & Organisms (ug/L) D1	D HUMAN HEALTH (10^{-6} risk for carcinogens) For Consumption of: Organisms Only (ug/L) D2
57	Acenaphthylene	208968						
58	Anthracene	120127					9600 a	110000 a
59	Benzidine	92875					0.00012 a,c	0.00054 a,c
60	Benzo(a)Anthracene	56553					0.0028 c	0.031 c
61	Benzo(a)Pyrene	50328					0.0028 c	0.031 c
62	Benzo(b)Fluoranthene	205992					0.0028 c	0.031 c
63	Benzo(ghi)Perylene	191242						
64	Benzo(k)Fluoranthene	207089					0.0028 c	0.031 c
65	Bis(2-Chloroethoxy)Methane	111911						
66	Bis(2-Chloroethyl)Ether	111444					0.031 a,c	1.4 a,c
67	Bis(2-Chloroisopropyl)Ether	108601					1400 a	170000 a
68	Bis(2-Ethylhexyl)Phthalate	117817					1.8 a,c	5.9 a,c
69	4-Bromophenyl Phenyl Ether	101553						
70	Butylbenzyl Phthalate	85687						
71	2-Chloronaphthalene	91587						
72	4-Chlorophenyl Phenyl Ether	7005723						
73	Chrysene	218019					0.0028 c	0.031 c
74	Dibenzo(a,h)Anthracene	53703					0.0028 c	0.031 c
75	1,2-Dichlorobenzene	95501					2700 a	17000 a
76	1,3-Dichlorobenzene	541731					400	2600
77	1,4-Dichlorobenzene	106467					400	2600
78	3,3'-Dichlorobenzidine	91941					0.04 a,c	0.077 a,c
79	Diethyl Phthalate	84662					23000 a	120000 a
80	Dimethyl Phthalate	131113					313000	2900000
81	Di-n-Butyl Phthalate	84742					2700 a	12000 a
82	2,4-Dinitrotoluene	121142					0.11 c	9.1 c
83	2,6-Dinitrotoluene	606202						
84	Di-n-Octyl Phthalate	117840						
85	1,2-Diphenylhydrazine	122667					0.040 a,c	0.54 a,c

(#)	A COMPOUND	CAS Number	B FRESHWATER Criterion Maximum Conc. d (ug/L) B1	 Criterion Continuous Conc. d (ug/L) B2	C SALTWATER Criterion Maximum Conc. d (ug/L) C1	 Criterion Continuous Conc. d (ug/L) C2	D HUMAN HEALTH (10^{-6} risk for carcinogens) For Consumption of: Water & Organisms (ug/L) D1	 Organisms Only (ug/L) D2
86	Fluoranthene	206440					300 a	370 a
87	Fluorene	86737					1300 a	14000 a
88	Hexachlorobenzene	118741					0.00075 a,c	0.00077 a,c
89	Hexachlorobutadiene	87683					0.44 a,c	50 a,c
90	Hexachlorocyclopentadiene	77474					240 a	17000 a,j
91	Hexachloroethane	67721					1.9 a,c	8.9 a,c
92	Indeno(1,2,3-cd)Pyrene	193395					0.0028 c	0.031 c
93	Isophorone	78591					8.4 a,c	600 a,c
94	Naphthalene	91203						
95	Nitrobenzene	98953					17 a	1900 a,j
96	N-Nitrosodimethylamine	62759					0.00069 a,c	8.1 a,c
97	N-Nitrosodi-n-Propylamine	621647						
98	N-Nitrosodiphenylamine	86306					5.0 a,c	16 a,c
99	Phenanthrene	85018						
100	Pyrene	129000					960 a	11000 a
101	1,2,4-Trichlorobenzene	120821						
102	Aldrin	309002	3 g		1.3 g		0.00013 a,c	0.00014 a,c
103	alpha-BHC	319846					0.0039 a,c	0.013 a,c
104	beta-BHC	319857					0.014 a,c	0.046 a,c
105	gamma-BHC	58899	2 g	0.08 g	0.16 g		0.019 c	0.063 c
106	delta-BHC	319868						
107	Chlordane	57749	2.4 g	0.0043 g	0.09 g	0.004 g	0.00057 a,c	0.00059 a,c
108	4-4'-DDT	50293	1.1 g	0.001 g	0.13 g	0.001 g	0.00059 a,c	0.00059 a,c
109	4,4'-DDE	72559					0.00059 a,c	0.00059 a,c
110	4,4'-DDD	72548					0.00083 a,c	0.00084 a,c
111	Dieldrin	60571	2.5 g	0.0019 g	0.71 g	0.0019 g	0.00014 a,c	0.00014 a,c
112	alpha-Endosulfan	959988	0.22 g	0.056 g	0.034 g	0.0087 g	0.93 a	2.0 a
113	beta-Endosulfan	33213659	0.22 g	0.056 g	0.034 g	0.0087 g	0.93 a	2.0 a

(#)	A COMPOUND	CAS Number	B FRESHWATER Criterion Maximum Conc. d (ug/L) B1	B FRESHWATER Criterion Continuous Conc. d (ug/L) B2	C SALTWATER Criterion Maximum Conc. d (ug/L) C1	C SALTWATER Criterion Continuous Conc. d (ug/L) C2	D HUMAN HEALTH (10^{-6} risk for carcinogens) For Consumption of: Water & Organisms (ug/L) D1	D HUMAN HEALTH (10^{-6} risk for carcinogens) For Consumption of: Organisms Only (ug/L) D2
114	Endosulfan Sulfate	1031078					0.93 a	2.0 a
115	Endrin	72208	0.18 g	0.0023 g	0.037 g	0.0023 g	0.76 a	0.81 a,j
116	Endrin Aldehyde	7421934					0.76 a	0.81 a,j
117	Heptachlor	76448	0.52 g	0.0038 g	0.053 g	0.0036 g	0.00021 a,c	0.00021 a,c
118	Heptachlor Epoxide	1024573	0.52 g	0.0038 g	0.053 g	0.0036 g	0.00010 a,c	0.00011 a,c
119	PCB-1242	53469219		0.014 g		0.03 g	0.000044 a,c	0.000045 a,c
120	PCB-1254	11097691		0.014 g		0.03 g	0.000044 a,c	0.000045 a,c
121	PCB-1221	11104282		0.014 g		0.03 g	0.000044 a,c	0.000045 a,c
122	PCB-1232	11141165		0.014 g		0.03 g	0.000044 a,c	0.000045 a,c
123	PCB-1248	12672296		0.014 g		0.03 g	0.000044 a,c	0.000045 a,c
124	PCB-1260	11096825		0.014 g		0.03 g	0.000044 a,c	0.000045 a,c
125	PCB-1016	12674112		0.014 g		0.03 g	0.000044 a,c	0.000045 a,c
126	Toxaphene	8001352	0.73	0.0002	0.21	0.0002	0.00073 a,c	0.00075 a,c
Total No. of Criteria (h) =			24	29	23	27	91	90

Footnotes:

a. Criteria revised to reflect current agency q_1^* or RfD, as contained in the Integrated Risk Information System (IRIS). The fish tissue bioconcentration factor (BCF) from the 1980 criteria documents was retained in all cases.

b. The criteria refers to the inorganic form only.

c. Criteria in the matrix based on carcinogenicity (10^{-6} risk). For a risk level of 10^{-5}, move the decimal point in the matrix value one place to the right.

d. Criteria Maximum Concentration (CMC) = the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time (1-hour average) without deleterious effects. Criteria Continuous Concentration (CCC) = the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects, ug/L = micrograms per liter

e. Freshwater aquatic life criteria for these metals are expressed as a function of total hardness (mg/L), and as a function of the pollutant's water effect ratio, WER, as defined in §131.36(c). The equations are provided in matrix at §131.36(b)(2). Values displayed above in the matrix correspond to a total hardness of 100 mg/L and a water effect ratio of 1.0.

f. Freshwater aquatic life criteria for pentachlorophenol are expressed as a function of pH, and are calculated as follows. Values displayed above in the matrix correspond to a pH of 7.8.

CMC = exp(1.005(pH) - 4.830) CCC = exp(1.005(pH) - 5.290)

g. Aquatic life criteria for these compounds were issued in 1980 utilizing the 1980 Guidelines for criteria development. The acute values shown are final acute values (FAV) which by the 1980 Guidelines are instantaneous values as contrasted with a CMC which is a one-hour average.

h. These totals simply sum the criteria in each column. For aquatic life, there are 30 priority toxic pollutants with some type of freshwater or saltwater, acute or chronic criteria. For human health, there are 91 priority toxic pollutants with either "water + fish" or "fish only" criteria. Note that these totals count chromium as one pollutant even though EPA has developed criteria based on two valence states. In the matrix, EPA has assigned numbers 5a and 5b to the criteria for chromium to reflect the fact that the list of 126 priority toxic pollutants includes only a single listing for chromium.

i. If the CCC for total mercury exceeds 0.012 ug/L more than once in a 3-year period in the ambient water, the edible portion of aquatic species of concern must be analyzed to determine whether the concentration of methyl mercury exceeds the FDA action level (1.0 mg/kg). If the FDA action level is exceeded, the State must notify the appropriate EPA Regional Administrator, initiate a revision of its mercury criterion in its water quality standards so as to protect designated uses, and take other appropriate action such as issuance of a fish consumption advisory for the affected area.

j. No criteria for protection of human health from consumption of aquatic organisms (excluding water) was presented in the 1980 criteria document or in the 1986 Quality Criteria for Water. Nevertheless, sufficient information was presented in the 1980 document to allow a calculation of a criterion, even though the results of such a calculation were not shown in the document.

k. The criterion for asbestos is the MCL (56 FR 3526, January 30, 1991).

l. This letter not used as a footnote.

m. Criteria for these metals are expressed as a function of the water effect ratio, WER, as defined in 40 CFR 131.36(c).

CMC = column B1 or C1 value × WER

CCC = column B2 or C2 value × WER

n. EPA is not promulgating human health criteria for this contaminant. However, permit authorities should address this contaminant in NPDES permit actions using the State's existing narrative criteria for toxics.

General Notes:

1. This chart lists all of EPA's priority toxic pollutants whether or not criteria recommendations are available. Blank spaces indicate the absence of criteria recommendations. Because of variations in chemical nomenclature systems, this listing of toxic pollutants does not duplicate the listing in Appendix A of 40 CFR Part 423. EPA has added the Chemical Abstracts Service (CAS) registry numbers, which provide a unique identification for each chemical.

2. The following chemicals have organoleptic based criteria recommendations that are not included on this chart (for reasons which are discussed in the preamble): copper, zinc, chlorobenzene, 2-chlorophenol, 2,4-dichlorophenol, acenaphthene, 2,4-dimethylphenol, 3-methyl-4-chlorophenol, hexachlorocyclopentadiene, pentachlorophenol, phenol

3. For purposes of this rulemaking, freshwater criteria and saltwater criteria apply as specified in 40 CFR 131.36(c).

(2) *Factors for Calculating Metals Criteria*

$$CMC = WER \exp\{m_A[\ln(\text{hardness})] + b_A\}$$

$$CCC = WER \exp\{m_C[\ln(\text{hardness})] + b_C\}$$

CMC=WER exp{m_A[ln(hardness)]+b_A} · CCC=WER exp{m_C[ln(hardness)]+b_C}

	m_A	b_A	m_C	b_C
Cadmium	1.128	-3.828	0.7852	-3.490
Copper	0.9422	-1.464	0.8545	-1.465
Chromium (III)	0.8190	3 688	0.8190	1.561
Lead	1.273	-1.460	1.273	-4.705
Nickel	0.8460	3.3612	0 8460	1.1645
Silver	1.72	-6.52		
Zinc	0.8473	0.8604	0.8473	0.7614

Note· The term "exp" represents the base e exponential function

(c) *Applicability.*

(1) The criteria in paragraph (b) of this section apply to the States' designated uses cited in paragraph (d) of this section and supersede any criteria adopted by the State, except when State regulations contain criteria which are more stringent for a particular use in which case the State's criteria will continue to apply.

(2) The criteria established in this section are subject to the State's general rules of applicability in the same way and to the same extent as are the other numeric toxics criteria when applied to the same use classifications including mixing zones, and low flow values below which numeric standards can be exceeded in flowing fresh waters.

(i) For all waters with mixing zone regulations or implementation procedures, the criteria apply at the appropriate locations within or at the boundary of the mixing zones; otherwise the criteria apply throughout the waterbody including at the end of any discharge pipe, canal or other discharge point.

(ii) A State shall not use a low flow value below which numeric standards can be exceeded that is less stringent than the following for waters suitable for the establishment of low flow return frequencies (i.e., streams and rivers):

Aquatic Life

Acute criteria (CMC)	1 Q 10 or 1 B 3
Chronic criteria (CCC)	7 Q 10 or 4 B 3

Human Health

Non-carcinogens	30 Q 5
Carcinogens	Harmonic mean flow

Where:

CMC—criteria maximum concentration—the water quality criteria to protect against acute effects in aquatic life and is the highest instream concentration of a priority toxic pollutant consisting of a one-hour average not to be exceeded more than once every three years on the average;

CCC—criteria continuous concentration—the water quality criteria to protect against chronic effects in aquatic life is the highest instream concentration of a priority toxic pollutant consisting of a 4-day average not to be exceeded more than once every three years on the average;

1 Q 10 is the lowest one day flow with an average recurrence frequency of once in 10 years determined hydrologically;

1 B 3 is biologically based and indicates an allowable exceedence of once every 3 years. It is determined by EPA's computerized method (DFLOW model);

7 Q 10 is the lowest average 7 consecutive day low flow with an average recurrence frequency of once in 10 years determined hydrologically;

4 B 3 is biologically based and indicates an allowable exceedence for 4 consecutive days once every 3 years. It is determined by EPA's computerized method (DFLOW model);

30 Q 5 is the lowest average 30 consecutive day low flow with an average recurrence frequency of once in 5 years determined hydrologically; and the harmonic mean flow is a long term mean flow value calculated by dividing the number of daily flows analyzed by the sum of the reciprocals of those daily flows.

(iii) If a State does not have such a low flow value for numeric standards compliance, then none shall apply and the criteria included in paragraph (d) of this section herein apply at all flows.

(3) The aquatic life criteria in the matrix in paragraph (b) of this section apply as follows:

(i) For waters in which the salinity is equal to or less than 1 part per thousand 95% or more of the time, the applicable criteria are the freshwater criteria in Column B;

(ii) For waters in which the salinity is equal to or greater than 10 parts per thousand 95% or more of the time, the applicable criteria are the saltwater criteria in Column C; and

(iii) For waters in which the salinity is between 1 and 10 parts per thousand as defined in paragraphs (c)(3) (i) and (ii) of this section, the applicable criteria are the more stringent of the freshwater or saltwater criteria. However, the Regional Administrator may approve the use of the alternative freshwater or saltwater criteria if scientifically defensible information and data demonstrate that on a site-specific basis the biology of the waterbody is dominated by freshwater aquatic life and that freshwater criteria are more appropriate; or conversely, the biology of the waterbody is dominated by saltwater aquatic life and that saltwater criteria are more appropriate.

(4) *Application of metals criteria.*

(i) For purposes of calculating freshwater aquatic life criteria for metals from the equations in paragraph (b)(2) of this section, the minimum hardness allowed for use in those equations shall not be less than 25 mg/l, as calcium carbonate, even if the actual ambient hardness is less than 25 mg/l as calcium carbonate. The maximum hardness value for use in those equations shall not exceed 400 mg/l as calcium carbonate, even if the actual ambient hardness is greater than 400 mg/l as calcium carbonate. The same provisions apply for calculating the metals criteria for the comparisons provided for in paragraph (c)(3)(iii) of this section.

(ii) The hardness values used shall be consistent with the design discharge conditions established in paragraph (c)(2) of this section for flows and mixing zones.

(iii) The criteria for metals (compounds #1-#13 in paragraph (b) of this section) are expressed as total recoverable. For purposes of calculating aquatic life criteria for metals from the equations in footnote M. in the criteria matrix in paragraph (b)(1) of this section and the equations in paragraph (b)(2) of this section, the water-effect ratio is computed as a

specific pollutant's acute or chronic toxicity values measured in water from the site covered by the standard, divided by the respective acute or chronic toxicity value in laboratory dilution water. The water-effect ratio shall be assigned a value of 1.0, except where the permitting authority assigns a different value that protects the designated uses of the water body from the toxic effects of the pollutant, and is derived from suitable tests on sampled water representative of conditions in the affected water body, consistent with the design discharge conditions established in paragraph (c)(2) of this section. For purposes of this paragraph, the term acute toxicity value is the toxicity test results, such as the concentration that is one-half of the test organisms (i.e., LC50) after 96 hours of exposure (e.g., fish toxicity tests) or the effect concentration to one-half of the test organisms, (i.e., EC50) after 48 hours of exposure (e.g., daphnia toxicity tests). For purposes of this paragraph, the term chronic value is the result from appropriate hypothesis testing or regression analysis of measurements of growth, reproduction, or survival from life cycle, partial life cycle, or early life stage tests. The determination of acute and chronic values shall be according to current standard protocols (e.g., those published by the American Society for Testing Materials (ASTM)) or other comparable methods. For calculation of criteria using site-specific values for both the hardness and the water effect ratio, the hardness used in the equations in paragraph (b)(2) of this section shall be as required in paragraph (c)(4)(ii) of this section. Water hardness shall be calculated from the measured calcium and magnesium ions present, and the ratio of calcium to magnesium shall be approximately the same in standard laboratory toxicity testing water as in the site water.

(d) *Criteria for Specific Jurisdictions—*

(1) *Rhode Island, EPA Region 1.*

(i) All waters assigned to the following use classifications in the Water Quality Regulations for Water Pollution Control adopted under Chapters 46-12, 42-17.1, and 42-35 of the General Laws of Rhode Island are subject to the criteria in paragraph (d)(1)(ii) of this section, without exception:

6.21 Freshwater	6.22 Saltwater
Class A	Class SA
Class B	Class SB
Class C	Class SC

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classifications identified in paragraph (d)(1)(i) of this section:

Use classification	Applicable criteria
Class A Class B waters where water supply use is designated	These classifications are assigned the criteria in: Column D1—all
Class B waters where water supply use is not designated, Class C; Class SA, Class SB; Class SC	Each of these classifications is assigned the criteria in. Column D2—all

(iii) The human health criteria shall be applied at the 10^{-5} risk level, consistent with the State policy. To determine appropriate value for carcinogens, see footnote c in the criteria matrix in paragraph (b)(1) of this section.

(2) *Vermont, EPA Region 1.*

(i) All waters assigned to the following use classifications in the Vermont Water Quality Standards adopted under the authority of the Vermont Water Pollution Control Act (10 V.S.A., Chapter 47) are subject to the criteria in paragraph (d)(2)(ii) of this section, without exception:

Class A
Class B
Class C

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classifications identified in paragraph (d)(2)(i) of this section:

Use classification	Applicable criteria
Class A Class B waters where water supply use is designated	This classification is assigned the criteria in: Column B1—all Column B2—all Column D1—all
Class B waters where water supply use is not designated Class C	These classifications are assigned the criteria in: Column B1—all Column B2—all Column D2—all

(iii) The human health criteria shall be applied at the State-proposed 10^{-6} risk level.

(3) *New Jersey, EPA Region 2.*

(i) All waters assigned to the following use classifications in the New Jersey Administrative Code (N.J.A.C.) 7:9-4.1 et seq., Surface Water Quality Standards, are subject to the criteria in paragraph (d)(3)(ii) of this section, without exception.

N.J.A.C. 7:9-4.12(b): Class PL
N.J.A.C. 7:9-4.12(c): Class FW2
N.J.A.C. 7:9-4.12(d): Class SE1
N.J.A.C. 7:9-4.12(e): Class SE2
N.J.A.C. 7:9-4.12(f): Class SE3
N.J.A.C. 7:9-4.12(g): Class SC
N.J.A.C. 7:9-4.13(a): Delaware River Zones 1C, 1D, and 1E
N.J.A.C. 7:9-4.13(b): Delaware River Zone 2
N.J.A.C. 7:9-4.13(c): Delaware River Zone 3
N.J.A.C. 7:9-4.13(d): Delaware River Zone 4
N.J.A.C. 7:9-4.13(e): Delaware River Zone 5
N.J.A.C. 7:9-4.13(f): Delaware River Zone 6

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classifications identified in paragraph (d)(3)(i) of this section:

Use classification	Applicable criteria
PL (Freshwater Pinelands), FW2	These classifications are assigned the criteria in: Column B1—all except #102, 105, 107, 108, 111, 112, 113, 115, 117, 118. Column B2—all excep #105, 107, 108, 111, 112, 113, 115, 117, 118, 119, 120, 121, 122, 123, 124, and 125. Column D1—all at a 10^{-6} risk level except #23, 30, 37, 38, 42, 68, 89, 91, 93, 104, 105; #23, 30, 37, 38, 42, 68, 89, 91, 93, 104, 105, at a 10^{-5} risk level. Column D2—all at a 10^{-6} risk level except #23, 30, 37, 38, 42, 68, 89, 91, 93, 104, 105; 23, 30, 37, 38, 42, 68, 89, 91, 93, 104, 105, at a 10^{-5} risk level.
PL (Saline Water Pinelands), SE1, SE2, SE3, SC	These classifications are assigned the criteria in.

Use classification	Applicable criteria
	Column C1—all except #102, 105, 107, 108, 111, 112, 113, 115, 117, and 118. Column C2—all except #105, 107, 108, 111, 112, 113, 115, 117, 118, 119, 120, 121, 122, 123, 124, and 125. Column D2—all at a 10^{-6} risk level except #23, 30, 37, 38, 42, 68, 89, 91, 93, 104, 105; #23, 30, 37, 38, 42, 68, 89, 91, 93, 104, 105, at a 10^{-5} risk level
Delaware River zones 1C, 1D, 1E, 2, 3, 4, 5 and Delaware Bay zone 6	These classifications are assigned the criteria in Column B1—all Column B2—all Column D1—all at a 10^{-6} risk level except #23, 30, 37, 38, 42, 68, 89, 91, 93, 104, 105; #23, 30, 37, 38, 42, 68, 89, 91, 93, 104, 105, at a 10^{-5} risk level. Column D2—all at a 10^{-6} risk level except #23, 30, 37, 38, 42, 68, 89, 91, 93, 104, 105, #23, 30, 37, 38, 42, 68, 89, 91, 93, 104, 105, at a 10^{-5} risk level.
Delaware River zones 3, 4, and 5, and Delaware Bay zone 6	These classifications are assigned the criteria in: Column C1—all Column C2—all Column D2—all at a 10^{-6} risk level except #23, 30, 37, 38, 42, 68, 89, 91, 93, 104, 105; #23, 30, 37, 38, 42, 68, 89, 91, 93, 104, 105, at a 10^{-5} risk level

(iii) The human health criteria shall be applied at the State-proposed 10^{-6} risk level for EPA rated Class A, B_1, and B_2 carcinogens; EPA rated Class C carcinogens shall be applied at 10^{-5} risk level. To determine appropriate value for carcinogens, see footnote c. in the matrix in paragraph (b)(1) of this section.

(4) *Puerto Rico, EPA Region 2.*

(i) All waters assigned to the following use classifications in the Puerto Rico Water Quality Standards (promulgated by Resolution Number R-83-5-2) are subject to the criteria in paragraph (d)(4)(ii) of this section, without exception.

Article 2.2.2—Class SB

Article 2.2.3—Class SC

Article 2.2.4—Class SD

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classifications identified in paragraph (d)(4)(i) of this section:

Use classification	Applicable criteria
Class SD	This Classification is assigned the criteria in: Column B1—all, except 10, 102, 105, 107, 108, 111, 112, 113, 115, 117, and 126 Column B2—all, except: 105, 107, 108, 112, 113, 115, and 117 Column D1—all, except: 6, 14, 105, 112, 113, and 115. Column D2—all, except: 14, 105, 112, 113, and 115.
Class SB, Class SC	This Classification is assigned the criteria in: Column C1—all, except 4, 5b, 7, 8, 10, 11, 13, 102, 105, 107, 108, 111, 112, 113, 115, 117, and 126. Column C2—all, except 4, 5b, 10, 13, 108, 112, 113, 115, and 117. Column D2—all, except: 14, 105, 112, 113, and 115.

(iii) The human health criteria shall be applied at the State-proposed 10^{-5} risk level. To determine appropriate value for carcinogens, see footnote c, in the criteria matrix in paragraph (b)(1) of this section.

(5) *District of Columbia, EPA Region 3.*

(i) All waters assigned to the following use classifications in chapter 11 Title 21 DCMR, Water Quality Standards of the District of Columbia are subject to the criteria in paragraph (d)(5)(ii) of this section, without exception:

1101.2 Class C waters

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classification identified in paragraph (d)(5)(i) of this section:

Use classification	Applicable criteria
Class C	This classification is assigned the additional criteria in: Colum B2—#10, 118, 126. Colum D1—#15, 16, 44, 67, 68, 79, 80, 81, 88, 114, 116, 118. Colum D2—all.

(iii) The human health criteria shall be applied at the State-adopted 10^{-6} risk level.

(6) *Florida, EPA Region 4.*

(i) All waters assigned to the following use classifications in Chapter 17-301 of the Florida Administrative Code (i.e., identified in Section 17-302.600) are subject to the criteria in paragraph (d)(6)(ii) of this section, without exception:

Class I

Class II

Class III

(ii) The following criteria from the matrix paragraph (b)(1) of this section apply to the use classifications identified in paragraph (d)(6)(i) of this section:

Use classification	Applicable criteria
Class I	This classification is assigned the criteria in. Column D1—#16
Class II and	This classification is assigned the criteria in:
Class III (marine)	Column D2-#16
Class III (fresh water)	This classification is assigned the criteria in: Column D2—#16

(iii) The human health criteria shall be applied at the State-adopted 10^{-6} risk level.

(7) *Michigan, EPA Region 5.*

(i) All waters assigned to the following use classifications in the Michigan Department of Natural Resources Commission General Rules, R 323.1100 designated uses, as defined at R 323.1043. Definitions; A to N, (i.e., identified in Section (g) "Designated use") are subject to the criteria in paragraph (d)(7)(ii) of this section, without exception:

Agriculture

Navigation

Industrial Water Supply

Public Water Supply at the Point of Water Intake

Warmwater Fish

Other Indigenous Aquatic Life and Wildlife

Partial Body Contact Recreation

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classifications identified in paragraph (d)(7)(i) of this section

Use classification	Applicable criteria
Public Water supply	This classification is assigned the criteria in: Column B1—all, Column B2—all, Column D1—all.
All other designations	These classifications are assigned the criteria in: Column B1—all, Column B2—all, and Column D2—all

(iii) The human health criteria shall be applied at the State-adopted 10^{-5} risk level. To determine appropriate value for carcinogens, see footnote c in the criteria matrix in paragraph (b)(1) of this section.

(8) *Arkansas, EPA Region 6.*

(i) All waters assigned to the following use classification in section 4C (Waterbody uses) identified in Arkansas Department of Pollution Control and Ecology's Regulation No. 2 as amended and entitled, "Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas" are subject to the criteria in paragraph (d)(8)(ii) of this section, without exception:

Extraordinary Resource Waters

Ecologically Sensitive Waterbody

Natural and Scenic Waterways

Fisheries:

(1) Trout

(2) Lakes and Reservoirs

(3) Streams

(a) Ozark Highlands Ecoregion

(b) Boston Mountains Ecoregion

(c) Arkansas River Valley Ecoregion

(d) Ouachita Mountains Ecoregion

(e) Typical Gulf Coastal Ecoregion

(f) Spring Water-influenced Gulf Coastal Ecoregion

(g) Least-altered Delta Ecoregion

(h) Channel-altered Delta Ecoregion

Domestic Water Supply

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classification identified in paragraph (d)(8)(i) of this section:

Use classification	Applicable criteria
Extraordinary Resource Waters Ecologically Sensitive Waterbody Natural and Scenic Waterways Fisheries. (1) Trout (2) Lakes and Reservoirs (3) Streams (a) Ozark Highlands Ecoregion (b) Boston Mountains Ecoregion (c) Arkansas River Valley Ecoregion (d) Ouachita Mountains Ecoregion (e) Typical Gulf Coastal Ecoregion (f) Spring Water-influenced Gulf Coastal Ecoregion (g) Least-altered Delta Ecoregion (h) Channel-altered Delta Ecoregion	These uses are each assigned the criteria in— Column B1— #4, 5a, 5b, 6, 7, 8, 9, 10, 11, 13, 14 Column B2— #4, 5a, 5b, 6, 7, 8, 9, 10, 13, 14

(9) *Kansas, EPA Region 7.*

(i) All waters assigned to the following use classification in the Kansas Department of Health and Environment regulations, K.A.R. 28-16-28b through K.A.R. 28-16-28f, are subject to the criteria in paragraph (d)(9)(ii) of this section, without exception.

Section 28-16-28d

Section (2)(A)—Special Aquatic Life Use Waters

Section (2)(B)—Expected Aquatic Life Use Waters

Section (2)(C)—Restricted Aquatic Life Use Waters

Section (3)—Domestic Water Supply

Section (6)(c)—Consumptive Recreation Use.

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classifications identified in paragraph (d)(9)(i) of this section:

Use classification	Applicable criteria
Sections (2)(A), (2)(B), (2)(C), (6)(C)	These classifactions are each assigned all criteria in: Column B1, all except #9, 11, 13, 102, 105, 107, 108, 111-113, 115, 117, and 126; Column B2, all except #9, 13, 105, 107, 108, 111-113, 115, 117, 119-125, and 126; and Column D2, all except #9, 112, 113, and 115.
Section (3)	This classification is assigned all criteria in; Column D1, all except #9, 12, 112, 113, and 115.

(iii) The human health criteria shall be applied at the State-proposed 10^{-6} risk level.

(10) *California, EPA Region 9.*

(i) All waters assigned any aquatic life or human health use classifications in the Water Quality Control Plans for the various Basins of the State ("Basin Plans"), as amended, adopted by the California State Water Resources Control Board ("SWRCB"), except for ocean waters covered by the Water Quality Control Plan for Ocean Waters of California ("Ocean Plan") adopted by the SWRCB with resolution Number 90-27 on March 22, 1990, are subject to the criteria in paragraph (d)(10)(ii) of this section, without exception. These criteria amend the portions of the existing State standards contained in the Basin Plans. More particularly these criteria amend water quality criteria contained in the Basin Plan Chapters specifying water quality objectives (the State equivalent of federal water quality criteria) for the toxic pollutants identified in paragraph (d)(10)(ii) of this section. Although the State has adopted several use designations for each of these waters, for purposes of this action, the specific standards to be applied in paragraph (d)(10)(ii) of this section are based on the presence in all waters of some aquatic life designation and the presence or absence of the MUN use designation (Municipal and domestic supply). (See Basin Plans for more detailed use definitions.)

Other Indigenous Aquatic Life and Wildlife

Partial Body Contact Recreation

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classifications identified in paragraph (d)(7)(i) of this section

Use classification	Applicable criteria
Public Water supply	This classification is assigned the criteria in: Column B1—all, Column B2—all, Column D1—all.
All other designations	These classifications are assigned the criteria in: Column B1—all, Column B2—all, and Column D2—all

(iii) The human health criteria shall be applied at the State-adopted 10^{-5} risk level. To determine appropriate value for carcinogens, see footnote c in the criteria matrix in paragraph (b)(1) of this section.

(8) *Arkansas, EPA Region 6.*

(i) All waters assigned to the following use classification in section 4C (Waterbody uses) identified in Arkansas Department of Pollution Control and Ecology's Regulation No. 2 as amended and entitled, "Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas" are subject to the criteria in paragraph (d)(8)(ii) of this section, without exception:

Extraordinary Resource Waters

Ecologically Sensitive Waterbody

Natural and Scenic Waterways

Fisheries:

(1) Trout

(2) Lakes and Reservoirs

(3) Streams

(a) Ozark Highlands Ecoregion

(b) Boston Mountains Ecoregion

(c) Arkansas River Valley Ecoregion

(d) Ouachita Mountains Ecoregion

(e) Typical Gulf Coastal Ecoregion

(f) Spring Water-influenced Gulf Coastal Ecoregion

(g) Least-altered Delta Ecoregion

(h) Channel-altered Delta Ecoregion

Domestic Water Supply

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classification identified in paragraph (d)(8)(i) of this section:

Use classification	Applicable criteria
Extraordinary Resource Waters Ecologically Sensitive Waterbody Natural and Scenic Waterways Fisheries: (1) Trout (2) Lakes and Reservoirs (3) Streams (a) Ozark Highlands Ecoregion (b) Boston Mountains Ecoregion (c) Arkansas River Valley Ecoregion (d) Ouachita Mountains Ecoregion (e) Typical Gulf Coastal Ecoregion (f) Spring Water-influenced Gulf Coastal Ecoregion (g) Least-altered Delta Ecoregion (h) Channel-altered Delta Ecoregion	These uses are each assigned the criteria in— Column B1— #4, 5a, 5b, 6, 7, 8, 9, 10, 11, 13, 14 Column B2— #4, 5a, 5b, 6, 7, 8, 9, 10, 13, 14

(9) *Kansas, EPA Region 7.*

(i) All waters assigned to the following use classification in the Kansas Department of Health and Environment regulations, K.A.R. 28-16-28b through K.A.R. 28-16-28f, are subject to the criteria in paragraph (d)(9)(ii) of this section, without exception.

Section 28-16-28d

Section (2)(A)—Special Aquatic Life Use Waters

Section (2)(B)—Expected Aquatic Life Use Waters

Section (2)(C)—Restricted Aquatic Life Use Waters

Section (3)—Domestic Water Supply

Section (6)(c)—Consumptive Recreation Use.

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classifications identified in paragraph (d)(9)(i) of this section:

Use classification	Applicable criteria
Sections (2)(A), (2)(B), (2)(C), (6)(C)	These classifactions are each assigned all criteria in. Column B1, all except #9, 11, 13, 102, 105, 107, 108, 111-113, 115, 117, and 126; Column B2, all except #9, 13, 105, 107, 108, 111-113, 115, 117, 119-125, and 126; and Column D2, all except #9, 112, 113, and 115.
Section (3)	This classification is assigned all criteria in, Column D1, all except #9, 12, 112, 113, and 115

(iii) The human health criteria shall be applied at the State-proposed 10^{-6} risk level.

(10) *California, EPA Region 9*

(i) All waters assigned any aquatic life or human health use classifications in the Water Quality Control Plans for the various Basins of the State ("Basin Plans"), as amended, adopted by the California State Water Resources Control Board ("SWRCB"), except for ocean waters covered by the Water Quality Control Plan for Ocean Waters of California ("Ocean Plan") adopted by the SWRCB with resolution Number 90-27 on March 22, 1990, are subject to the criteria in paragraph (d)(10)(ii) of this section, without exception. These criteria amend the portions of the existing State standards contained in the Basin Plans. More particularly these criteria amend water quality criteria contained in the Basin Plan Chapters specifying water quality objectives (the State equivalent of federal water quality criteria) for the toxic pollutants identified in paragraph (d)(10)(ii) of this section. Although the State has adopted several use designations for each of these waters, for purposes of this action, the specific standards to be applied in paragraph (d)(10)(ii) of this section are based on the presence in all waters of some aquatic life designation and the presence or absence of the MUN use designation (Municipal and domestic supply). (See Basin Plans for more detailed use definitions.)

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the water and use classifications defined in paragraph (d)(10)(i) of this section and identified below.

Water and use classification	Applicable criteria
Waters of the State defined as bays or estuaries except the Sacramento-San Joaquin Delta and San Francisco Bay	These waters are assigned the criteria in: Column B1—pollutants 5a and 14 Column B2—pollutants 5a and 14 Column C1—pollutant 14 Column C2—pollutant 14 Column D2—pollutants 1, 12, 17, 18, 21, 22, 29, 30, 32, 33, 37, 38, 42-44, 46, 48, 49, 54, 59, 66, 67, 68, 78-82, 85, 89, 90, 91, 93, 95, 96, 98
Waters of the Sacramento—San Joaquin Delta and waters of the State defined as inland (i.e., all surface waters of the State not bays or estuaries or ocean) that include a MUN use designation	These waters are assigned the criteria in: Column B1—pollutants 5a and 14 Column B2—pollutants 5a and 14 Column D1—pollutants, 1, 12, 15, 17, 18, 21, 22, 29, 30, 32, 33, 37, 38, 42-48, 49, 59, 66, 68, 78-82, 85, 89, 90, 91, 93, 95, 96, 98
Waters of the State defined as inland without an MUN use designation	These waters are assigned the criteria in: Column B1—pollutants 5a and 14 Column B2—pollutants 5a and 14 Column D2—pollutants 1, 12, 17, 18, 21, 22, 29, 30, 32, 33, 37, 38, 42-44, 46, 48, 49, 54, 59, 66, 67, 68, 78-82, 85, 89, 90, 91, 93, 95, 96, 98
Waters of the San Joaquin River from the mouth of the Merced River to Vernahs	In addition to the criteria assigned to these waters elsewhere in this rule, these waters are assigned the criteria in: Column B2—pollutant 10
Waters of Salt Slough, Mud Slough (north) and the San Joaquin River, Sack Dam to the mouth of the Merced River	In addition to the criteria assigned to these waters elsewhere in this rule, these waters are assigned the criteria in: Column B1—pollutant 10 Column B2—pollutant 10
Waters of San Francisco Bay upstream to and including Suisun Bay and the Sacramento San Joaquin Delta	These waters are assigned the criteria in: Column B1—pollutants 5a, 10* and 14 Column B2—pollutants 5a, 10* and 14 Column C1—pollutant 14 Column C2—pollutant 14 Column D2—pollutants 1, 12, 17, 18, 21, 22, 29, 30, 32, 33, 37, 38, 42-44, 46, 48, 49, 54, 59, 66, 67, 68, 78-82, 85, 89, 90, 91, 93, 95, 96, 98
All inland waters of the United States or enclosed bays and estuaries that are waters of the United States that include an MUN use designation and that the State has either excluded or partially excluded from coverage under its Water Quality Control Plan for Inland Surface Waters of California, Tables 1 and 2, or its Water Quality Control Plan for Enclosed Bays and Estuaries of California, Tables 1 and 2, or has deferred applicability of those tables. (Category (a), (b), and (c) waters described on page 6 of Water Quality Control Plan for Inland Surface Waters of California or page 6 of its Water Quality Control Plan for Enclosed Bays and Estuaries of California.)	These waters are assigned the criteria for pollutants for which the State does not apply Table 1 or 2 standards. These criteria are: Column B1—all pollutants Column B2—all pollutants Column D1—all pollutants except #2
All inland waters of the United States that do not include an MUN use designation and that the State has either excluded or partially excluded from coverage under its Water Quality Control Plan for Inland Surface Waters of California, Tables 1 and 2, or has deferred applicability of these tables. (Category (a), (b), and (c) waters described on page 6 of Water Quality Control Plan Inland Surface Waters of California)	

Water and use classification	Applicable criteria
that do not include an MCW designation All enclosed bays and estuaries that are waters of the United States and that the State has either excluded or partially excluded from coverage under its Water Quality Control Plan for Inland Surface Waters of California, Tables 1 and 2, or its Water Quality Control Plan for Enclosed Bays and Estuaries of California, Tables 1 and 2, or has deferred applicability of those tables. (Category (a), (b), and (c) waters described on page 6 of Water Quality Control Plan for Inland Surface Waters of California or page 6 of its Water Quality Control Plan for Enclosed Bays and Estuaries of California.)	These waters are assigned the criteria for pollutants for which the State does not apply Table 1 or 2 standards. These criteria are: Column B1—all pollutants Column B2—all pollutants Column D2—all pollutants except #2
	These waters are assigned the criteria for pollutants for which the State does not apply Table 1 or 2 standards. These criteria are: Column B1—all pollutants Column B2—all pollutants Column C1—all pollutants Column C2—all pollutants Column D2—all pollutants except #2

* The fresh water selenium criteria are included for the San Francisco Bay estuary because high levels of bioaccumulation of selenium in the estuary indicate that the salt water criteria are underprotective for San Francisco Bay.

(iii) The human health criteria shall be applied at the State-adopted 10^{-6} risk level.

(11) *Nevada, EPA Region 9.*

(i) All waters assigned the use classifications in Chapter 445 of the Nevada Administrative Code (NAC), Nevada Water Pollution Control Regulations, which are referred to in paragraph (d)(11)(ii) of this section, are subject to the criteria in paragraph (d)(11)(ii) of this section, without exception. These criteria amend the existing State standards contained in the Nevada Water Pollution Control Regulations. More particularly, these criteria amend or supplement the table of numeric standards in NAC 445.1339 for the toxic pollutants identified in paragraph (d)(11)(ii) of this section.

(ii) The following criteria from matrix in paragraph (b)(1) of this section apply to the waters defined in paragraph (d)(11)(i) of this section and identified below:

Water and use classification	Applicable criteria
Waters that the State has included in NAC 445.1339 where Municipal or domestic supply is a designated use	These waters are assigned the criteria in: Column B1—pollutant #118 Column B2—pollutant #118 Column D1—pollutants #15, 16, 18, 19, 20, 21, 23, 26, 27, 29, 30, 34, 37, 38, 42, 43, 55, 58–62, 64, 66, 73, 74, 78, 82, 85, 87–89, 91, 92, 96, 98, 100, 103, 104, 105, 114, 116, 117, 118
Waters that the State has included in NAC 445.1339 where Municipal or domestic supply is not a designated use	These waters are assigned the criteria in: Column B1—pollutant #118 Column B2—pollutant #118 Column D2—all pollutants except #2.

(iii) The human health criteria shall be applied at the 10^{-5} risk level, consistent with State policy. To determine appropriate value for carcinogens, see footnote c in the criteria matrix in paragraph (b)(1) of this section.

(12) *Alaska, EPA Region 10.*

(i) All waters assigned to the following use classifications in the Alaska Administrative Code (AAC), Chapter 18 (i.e., identified in 18 AAC 70.020) are subject to the criteria in paragraph (d)(12)(ii) of this section, without exception:

70.020.(1) (A) Fresh Water
70.020.(1) (A) Water Supply
(i) Drinking, culinary, and food processing,
(iii) Aquaculture;
70.020.(1) (B) Water Recreation
(i) Contact recreation,
(ii) Secondary recreation;
70.020.(1) (C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife
70.020.(2) (A) Marine Water
70.020.(2) (A) Water Supply
(i) Aquaculture,
70.020.(2) (B) Water Recreation
(i) contact recreation,
(ii) secondary recreation;
70.020.(2) (C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife;
70.020.(2) (D) Harvesting for consumption of raw mollusks or other raw aquatic life.

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classifications identified in paragraph (d)(12)(i) of this section:

Use classification	Applicable criteria
(1)(A) i	Column B1—all Column B2—#10 Column D1

Use classification	Applicable criteria
	#'s 2, 16, 18-21, 23, 26, 27, 29, 30, 32, 37, 38, 42-44, 53, 55, 59-62, 64, 66, 68, 73, 74, 78, 82, 85, 88, 89, 91-93, 96, 98, 102-105, 107-111, 117-126
(1)(A) iii	Column B1—all Column B2—#10 Column D2 #'s 2, 14, 16, 18-21, 22, 23, 26, 27, 29, 30, 32, 37, 38, 42-44, 46, 53, 54, 55, 59-62, 64, 66, 68, 73, 74, 78, 82, 85, 88-93, 95, 96, 98, 102-105, 107-111, 115-126
(1)(B) i, (1)(B) ii, (1)(C)	Column B1—all Column B2—#10 Column D2 #'s 2, 14, 16, 18-21, 22, 23, 26, 27, 29, 30, 32, 37, 38, 42-44, 46, 53, 54, 55, 59-62, 64, 66, 68, 73, 74, 78, 82, 85, 88-93, 95, 96, 98, 102-105, 107-111, 115-126
(2)(A)i, (2)(B)i, and (2)(B)ii, (2)(C), (2)(D)	Column C1—all Column C2—#10 Column D2 #'s 2, 14, 16, 18-21, 22, 23, 26, 27, 29, 30, 32, 37, 38, 42-44, 46, 53, 54, 55, 59-62, 64, 66, 68, 73, 74, 78, 82, 85, 88-93, 95, 96, 98, 102-105, 107-111, 115-126

(iii) The human health criteria shall be applied at the State-proposed risk level of 10^{-5}. To determine appropriate value for carcinogens, see footnote c in the criteria matrix in paragraph (b)(1) of this section.

(13) *Idaho, EPA Region 10.*

(i) All waters assigned to the following use classifications in the Idaho Administrative Procedures Act (IDAPA), Chapter 16 (i.e., identified in IDAPA 16.01.2100,02-16.01.2100,07) are subject to the criteria in paragraph (d)(13)(ii) of this section, without exception:

16.01.2100.01.b. Domestic Water Supplies

16.01.2100.02.a. Cold Water Biota

16.01.2100.02.b. Warm Water Biota

16.01.2100.02cc. Salmonid Spawning

16.01.2100.03.a. Primary Contact Recreation

16.01.2100.03.b Secondary Contact Recreation

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classifications identified in paragraph (d)(13)(i) of this section:

Use classification	Applicable criteria
01.b	This classification is assigned the criteria in Column D1—all *except* #14 and 115
02.a 02 b 02 cc	These classifications are assigned the criteria in: Column B1—all Column B2—all Column D2—all
03.a	This classification is assigned the criteria in: Column D2—all
03 b	This classification is assigned the criteria in: Column D2—all

(iii) The human health criteria shall be applied at the 10^{-6} risk level, consistent with State policy.

(14) *Washington, EPA Region 10.*

(i) All waters assigned to the following use classifications in the Washington Administrative Code (WAC), Chapter 173-201 (i.e., identified in WAC 173-201-045) are subject to the criteria in paragraph (d)(14)(ii) of this section, without exception:

173-201-045

Fish and Shellfish

Fish

Water Supply (domestic)

Recreation

(ii) The following criteria from the matrix in paragraph (b)(1) of this section apply to the use classifications identified in paragraph (d)(14)(i) of this section:

Use classification	Applicable criteria
Fish and Shellfish; Fish	These classifications are assigned the criteria in: Column B1 and B(2)—#2, 10 Column C1—#2, 10 Column C2—#2, 6, 10, 14 Column D2—all
Water Supply (domestic)	These classifictions are assigned the criteria in: Column D1—all
Recreation	This classification is assigned the criteria in. Column D2—Marine waters and freshwaters not protected for domestic water supply

(Aquatic life criteria for arsenic and selenium withdrawn JULY 6, 1993 - 58 FR 36141)

(iii) The human health criteria shall be applied at the State proposed risk level of 10^{-6}.

[§131.36 added at 57 FR 60910, Dec. 22, 1992]

APPENDIX B

Chronological Summary of Federal Water Quality Standards Promulgation Actions

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF SCIENCE AND TECHNOLOGY
STANDARDS AND APPLIED SCIENCE DIVISION

JANUARY 1993

CHRONOLOGICAL SUMMARY OF FEDERAL WATER QUALITY STANDARDS PROMULGATION ACTIONS

STATE	DATE	STATUS	REFERENCE	ACTION
1. Kentucky	12/2/74	Final	39 FR 41709	Established statement in WQS giving EPA Administrator authority to grant a temporary exception to stream classification and/or criteria after case-by-case studies. Also, established statement that streams not listed in the WQS are understood to be classified as Aquatic Life and criteria for this use to be met.
2*. Arizona	6/22/76	Final	41 FR 25000	Established nutrient standards for 11 streams.
3. Nebraska	6/6/78	Final	43 FR 24529	Redesignated eight stream segments for full body contact recreation and three for partial body contact recreation and the protection of fish and wildlife.
4. Mississippi	4/30/79	Final	44 FR 25223	Established dissolved oxygen criterion for all water uses recognized by the State. Established criterion for a daily average of not less than 5.0 mg/l with a daily instantaneous minimum of not less than 4.0 mg/l.

5.	Alabama	11/26/79	Proposed	44 FR 67442	Proposal to reestablish previously approved use classifications for segments of four navigable waterways, Five Mile Creek, Opossum Creek, Valley Creek, Village Creek, and upgrade the use designation of a segment of Village Creek from river mile 30 to its source.
6.	Alabama	2/14/80	Final	45 FR 9910	Established beneficial stream use classification for 16 streams: 8 were designated for fish and wildlife, 7 were upgraded to a fish and wildlife classification, 1 was designated as agricultural and industrial water supply. Proposed streams classification rulemaking for 7 streams withdrawn.
7.	North Carolina	4/1/80	Final	45 FR 21246	Nullified a zero dissolved oxygen standard variance in a segment of Welch Creek and reestablished the State's previous standard of 5 mg/l average, 4 mg/l minimum, except for lower concentrations caused by natural swamp conditions.
8.	Ohio	11/28/80	Final	45 FR 79053	(1) Established water use designation, (2) establish a DO criterion of 5 mg/l for warmwater use, (3) designated 17 streams as warmwater habitat, (4) placed 111 streams downgraded by Ohio into modified warmwater habitat, (5) revised certain provisions relating to mixing zones (principally on Lake Erie), (6) revised low flow and other exceptions to standards, (7) amended sampling and analytical protocols, and (8) withdrew EPA proposal to establish a new cyanide criterion.
9.	Kentucky	12/9/80	Final (withdrawal)	45 FR 81042	Withdrew the Federal promulgation action of 12/2/74 after adoption of ppropriate water quality standards by the State.

10. North Carolina	11/10/81	Final (withdrawal)	46 FR 55520	Withdrew the Federal promulgation action of 4/1/80 following State adoption of a dissolved oxygen criterion consistent with the Federally promulgated standard.
11. Ohio	2/16/82	Final (withdrawal)	47 FR 29541	Withdrew Federal promulgation of 11/28/80 because it was based on a portion of the water quality standards regulation that has been determined to be invalid.
12. Nebraska	7/26/82	Final (withdrawal)	47 FR 32128	Withdrew Federal promulgation action of 6/6/78 after adoption of appropriate water quality standards by the State.
13. Alabama	11/26/82	Final (withdrawal)	47 FR 53372	Withdrew the Federal promulgation action of 2/14/80 following State adoption of requirements consistent with the Federally promulgated standard.
14. Idaho	8/20/85	Proposed	50 FR 33672	Proposal to replace DO criterion downstream from dams, partially replace Statewide ammonia criterion, replace ammonia criterion for Indian Creek, and delete categorical exemption of dams from Antidegradation Policy.
15. Mississippi	4/4/86	Final (withdrawal)	51 FR 11581	Withdrew the Federal promulgation of 4/30/79 following State adoption of requirements consistent with the Federally promulgated standard.
16. Idaho	7/14/86	Final (withdrawal)	51 FR 25372	Withdrew portions of proposed rule to replace DO criterion downstream from dams and delete categorical exemptions of dams from antidegradation rule since State adopted acceptable standards in both instances.
17. Kentucky	3/20/87	Final	50 FR 9102	Established a chloride criterion of 600 mg/l as a 30-day average, not to exceed a maximum of 1,200 mg/l at any time.

18. Idaho	7/25/88	Final (withdrawal)	53 FR 27882	Withdrew portion of proposed rule which would have established a Statewide ammonia criterion and a site-specific ammonia criterion applicable to lower Indian Creek since State adopted acceptable standards.
19*. Coleville Indian Reservation	7/6/89	Final	54 FR 28622	Established designated uses and criteria for all surface waters on the Reservation.
20. Kentucky	4/3/91	Final (withdrawal)	56 FR 13592	Withdrew the Federal promulgation of 3/20/87 after adoption of appropriate WQS by the State.
21*. 12 States 2 Territories	12/22/92	Final	57 FR 60848	Established numeric water quality for toxic pollutants (aquatic life and human health).
22. Washington	7/6/93	Final (withdrawal)	58 FR 36141	Withdrew, in part, the Federal Promulgation of 12/22/92 after adoption of appropriate criteria by the State.

* Final federal rule remains in force

SUMMARY OF FEDERAL PROMULGATION ACTIONS

Total Number of Proposed or Final Rules	22
Final Standards Promulgated	10
Withdrawal of Final Standards	8
Federal Rules Remaining In Force	3
No Action Taken on Proposals or Proposal Withdrawn	3

APPENDIX C

Biological Criteria: National Program Guidance for Surface Waters

WATER QUALITY STANDARDS HANDBOOK

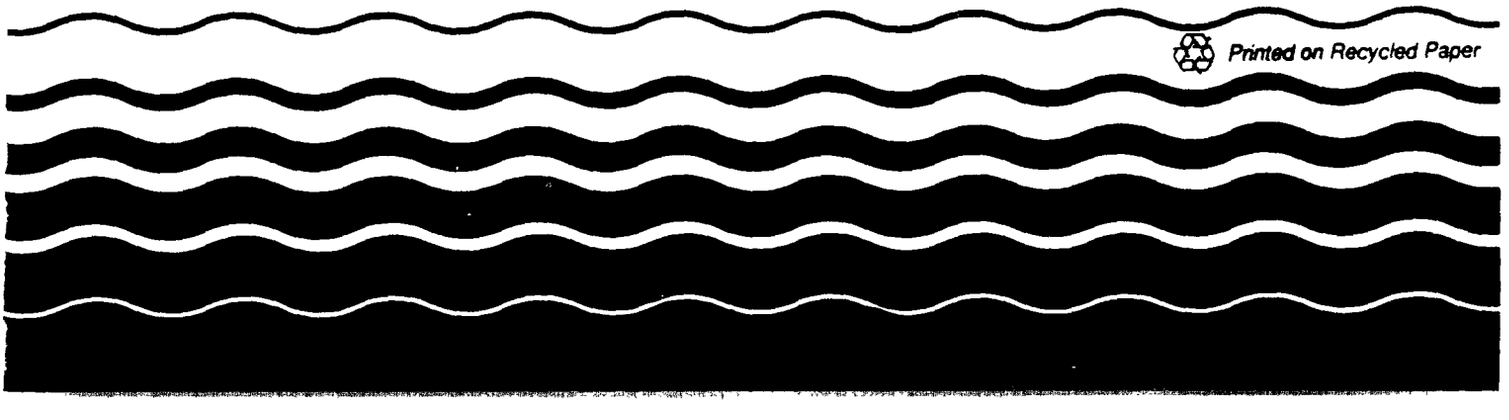
SECOND EDITION

United States Environmental Protection Agency
Office of Water Regulations and Standards (WH-585) Washington, DC 20460
EPA-440/5-90-004 April 1990

EPA

Biological Criteria

National Program Guidance For Surface Waters



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Biological Criteria

National Program Guidance for Surface Waters

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In Memory of

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Definitions

To effectively use biological criteria, a clear understanding of how these criteria are developed and applied in a water quality standards framework is necessary. This requires, in part, that users of biological criteria start from the same frame of reference. To help form this frame of reference, the following definitions are provided. Please consider them carefully to ensure a consistent interpretation of this document.

Definitions

- An **AQUATIC COMMUNITY** is an association of interacting populations of aquatic organisms in a given waterbody or habitat.

- A **BIOLOGICAL ASSESSMENT** is an evaluation of the biological condition of a waterbody using biological surveys and other direct measurements of resident biota in surface waters.

- **BIOLOGICAL CRITERIA,** or biocriteria, are numerical values or narrative expressions that describe the reference biological integrity of aquatic communities inhabiting waters of a given designated aquatic life use.

- **BIOLOGICAL INTEGRITY** is functionally defined as the condition of the aquatic community inhabiting unimpaired waterbodies of a specified habitat as measured by community structure and function.

- **BIOLOGICAL MONITORING** is the use of a biological entity as a detector and its response as a measure to determine environmental conditions. Toxicity tests and biological surveys are common biomonitoring methods.

- A **BIOLOGICAL SURVEY,** or biosurvey, consists of collecting, processing and analyzing representative portions of a resident aquatic community to determine the community structure and function.

- A **COMMUNITY COMPONENT** is any portion of a biological community. The community component may pertain to the taxomonic group (fish, invertebrates, algae), the taxonomic category (phylum, order, family, genus, species), the feeding strategy (herbivore, omnivore, carnivore) or organizational level (individual, population, community association) of a biological entity within the aquatic community.

- **REGIONS OF ECOLOGICAL SIMILARITY** describe a relatively homogeneous area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variable. Regions of ecological similarity help define the potential for designated use classifications of specific waterbodies.

- **DESIGNATED USES** are those uses specified in water quality standards for each waterbody or segment whether or not they are being attained.

- An **IMPACT** is a change in the chemical, physical or biological quality or condition of a waterbody caused by external sources.

- An **IMPAIRMENT** is a detrimental effect on the biological integrity of a waterbody caused by an impact that prevents attainment of the designated use.

- A **POPULATION** is an aggregate of interbreeding individuals of a biological species within a specified location.

- A **WATER QUALITY ASSESSMENT** is an evaluation of the condition of a waterbody using biological surveys, chemical-specific analyses of pollutants in waterbodies, and toxicity tests.

- An **ECOLOGICAL ASSESSMENT** is an evaluation of the condition of a waterbody using water quality and physical habitat assessment methods.

Executive Summary

The Clean Water Act (Act) directs the U.S. Environmental Protection Agency (EPA) to develop programs that will evaluate, restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In response to this directive, States and EPA implemented chemically based water quality programs that successfully addressed significant water pollution problems. However, these programs alone cannot identify or address all surface water pollution problems. To create a more comprehensive program, EPA is setting a new priority for the development of biological water quality criteria. The initial phase of this program directs State adoption of narrative biological criteria as part of State water quality standards. This effort will help States and EPA achieve the objectives of the Clean Water Act set forth in Section 101 and comply with statutory requirements under Sections 303 and 304. The *Water Quality Standards Regulation* provides additional authority for biological criteria development.

In accordance with priorities established in the *FY 1991 Agency Operating Guidance,* States are to adopt narrative biological criteria into State water quality standards during the FY 1991-1993 triennium. To support this priority, EPA is developing a *Policy on the Use of Biological Assessments and Criteria in the Water Quality Program* and is providing this program guidance document on biological criteria.

This document provides guidance for development and implementation of narrative biological criteria. Future guidance documents will provide additional technical information to facilitate development and implementation of narrative and numeric criteria for each of the surface water types.

When implemented, biological criteria will expand and improve water quality standards programs, help identify impairment of beneficial uses, and help set program priorities. Biological criteria are valuable because they directly measure the condition of the resource at risk, detect problems that other methods may miss or underestimate, and provide a systematic process for measuring progress resulting from the implementation of water quality programs.

Biological criteria require direct measurements of the structure and function of resident aquatic communities to determine biological integrity and ecological function. They supplement, rather than replace chemical and toxicological methods. It is EPA's policy that biological survey methods be fully integrated with toxicity and chemical-specific assessment methods and that chemical-specific criteria, whole-effluent toxicity evaluations and biological criteria be used as independent evaluations of non-attainment of designated uses.

Biological criteria are narrative expressions or numerical values that describe the biological integrity of aquatic communities inhabiting waters of a given aquatic life use. They are developed under the assumptions that surface waters impacted by anthropogenic activities may contain impaired aquatic communities (the greater the impact the greater the expected impairment) and that surface waters not impacted by anthropogenic activities are generally not impaired. Measures of aquatic community structure and function in unimpaired surface waters functionally define biological integrity and form the basis for establishing the biological criteria.

Narrative biological criteria are definable statements of condition or attainable goals for a given use designation. They establish a positive statement about aquatic community characteristics expected to occur within a waterbody (e.g., "Aquatic life shall be as it naturally occurs" or "A natural variety of aquatic life shall be present and all functional groups well represented"). These criteria can be developed using existing information. Numeric criteria describe the expected attainable community attributes and establish values based on measures such as species richness, presence or absence of indicator taxa, and distribution of classes of organisms. To implement narrative criteria and develop numeric criteria, biota in reference waters must be carefully assessed. These are used as the reference values to determine if, and to what extent, an impacted surface waterbody is impaired.

Biological criteria support designated aquatic life use classifications for application in standards. The designated use determines the benefit or purpose to be derived from the waterbody; the criteria provide a measure to determine if the use is impaired. Refinement of State water quality standards to include more detailed language about aquatic life is essential to fully implement a biological criteria program. Data collected from biosurveys can identify consistently distinct characteristics among aquatic communities inhabiting different waters with the same designated use. These biological and ecological characteristics may be used to define separate categories within a designated use, or separate one designated use into two or more use classifications.

To develop values for biological criteria, States should (1) identify unimpaired reference waterbodies to establish the reference condition and (2) characterize the aquatic communities inhabiting reference surface waters. Currently, two principal approaches are used to establish reference sites: (1) the site-specific approach, which may require upstream-downstream or near field-far field evaluations, and (2) the regional approach, which identifies similarities in the physico-chemical characteristics of watersheds that influence aquatic ecology. The basis for choosing reference sites depends on classifying the habitat type and locating unimpaired (minimally impacted) waters.

Once reference sites are selected, their biological integrity must be evaluated using quantifiable biological surveys. The success of the survey will depend in part on the careful selection of aquatic community components (e.g., fish, macroinvertebrates, algae). These components should serve as effective indicators of high biological integrity, represent a range of pollution tolerances, provide predictable, repeatable results, and be readily identified by trained State personnel. Well-planned quality assurance protocols are required to reduce variability in data collection and to assess the natural variability inherent in aquatic communities. A quality survey will include multiple community components and may be measured using a variety of metrics. Since multiple approaches are available, factors to consider when choosing possible approaches for assessing biological integrity are presented in this document and will be further developed in future technical guidance documents.

To apply biological criteria in a water quality standards program, standardized sampling methods and statistical protocols must be used. These procedures must be sensitive enough to identify significant differences between established criteria and tested communities. There are three possible outcomes from hypothesis testing using these analyses: (1) the use is impaired, (2) the biological criteria are met, or (3) the outcome is indeterminate. If the use is impaired, efforts to diagnose the cause(s) will help determine appropriate action. If the use is not impaired, no action is required based on these analyses. The outcome will be indeterminate if the study design or evaluation was incomplete. In this case, States would need to re-evaluate their protocols.

If the designated use is impaired, diagnosis is the next step. During diagnostic evaluations three main impact categories must be considered: chemical, physical, and biological stress. Two questions are posed during initial diagnosis: (1) what are obvious potential causes of impairment, and (2) what possible causes do the biological data suggest? Obvious potential causes of impairment are often identified during normal field biological assessments. When an impaired use cannot be easily related to an obvious cause, the diagnostic process becomes investigative and iterative. Normally the diagnoses of biological impairments are relatively straightforward; States can use biological criteria to confirm impairment from a known source of impact.

There is considerable State interest in integrating biological assessments and criteria in water quality management programs. A minimum of 20 States now use some form of standardized biological assessments to determine the status of biota in State waters. Of these, 15 States are developing biological assessments for future criteria development. Five States use biological criteria to define aquatic life use classifications and to enforce water quality standards. Several States have established narrative biological criteria in their standards. One State has instituted numeric biological criteria.

Whether a State is just beginning to establish narrative biological criteria or is developing a fully integrated biological approach, the programmatic expansion from source control to resource management represents a natural progression in water quality programs. Implementation of biological criteria will provide new options for expanding the scope and application of ecological perspectives.

Part I

Program Elements

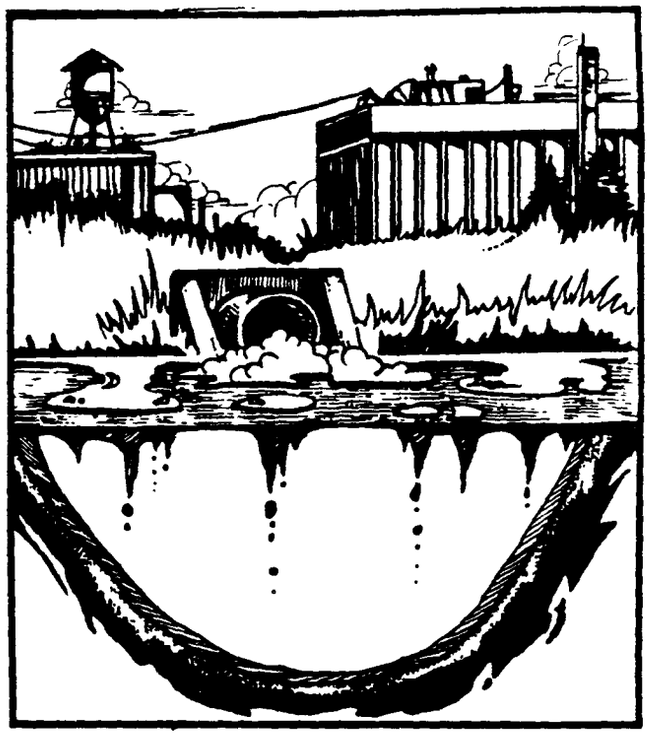
Chapter 1

Introduction

The principal objectives of the Clean Water Act are "to restore and maintain the chemical, physical and biological integrity of the Nation's waters" (Section 101). To achieve these objectives, EPA, States, the regulated community, and the public need comprehensive information about the ecological integrity of aquatic environments. Such information will help us identify waters requiring special protection and those that will benefit most from regulatory efforts.

To meet the objectives of the Act and to comply with statutory requirements under Sections 303 and 304, States are to adopt biological criteria in State standards. The *Water Quality Standards Regulation* provides additional authority for this effort. In accordance with the *FY 1991 Agency Operating Guidance*, States and qualified Indian tribes are to adopt narrative biological criteria into State water quality standards during the FY 1991-1993 triennium. To support this effort, EPA is developing a *Policy on the Use of Biological Assessments and Criteria in the Water Quality Program* and providing this program guidance document on biological criteria.

Like other water quality criteria, biological criteria identify water quality impairments, support regulatory controls that address water quality problems, and assess improvements in water quality from regulatory efforts. Biological criteria are numerical values or narrative expressions that describe the reference biological integrity of aquatic communities inhabiting waters of a given designated aquatic life use. They are developed through the direct measurement of aquatic community components inhabiting unimpaired surface waters.



Anthropogenic impacts, including point source discharges, nonpoint runoff, and habitat degradation continue to impair the nation's surface waters.

Biological criteria complement current programs. Of the three objectives identified in the Act (chemical, physical, and biological integrity), current water quality programs focus on direct measures of

chemical integrity (chemical-specific and whole-effluent toxicity) and, to some degree, physical integrity through several conventional criteria (e.g., pH, turbidity, dissolved oxygen). Implementation of these programs has significantly improved water quality. However, as we learn more about aquatic ecosystems it is apparent that other sources of waterbody impairment exist. Biological impairments from diffuse sources and habitat degradation can be greater than those caused by point source discharges (Judy et al. 1987; Miller et al. 1989). In Ohio, evaluation of instream biota indicated that 36 percent of impaired stream segments could not be detected using chemical criteria alone (see Fig. 1). Although effective for their purpose, chemical-specific criteria and whole-effluent toxicity provide only indirect evaluations and protection of biological integrity (see Table 1).

To effectively address our remaining water quality problems we need to develop more integrated and comprehensive evaluations. Chemical and physical integrity are necessary, but not sufficient conditions to attain biological integrity, and only when chemical, physical, and biological integrity are achieved, is ecological integrity possible (see Fig. 2). Biological criteria provide an essential third element for water quality management and serve as a natural progression in regulatory programs. Incorporating biological criteria into a fully integrated program directly protects the biological integrity of surface waters and provides indirect protection for chemical and physical integrity (see Table 2). Chemical-specific criteria, whole-effluent toxicity evaluations, and biological criteria, when used together, complement the relative strengths and weaknesses of each approach.

Figure 1.—Ohio Biosurvey Results Agree with Instream Chemistry or Reveal Unknown Problems

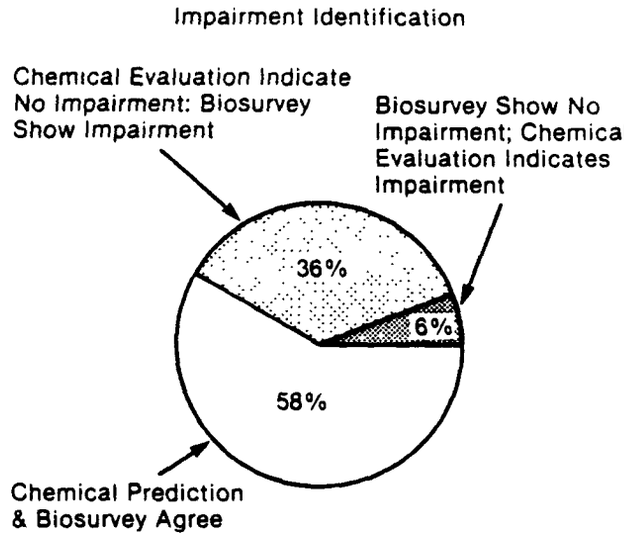


Fig. 1: In an intensive survey, 431 sites in Ohio were assessed using instream chemistry and biological surveys. In 36% of the cases, chemical evaluations implied no impairment but biological survey evaluations showed impairment. In 58% of the cases the chemical and biological assessments agreed. Of these, 17% identified waters with no impairment, 41% identified waters which were considered impaired. (Modified from Ohio EPA Water Quality Inventory, 1988.)

Biological assessments have been used in biomonitoring programs by States for many years. In this respect, biological criteria support earlier work. However, implementing biological criteria in water quality standards provides a systematic, structured, and objective process for making decisions about compliance with water quality standards. This distinguishes biological criteria from earlier use of biological information and increases the value of biological data in regulatory programs.

Table 1.—Current Water Quality Program Protection of the Three Elements of Ecological Integrity.

ELEMENTS OF ECOLOGICAL INTEGRITY	PROGRAM THAT DIRECTLY PROTECTS	PROGRAM THAT INDIRECTLY PROTECTS
Chemical Integrity	Chemical Specific Criteria (toxics) Whole Effluent Toxicity (toxics)	
Physical Integrity	Criteria for Conventionals (pH, DO, turbidity)	
Biological Integrity		Chemical/Whole Effluent Toxicity (biotic response in lab)

Table 1: Current programs focus on chemical specific and whole-effluent toxicity evaluations. Both are valuable approaches for the direct evaluation and protection of chemical integrity. Physical integrity is also directly protected to a limited degree through criteria for conventional pollutants. Biological integrity is only indirectly protected under the assumption that by evaluating toxicity to organisms in laboratory studies. estimates can be made about the toxicity to other organisms inhabiting ambient waters.

Table 2.—Water Quality Programs that Incorporate Biological Criteria to Protect Elements of Ecological Integrity.

ELEMENTS OF ECOLOGICAL INTEGRITY	DIRECTLY PROTECTS	INDIRECTLY PROTECTS
Chemical Integrity	Chemical Specific Criteria (toxics) Whole Effluent Toxicity (toxics)	Biocriteria (identification of impairment)
Physical Integrity	Criteria for conventionals (pH, temp., DO)	Biocriteria (habitat evaluation)
Biological Integrity	Biocriteria (biotic response in surface water)	Chemical/Whole Effluent Testing (biotic response in lab)

Table 2: When biological criteria are incorporated into water quality programs the biological integrity of surface waters may be directly evaluated and protected. Biological criteria also provide additional benefits by requiring an evaluation of physical integrity and providing a monitoring tool to assess the effectiveness of current chemically based criteria.

Figure 2.—The Elements of Ecological Integrity

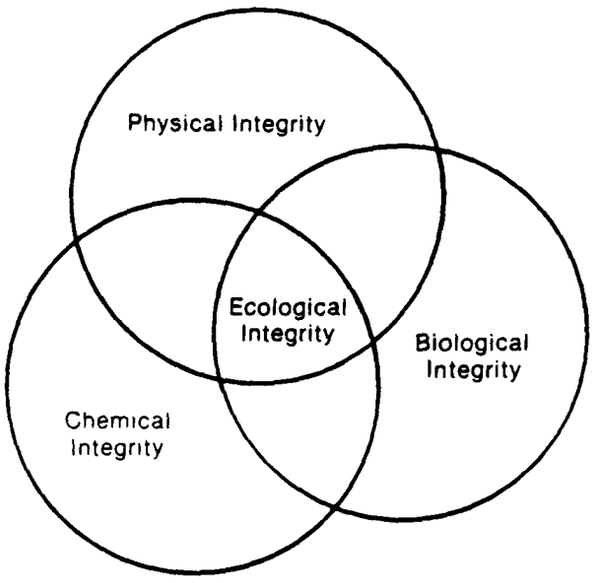


Fig. 2: Ecological Integrity is attainable when chemical, physical, and biological integrity occur simultaneously.

Value of Biological Criteria

Biological criteria provide an effective tool for addressing remaining water quality problems by directing regulatory efforts toward assessing the biological resources at risk from chemical, physical or biological impacts. A primary strength of biological criteria is the detection of water quality problems that other methods may miss or underestimate. Biological criteria can be used to determine to what extent current regulations are protecting the use.

Biological assessments provide integrated evaluations of water quality. They can identify impairments from contamination of the water column and sediments from unknown or unregulated chemicals, non-chemical impacts, and altered physical habitat. Resident biota function as continual monitors of environmental quality, increasing the likelihood of detecting the effects of episodic events (e.g., spills, dumping, treatment plant malfunctions, nutrient enrichment), toxic nonpoint source pollution (e.g., agricultural pesticides), cumulative pollution (i.e., multiple impacts over time or continuous low-level stress), or other impacts that periodic chemical sampling is unlikely to detect. Impacts on the physical habitat such as sedimentation from stormwater runoff and the effects of physical or structural habitat alterations (e.g., dredging, filling, channelization) can also be detected.

Biological criteria require the direct measure of resident aquatic community structure and function to determine biological integrity and ecological function. Using these measures, impairment can be detected and evaluated without knowing the impact(s) that may cause the impairment.

Biological criteria provide a regulatory framework for addressing water quality problems and offer additional benefits, including providing:

- the basis for characterizing high quality waters and identifying habitats and community components requiring special protection under State anti-degradation policies;
- a framework for deciding 319 actions for best control of nonpoint source pollution;
- an evaluation of surface water impairments predicted by chemical analyses, toxicity

testing, and fate and transport modeling (e.g., wasteload allocation);

- improvements in water quality standards (including refinement of use classifications);
- a process for demonstrating improvements in water quality after implementation of pollution controls;
- additional diagnostic tools.

The role of biological criteria as a regulatory tool is being realized in some States (e.g., Arkansas, Maine, Ohio, North Carolina, Vermont). Biological assessments and criteria have been useful for regulatory, resource protection, and monitoring and reporting programs. By incorporating biological criteria in programs, States can improve standards setting and enforcement, measure impairments from permit violations, and refine wasteload allocation models. In addition, the location, extent, and type of biological impairments measured in a waterbody provide valuable information needed for identifying the cause of impairment and determining actions required to improve water quality. Biological assessment and criteria programs provide a cost-effective method for evaluating water quality when a standardized, systematic approach to study design, field methods, and data analysis is established (Ohio EPA 1988a).

Process for Implementation

The implementation of biological criteria will follow the same process used for current chemical-specific and whole-effluent toxicity applications: national guidance produced by U.S. EPA will support States working to establish State standards for the implementation of regulatory programs (see Table 3). Biological criteria differ, however, in the degree of State involvement required. Because surface waters vary significantly from region to region, EPA will provide guidance on acceptable approaches for biological criteria development rather than specific criteria with numerical limitations. States are to establish assessment procedures, conduct field evaluations, and determine criteria values to implement biological criteria in State standards and apply them in regulatory programs.

The degree of State involvement required influences how biological criteria will be implemented. It is expected that States will implement these criteria in phases.

- **Phase I** includes the development and adoption of narrative biological criteria into State standards for all surface waters (streams, rivers, lakes, wetlands, estuaries). Definitions of terms and expressions in the narratives must be included in these standards (see the Narrative Criteria Section, Chapter 3). Adoption of narrative biological criteria in State standards provides the legal and programmatic basis for using ambient biological surveys and assessments in regulatory actions.
- **Phase II** includes the development of an implementation plan. The plan should include program objectives, study design, research protocols, criteria for selecting reference conditions and community components, quality assurance and quality control procedures,

Table 3.—Process for Implementation of Water Quality Standards.

CRITERIA	EPA GUIDANCE	STATE IMPLEMENTATION	STATE APPLICATION
Chemical Specific	Pollutant specific numeric criteria	State Standards · use designation · numeric criteria · antidegradation	Permit limits Monitoring Best Management Practices Wasteload allocation
Narrative Free Forms	Whole effluent toxicity guidance	Water Quality Narrative · no toxic amounts translator	Permit limits Monitoring Wasteload allocation Best Management Practices
Biological	Biosurvey *minimum* requirement guidance	State Standards · refined use · narrative/numeric criteria · antidegradation	Permit conditions Monitoring Best Management Practices Wasteload allocation

Table 3: Similar to chemical specific criteria and whole effluent toxicity evaluations, EPA is providing guidance to States for the adoption of biological criteria into State standards to regulate sources of water quality impairment.

and training for State personnel. In Phase II, States are to develop plans necessary to implement biological criteria for each surface water type.

- **Phase III** requires full implementation and integration of biological criteria in water quality standards. This requires using biological surveys to derive biological criteria for classes of surface waters and designated uses. These criteria are then used to identify nonattainment of designated uses and make regulatory decisions.

Narrative biological criteria can be developed for all five surface water classifications with little or no data collection. Application of narrative criteria in seriously degraded waters is possible in the short term. However, because of the diversity of surface waters and the biota that inhabit these waters, significant planning, data collection, and evaluation will be needed to fully implement the program. Criteria for each type of surface water are likely to be developed at different rates. The order and rate of development will depend, in part, on the development of EPA guidance for specific types of surface water. Biological criteria technical guidance for streams will be produced during FY 1991. The tentative order for future technical guidance documents includes guidance for rivers (FY 1992), lakes (FY 1993), wetlands (FY 1994) and estuaries (FY 1995). This order and timeline for guidance does not reflect the relative importance of these surface waters, but rather indicates the relative availability of research and the anticipated difficulty of developing guidance.

Independent Application of Biological Criteria

Biological criteria supplement, but do not replace, chemical and toxicological methods. Water chemistry methods are necessary to predict risks (particularly to human health and wildlife), and to diagnose, model, and regulate important water quality problems. Because biological criteria are able to detect different types of water quality impairments and, in particular, have different levels of sensitivity for detecting certain types of impairment compared to toxicological methods, they are not used in lieu of, or in conflict with, current regulatory efforts.

As with all criteria, certain limitations to biological criteria make independent application essential. Study design and use influences how sensitive biological criteria are for detecting community impairment. Several factors influence sensitivity: (1) State decisions about what is significantly different between reference and test communities, (2) study design, which may include community components that are not sensitive to the impact causing impairment, (3) high natural variability that makes it difficult to detect real differences, and (4) types of impacts that may be detectable sooner by other methods (e.g., chemical criteria may provide earlier indications of impairment from a bioaccumulative chemical because aquatic communities require exposure over time to incur the full effect).

Since each type of criteria (biological criteria, chemical-specific criteria, or whole-effluent toxicity evaluations) has different sensitivities and purposes, a criterion may fail to detect real impairments when used alone. As a result, these methods should be used together in an integrated water quality assessment, each providing an independent evaluation of nonattainment of a designated use. If any one type of criteria indicates impairment of the surface water, regulatory action can be taken to improve water quality. However, no one type of criteria can be used to confirm attainment of a use if another form of criteria indicates nonattainment (see Hypothesis Testing: Biological Criteria and the Scientific Method, Chapter 7). When these three methods are used together, they provide a powerful, integrated, and effective foundation for waterbody management and regulations.

How to Use this Document

The purpose of this document is to provide EPA Regions, States and others with the conceptual framework and assistance necessary to develop and implement narrative and numeric biological criteria and to promote national consistency in application. There are two main parts of the document. Part One (Chapters 1, 2, 3, and 4) includes the essential concepts about what biological criteria are

and how they are used in regulatory programs. Part Two (Chapters 5, 6, and 7) provides an overview of the process that is essential for implementing a State biological criteria program. Specific chapters include the following:

Part I: PROGRAM ELEMENTS

- **Chapter 2, Legal Authority**, reviews the legal basis for biological criteria under the Clean Water Act and includes possible applications under the Act and other legislation.

- **Chapter 3, Conceptual Framework**, discusses the essential program elements for biological criteria, including what they are and how they are developed and used within a regulatory program. The development of narrative biological criteria is discussed in this chapter.

- **Chapter 4, Integration**, discusses the use of biological criteria in regulatory programs.

Part II: THE IMPLEMENTATION PROCESS

- **Chapter 5, The Reference Condition**, provides a discussion on alternative forms of reference conditions that may be developed by a State based on circumstances and needs.

- **Chapter 6, The Biological Survey**, provides some detail on the elements of a quality biological survey.

- **Chapter 7, Hypothesis Testing: Biological Criteria and the Scientific Method**, discusses how biological surveys are used to make regulatory and diagnostic decisions.

- **Appendix A** includes commonly asked questions and their answers about biological criteria.

Two additional documents are planned in the near term to supplement this program guidance document.

1. "*Biological Criteria Technical Reference Guide*" will contain a cross reference of technical papers on available approaches and methods for developing biological criteria (see tentative table of contents in Appendix B),

2. "*Biological Criteria Development by States*" will provide a summary of different mechanisms several States have used to implement and apply biological criteria in water quality programs (see tentative outline in Appendix C).

Both documents are planned for FY 1991. As previously discussed, over the next triennium technical guidance for specific systems (e.g., streams, wetlands) will be developed to provide guidance on acceptable biological assessment procedures to further support State implementation of comprehensive programs.

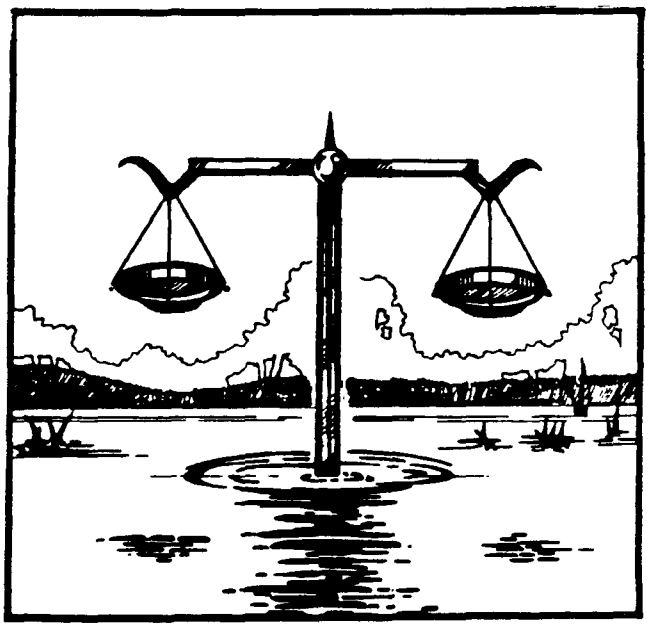
This biological criteria program guidance document supports development and implementation of biological criteria by providing guidance to States working to comply with requirements under the Clean Water Act and the Water Quality Standards Regulation. This guidance is not regulatory.

Chapter 2

Legal Authority

The Clean Water Act (Federal Water Pollution Control Act of 1972, Clean Water Act of 1977, and the Water Quality Act of 1987) mandates State development of criteria based on biological assessments of natural ecosystems.

The general authority for biological criteria comes from Section 101(a) of the Act which establishes as the objective of the Act the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's waters. To meet this objective, water quality criteria must include criteria to protect biological integrity. Section 101(a)(2) includes the interim water quality goal for the protection and propagation of fish, shellfish, and wildlife. Propagation includes the full range of biological conditions necessary to support reproducing populations of all forms of aquatic life and other life that depend on aquatic systems. Sections 303 and 304 provide specific directives for the development of biological criteria.



Balancing the legal authority for biological criteria.

Section 303

Under Section 303(c) of the Act, States are required to adopt protective water quality standards that consist of uses, criteria, and antidegradation. States are to review these standards every three years and to revise them as needed.

Section 303(c)(2)(A) requires the adoption of water quality standards that ". . . serve the purposes of the Act," as given in Section 101. Section 303(c)(2)(B), enacted in 1987, requires States to adopt numeric criteria for toxic pollutants for which EPA has published 304(a)(1) criteria. The section further requires that, where numeric 304(a) criteria are not available, States should adopt criteria based on biological assessment and monitoring methods, consistent with information published by EPA under 304(a)(8).

These specific directives do not serve to restrict the use of biological criteria in other settings where they may be helpful. Accordingly, this guidance document provides assistance in implementing various sections of the Act, not just 303(c)(2)(B).

Section 304

Section 304(a) directs EPA to develop and publish water quality criteria and information on methods for measuring water quality and establishing water quality criteria for toxic pollutants on bases other than pollutant-by-pollutant, including biological monitoring and assessment methods which assess:

- the effects of pollutants on aquatic community components (". . . plankton, fish, shellfish, wildlife, plant life . . .") and community attributes (". . . biological community diversity, productivity, and stability . . ."); in any body of water and;
- factors necessary ". . . to restore and maintain the chemical, physical, and biological integrity of all navigable waters . . ." for ". . . the protection of shellfish, fish, and wildlife for classes and categories of receiving waters . . ."

Potential Applications Under the Act

Development and use of biological criteria will help States to meet other requirements of the Act, including:

- setting planning and management priorities for waterbodies most in need of controls [Sec. 303(d)];
- determining impacts from nonpoint sources [i.e., Section 304(f) "(1) guidelines for identifying and evaluating the nature and extent of nonpoint sources of pollutants, and (2) processes, procedures, and methods to control pollution . . ."].
- biennial reports on the extent to which waters support balanced biological communities [Sec. 305(b)];
- assessment of lake trophic status and trends [Sec. 314];
- lists of waters that cannot attain designated uses without nonpoint source controls [Sec. 319];
- development of management plans and conducting monitoring in estuaries of national significance [Sec. 320];
- issuing permits for ocean discharges and monitoring ecological effects [Sec. 403(c) and 301(h)(3)];
- determination of acceptable sites for disposal of dredge and fill material [Sec. 404];

Potential Applications Under Other Legislation

Several legislative acts require an assessment of risk to the environment (including resident aquatic communities) to determine the need for regulatory action. Biological criteria can be used in this context to support EPA assessments under:

- *Toxic Substances Control Act (TSCA) of 1976*
- *Resource Conservation and Recovery Act (RCRA),*
- *Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA),*
- *Superfund Amendments and Reauthorization Act of 1986 (SARA),*
- *Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA);*
- *National Environmental Policy Act (NEPA);*
- *Federal Lands Policy and Management Act (FLPMA).*
- *The Fish and Wildlife Conservation Act of 1980*
- *Marine Protection, Research, and Sanctuaries Act*
- *Coastal Zone Management Act*

- *Wild and Scenic Rivers Act*

- *Fish and Wildlife Coordination Act, as Amended in 1965*

A summary of the applicability of these Acts for assessing ecological impairments may be found in *Risk Assessment Guidance for Superfund-Environmental Evaluation Manual (Interim Final) 1989.*

Other federal and State agencies can also benefit from using biological criteria to evaluate the biological integrity of surface waters within their jurisdiction and to the effects of specific practices on surface water quality. Agencies that could benefit include:

- **Department of the Interior** (*U.S. Fish and Wildlife Service, U.S. Geological Survey, Bureau of Mines, and Bureau of Reclamation, Bureau of Indian Affairs, Bureau of Land Management, and National Park Service*),

- **Department of Commerce** (*National Oceanic and Atmospheric Administration, National Marine Fisheries Service*),

- **Department of Transportation** (*Federal Highway Administration*)

- **Department of Agriculture** (*U.S. Forest Service, Soil Conservation Service*)

- **Department of Defense,**

- **Department of Energy,**

- **Army Corps of Engineers,**

- **Tennessee Valley Authority.**

Chapter 3

The Conceptual Framework

Biological integrity and the determination of use impairment through assessment of ambient biological communities form the foundation for biological criteria development. The effectiveness of a biological criteria program will depend on the development of quality criteria, the refinement of use classes to support narrative criteria, and careful application of scientific principles.

Premise for Biological Criteria

Biological criteria are based on the premise that the structure and function of an aquatic biological community within a specific habitat provide critical information about the quality of surface waters. Existing aquatic communities in pristine environments not subject to anthropogenic impact exemplify biological integrity and serve as the best possible goal for water quality. Although pristine environments are virtually non-existent (even remote waters are impacted by air pollution), minimally impacted waters exist. Measures of the structure and function of aquatic communities inhabiting unimpaired (minimally impacted) waters provide the basis for establishing a reference condition that may be compared to the condition of impacted surface waters to determine impairment.

Based on this premise, biological criteria are developed under the assumptions that: (1) surface waters subject to anthropogenic disturbance may contain impaired populations or communities of aquatic organisms—the greater the anthropogenic

Aquatic communities assessed in unimpaired waterbodies (top) provide a reference for evaluating impairments in the same or similar waterbodies suffering from increasing anthropogenic impacts (bottom).

disturbance, the greater the likelihood and magnitude of impairment; and (2) surface waters not subject to anthropogenic disturbance generally contain unimpaired (natural) populations and communities of aquatic organisms exhibiting biological integrity.

Biological Integrity

The expression "biological integrity" is used in the Clean Water Act to define the Nation's objectives for water quality. According to Webster's New World Dictionary (1966), integrity is, "the quality or state of being complete; unimpaired." Biological integrity has been defined as "the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitats within a region" (Karr and Dudley 1981). For the purposes of biological criteria, these concepts are combined to develop a functional definition for evaluating biological integrity in water quality programs. Thus, biological integrity is functionally defined as:

> *the condition of the aquatic community inhabiting the unimpaired waterbodies of a specified habitat as measured by community structure and function.*

It will often be difficult to find unimpaired waters to define biological integrity and establish the reference condition. However, the structure and function of aquatic communities of high quality waters can be approximated in several ways. One is to characterize aquatic communities in the most protected waters representative of the regions where such sites exist. In areas where few or no unimpaired sites are available, characterization of least impaired systems approximates unimpaired systems. Concurrent analysis of historical records should supplement descriptions of the condition of least impaired systems. For some systems, such as lakes, evaluating paleoecological information (the record stored in sediment profiles) can provide a measure of less disturbed conditions.

Surface waters, when inhabited by aquatic communities, are exhibiting a degree of biological integrity. However, the best representation of biological integrity for a surface water should form the basis for establishing water quality goals for those waters. When tied to the development of biological criteria, the realities of limitations on biological integrity can be considered and incorporated into a progressive program to improve water quality.

Biological Criteria

Biological criteria are narrative expressions or numerical values that describe the biological integrity of aquatic communities inhabiting waters of a given designated aquatic life use. While biological integrity describes the ultimate goal for water quality, biological criteria are based on aquatic community structure and function for waters within a variety of designated uses. Designated aquatic life uses serve as general statements of attained or attainable uses of State waters. Once established for a designated use, biological criteria are quantifiable values used to determine whether a use is impaired, and if so, the level of impairment. This is done by specifying what aquatic community structure and function should exist in waters of a given designated use, and then comparing this condition with the condition of a site under evaluation. If the existing aquatic community measures fail to meet the criteria, the use is considered impaired.

Since biological surveys used for biological criteria are capable of detecting water quality problems (use impairments) that may not be detected by chemical or toxicity testing, violation of biological criteria is sufficient cause for States to initiate regulatory action. Corroborating chemical and toxicity testing data are not required (though they may be desirable) as supporting evidence to sustain a determination of use impairment. However, a finding that biological criteria fail to indicate use impairment does not mean the use is automatically attained. Other evidence, such as violation of physical or chemical criteria, or results from toxicity tests, can also be used to identify impairment. Alternative forms of criteria provide independent assessments of nonattainment.

As stated above, biological criteria may be narrative statements or numerical values. States can establish general narrative biological criteria early in program development without conducting biological assessments. Once established in State standards, narrative biological criteria form the legal and

programmatic basis for expanding biological assessment and biosurvey programs needed to implement narrative criteria and develop numeric biological criteria. Narrative biological criteria should become part of State regulations and standards.

Narrative Criteria

Narrative biological criteria are general statements of attainable or attained conditions of biological integrity and water quality for a given use designation. Although similar to the "free from" chemical water quality criteria, narrative biological criteria establish a positive statement about what should occur within a water body. Narrative criteria can take a number of forms but they must contain several attributes to support the goals of the Clean Water Act to provide for the protection and propagation of fish, shellfish, and wildlife. Thus, narrative criteria should include specific language about aquatic community characteristics that (1) must exist in a waterbody to meet a particular designated aquatic life use, and (2) are quantifiable. They must be written to protect the use. Supporting statements for the criteria should promote water quality to protect the most natural community possible for 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 use and support antidegradation.

Several States currently use narrative criteria. In Maine, for example, narrative criteria were established for four classes of water quality for streams and rivers (see Table 4). The classifications were based on the range of goals in the Act from "no discharge" to "protection and propagation of fish, shellfish, and wildlife" (Courtemanch and Davies 1987). Maine separated its "high quality water" into two categories, one that reflects the highest goal of the Act (no discharge, Class AA) and one that reflects high integrity but is minimally impacted by human activity (Class A). The statement "The aquatic life . . . shall be as naturally occurs" is a narrative biological criterion for both Class AA and A waters. Waters in Class B meet the use when the life stages of all indigenous aquatic species are supported and no detrimental changes occur in community composition (Maine DEP 1986). These criteria directly support refined designated aquatic life uses (see Section D, Refining Aquatic Life Use Classifications).

These narrative criteria are effective only if, as Maine has done, simple phrases such as "as naturally occurs" and "nondetrimental" are clearly operationally defined. Rules for sampling procedures and data analysis and interpretation should become part of the regulation or supporting documentation. Maine was able to develop these criteria and their supporting statements using avail-

Table 4.—Aquatic Life Classification Scheme for Maine's Rivers and Streams.

RIVERS AND STREAMS	MANAGEMENT PERSPECTIVE	LEVEL OF BIOLOGICAL INTEGRITY
Class AA	High quality water for preservation of recreational and ecological interests. No discharges of any kind permitted. No impoundment permitted.	Aquatic life shall be as naturally occurs.
Class A	High quality water with limited human interference. Discharges restricted to noncontact process water or highly treated wastewater of quality equal to or better than the receiving water. Impoundment permitted.	Aquatic life shall be as naturally occurs.
Class B	Good quality water. Discharges of well treated effluents with ample dilution permitted.	Ambient water quality sufficient to support life stages of all indigenous aquatic species. Only nondetrimental changes in community composition may occur.
Class C	Lowest quality water. Requirements consistent with interim goals of the federal Water Quality Law (fishable and swimmable).	Ambient water quality sufficient to support the life stages of all indigenous fish species Changes in species composition may occur but structure and function of the aquatic community must be maintained.

able data from water quality programs. To implement the criteria, aquatic life inhabiting unimpaired waters must be measured to quantify the criteria statement.

Narrative criteria can take more specific forms than illustrated in the Maine example. Narrative criteria may include specific classes and species of organisms that will occur in waters for a given designated use. To develop these narratives, field evaluations of reference conditions are necessary to identify biological community attributes that differ significantly between designated uses. For example in the Arkansas use class *Typical Gulf Coastal Ecoregion* (i.e., South Central Plains) the narrative criterion reads:

> *"Streams supporting diverse communities of indigenous or adapted species of fish and other forms of aquatic life. Fish communities are characterized by a limited proportion of sensitive species; sunfishes are distinctly dominant, followed by darters and minnows. The community may be generally characterized by the following fishes: Key Species—Redfin shiner, Spotted sucker, Yellow bullhead, Flier, Slough darter, Grass pickerel; Indicator Species—Pirate perch, Warmouth, Spotted sunfish, Dusky darter, Creek chubsucker, Banded pygmy sunfish (Arkansas DPCE 1988).*

In Connecticut, current designated uses are supported by narratives in the standard. For example, under Surface Water Classifications, Inland Surface Waters Class AA, the Designated Use is: "Existing or proposed drinking water supply; fish and wildlife habitat; recreational use; agricultural, industrial supply, and other purposes (recreation uses may be restricted)."

The supporting narratives include:

> *Benthic invertebrates which inhabit lotic waters: A wide variety of macroinvertebrate taxa should normally be present and all functional groups should normally be well represented . . . Water quality shall be sufficient to sustain a diverse macroinvertebrate community of indigenous species. Taxa within the Orders Plecoptera (stoneflies), Ephemeroptera (mayflies), Coleoptera (beetles), Tricoptera (caddisflies) should be well represented (Connecticut DEP 1987).*

For these narratives to be effective in a biological criteria program expressions such as "a wide variety" and "functional groups should normally be well represented" require quantifiable definitions that become part of the standard or supporting documentation. Many States may find such narratives in their standards already. If so, States should evaluate current language to determine if it meets the requirements of quantifiable narrative criteria that support refined aquatic life uses.

Narrative biological criteria are similar to the traditional narrative "free froms" by providing the legal basis for standards applications. A sixth "free from" could be incorporated into standards to help support narrative biological criteria such as "free from activities that would impair the aquatic community as it naturally occurs." Narrative biological criteria can be used immediately to address obvious existing problems.

Numeric Criteria

Numerical indices that serve as biological criteria should describe expected attainable community attributes for different designated uses. It is important to note that full implementation of narrative criteria will require similar data as that needed for developing numeric criteria. At this time, States may or may not choose to establish numeric criteria but may find it an effective tool for regulatory use.

To derive a numeric criterion, an aquatic community's structure and function is measured at reference sites and set as a reference condition. Examples of relative measures include similarity indices, coefficients of community loss, and comparisons of lists of dominant taxa. Measures of existing community structure such as species richness, presence or absence of indicator taxa, and distribution of trophic feeding groups are useful for establishing the normal range of community components to be expected in unimpaired systems. For example, Ohio uses criteria for the warmwater habitat use class based on multiple measures in different reference sites within the same ecoregion. Criteria are set as the 25th percentile of all biological index scores recorded at established reference

sites within the ecoregion. Exceptional warmwater habitat index criteria are set at the 75th percentile (Ohio EPA 1988a). Applications such as this require an extensive data base and multiple reference sites for each criteria value.

To develop numeric biological criteria, careful assessments of biota in reference sites must be conducted (Hughes et al. 1986). There are numerous ways to assess community structure and function in surface waters. No single index or measure is universally recognized as free from bias. It is important to evaluate the strengths and weaknesses of different assessment approaches. A multimetric approach that incorporates information on species richness, trophic composition, abundance or biomass, and organism condition is recommended. Evaluations that measure multiple components of communities are also recommended because they tend to be more reliable (e.g., measures of fish and macroinvertebrates combined will provide more information than measures of fish communities alone). The weaknesses of one measure or index can often be compensated by combining it with the strengths of other community measurements.

The particular indices used to develop numeric criteria depend on the type of surface waters (streams, rivers, lakes, Great Lakes, estuaries, wetlands, and nearshore marine) to which they must be applied. In general, community-level indices such as the Index of Biotic Integrity developed for midwestern streams (Karr et al. 1986) are more easily interpreted and less variable than fluctuating numbers such as population size. Future EPA technical guidance documents will include evaluations of the effectiveness of different biological survey and assessment approaches for measuring the biological integrity of surface water types and provide guidance on acceptable approaches for biological criteria development.

Refining Aquatic Life Use Classifications

State standards consist of (1) designated aquatic life uses, (2) criteria sufficient to protect the designated and existing use, and (3) an antidegradation clause. Biological criteria support designated aquatic life use classifications for application in State standards. Each State develops its own designated use classification system based on the generic uses cited in the Act (e.g., protection and propagation of fish, shellfish, and wildlife). Designated uses are intentionally general. However, States may develop subcategories within use designations to refine and clarify the use class. Clarification of the use class is particularly helpful when a variety of surface waters with distinct characteristics fit within the same use class, or do not fit well into any category. Determination of nonattainment in these waters may be difficult and open to alternative interpretations. If a determination is in dispute, regulatory actions will be difficult to accomplish. Emphasizing aquatic community structure within the designated use focuses the evaluation of attainment/nonattainment on the resource of concern under the Act.

Flexibility inherent in the State process for designating uses allows the development of subcategories of uses within the Act's general categories. For example, subcategories of aquatic life uses may be on the basis of attainable habitat (e.g., cold versus warmwater habitat); innate differences in community structure and function, (e.g., high versus low species richness or productivity); or fundamental differences in important community components (e.g., warmwater fish communities dominated by bass versus catfish). Special uses may also be designated to protect particularly unique, sensitive, or valuable aquatic species, communities, or habitats.

Refinement of use classes can be accomplished within current State use classification structures. Data collected from biosurveys as part of a developing biocriteria program may reveal unique and consistent differences among aquatic communities inhabiting different waters with the same designated use. Measurable biological attributes could then be used to separate one class into two or more classes. The result is a refined aquatic life use. For example, in Arkansas the beneficial use Fisheries "provides for the protection and propagation of fish, shellfish, and other forms of aquatic life" (Arkansas DPCE 1988). This use is subdivided into Trout, Lakes and Reservoirs, and Streams. Recognizing that stream characteristics across regions of the State differed ecologically, the State further subdivided the stream designated uses into eight additional uses based on regional characteristics (e.g Springwater-influenced Gulf Coastal Ecoregion, Ouachita Mountains Ecoregion). Within this classification system, it was relatively straightforward for

Arkansas to establish detailed narrative biological criteria that list aquatic community components expected in each ecoregion (see Narrative Criteria section). These narrative criteria can then be used to establish whether the use is impaired.

States can refine very general designated uses such as high, medium, and low quality to specific categories that include measurable ecological characteristics. In Maine, for example, Class AA waters are defined as "the highest classification and shall be applied to waters which are outstanding natural resources and which should be preserved because of their ecological, social, scenic, or recreational importance." The designated use includes 'Class AA waters shall be of such quality that they are suitable . . . as habitat for fish and other aquatic life. The habitat shall be characterized as free flowing and natural." This use supports development of narrative criteria based on biological characteristics of aquatic communities (Maine DEP 1986; see the Narrative Criteria section).

Biological criteria that include lists of dominant or typical species expected to live in the surface water are particularly effective. Descriptions of impaired conditions are more difficult to interpret. However, biological criteria may contain statements concerning which species dominate disturbed sites, as well as those species expected at minimally impacted sites.

Most States collect biological data in current programs. Refining aquatic life use classifications and incorporating biological criteria into standards will enable States to evaluate these data more effectively.

Developing and Implementing Biological Criteria

Biological criteria development and implementation in standards require an understanding of the selection and evaluation of reference sites, measurement of aquatic community structure and function, and hypothesis testing under the scientific method. The developmental process is important for State water quality managers and their staff to understand to promote effective planning for resource and staff needs. This major program element deserves careful consideration and has been separated out in Part II by chapter for each developmental step as noted below. Additional guidance will be provided in future technical guidance documents.

The developmental process is illustrated in Figure 3. The first step is establishing narrative criteria in standards. However, to support these narratives, standardized protocols need to be developed to quanitify the narratives for criteria implementation. They should include data collection procedures, selection of reference sites, quality assurance and quality control procedures, hypothesis testing, and statistical protocols. Pilot studies should be conducted using these standard protocols to ensure they meet the needs of the program, test the hypotheses, and provide effective measures of the biological integrity of surface waters in the State.

Figure 3.—Process for the Development and Implementation of Biological Criteria

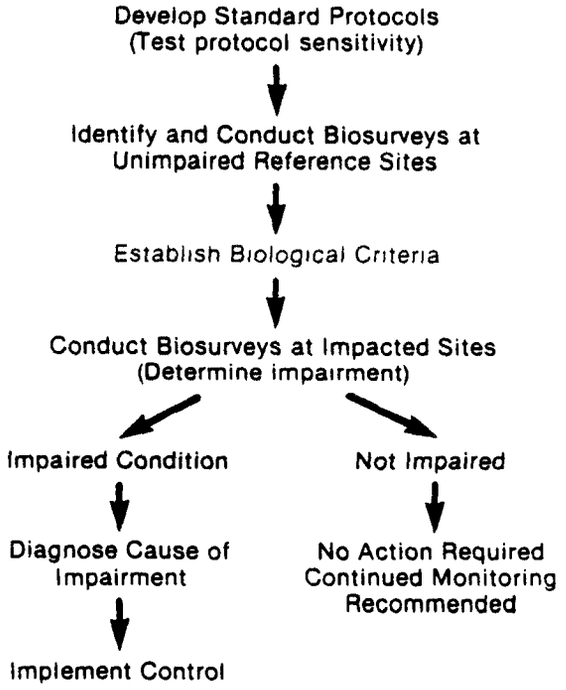


Fig. 3: Implementation of biological criteria requires the initial selection of reference sites and characterization of resident aquatic communities inhabiting those sites to establish the reference condition and biological criteria. After criteria development, impacted sites are evaluated using the same biosurvey procedures to assess resident biota. If impairment is found, diagnosis of cause will lead to the implementation of a control. Continued monitoring should accompany control implementation to determine the effectiveness of intervention. Monitoring is also recommended where no impairment is found to ensure that the surface water maintains or improves in quality.

The next step is establishing the reference condition for the surface water being tested. This reference may be site specific or regional but must establish the unimpaired baseline for comparison (see Chapter 5, The Reference Condition). Once reference sites are selected, the biological integrity of the site must be evaluated using carefully chosen biological surveys. A quality biological survey will include multiple community components and may be measured using a variety of metrics (see Chapter 6, The Biological Survey). Establishing the reference condition and conducting biological surveys at the reference locations provide the necessary information for establishing the biological criteria.

To apply biological criteria, impacted surface waters with comparable habitat characteristics are evaluated using the same procedures as those used to establish the criteria. The biological survey must support standardized sampling methods and statistical protocols that are sensitive enough to identify biologically relevant differences between established criteria and the community under evaluation. Resulting data are compared through hypothesis testing to determine impairment (see Chapter 7, Hypothesis Testing).

When water quality impairments are detected using biological criteria, they can only be applied in a regulatory setting if the cause for impairment can be identified. Diagnosis is iterative and investigative (see Chapter 7, Diagnosis). States must then determine appropriate actions to implement controls. Monitoring should remain a part of the biological criteria program whether impairments are found or not. If an impairment exists, monitoring provides a mechanism to determine if the control effort (intervention) is resulting in improved water quality. If there is no impairment, monitoring ensures the water quality is maintained and documents any improvements. When improvements in water quality are detected through monitoring programs two actions are recommended. When reference condition waters improve, biological criteria values should be recalculated to reflect this higher level of integrity. When impaired surface waters improve, states should reclassify those waters to reflect a refined designated use with a higher level of biological integrity. This provides a mechanism for progressive water quality improvement.

Chapter 4

Integrating Biological Criteria Into Surface Water Management

Integrating biological criteria into existing water quality programs will help to assess use attainment/nonattainment, improve problem discovery in specific waterbodies, and characterize overall water resource condition within a region. Ideally, biological criteria function in an iterative manner. New biosurvey information can be used to refine use classes. Refined use classes will help support criteria development and improve the value of data collected in biosurveys.

Implementing Biological Criteria

As biological survey data are collected, these data will increasingly support current use of biomonitoring data to identify water quality problems, assess their severity, and set planning and management priorities for remediation. Monitoring data and biological criteria should be used at the outset to help make regulatory decisions, develop appropriate controls, and evaluate the effectiveness of controls once they are implemented.

The value of incorporating biological survey information in regulatory programs is illustrated by evaluations conducted by North Carolina. In response to amendments of the Federal Water Pollution Control Act requiring secondary effluent limits for all wastewater treatment plants, North Carolina became embroiled in a debate over whether meeting secondary effluent limits (at considerable cost) would result in better water quality. North Carolina chose to test the effectiveness of additional treatment by conducting seven chemical and biological surveys before and after facility upgrades (North

To integrate biological criteria into water quality programs, states must carefully determine where and how data are collected to assess the biological integrity of surface waters.

Carolina DNRCD 1984). Study results indicated that moderate to substantial in-stream improvements were observed at six of seven facilities. Biological surveys were used as an efficient, cost-effective monitoring tool for assessing in-stream improvements after facility modification. North Carolina has also conducted comparative studies of benthic macroinvertebrate surveys and chemical-specific and whole-effluent evaluations to assess sensitivities of these measures for detecting impairments (Eagleson et al. 1990).

Narrative biological criteria provide a scientific framework for evaluating biosurvey, bioassessment, and biomonitoring data collected in most States. Initial application of narrative biological criteria may require only an evaluation of current work. States can use available data to define variables for choosing reference sites, selecting appropriate biological surveys, and assessing the response of local biota to a variety of impacts. States should also consider the decision criteria that will be used for determining appropriate State action when impairment is found.

Recent efforts by several States to develop biological criteria for freshwater streams provide excellent examples for how biological criteria can be integrated into water quality programs. Some of this work is described in the *National Workshop on Instream Biological Monitoring and Criteria* proceedings which recommended that "the concept of biological sampling should be integrated into the full spectrum of State and Federal surface water programs" (U.S. EPA 1987b). States are actively developing biological assessment and criteria programs; several have programs in place.

Biological Criteria in State Programs

Biological criteria are used within water programs to refine use designations, establish criteria for determining use attainment/nonattainment, evaluate effectiveness of current water programs, and detect and characterize previously unknown impairments. Twenty States are currently using some form of standardized ambient biological assessments to determine the status of biota within State waters. Levels of effort vary from bioassessment studies to fully developed biological criteria programs.

Fifteen States are developing aspects of biological assessments that will support future development of biological criteria. Colorado, Illinois, Iowa, Kentucky, Massachusetts, Tennessee, and Virginia conduct biological monitoring to evaluate biological conditions, but are not developing biological criteria. Kansas is considering using a community metric for water resource assessment. Arizona is planning to refine ecoregions for the State. Delaware, Minnesota, Texas, and Wisconsin are developing sampling and evaluation methods to apply to future biological criteria programs. New York is proposing to use biological criteria for site-specific evaluations of water quality impairment. Nebraska and Vermont use informal biological criteria to support existing aquatic life narratives in their water quality standards and other regulations. Vermont recently passed a law requiring that biological criteria be used to regulate through permitting the indirect discharge of sanitary effluents.

Florida incorporated a specific biological criterion into State standards for invertebrate species diversity. Species diversity within a waterbody, as measured by a Shannon diversity index, may not fall below 75 percent of reference values. This criterion has been used in enforcement cases to obtain injunctions and monetary settlements. Florida's approach is very specific and limits alternative applications.

Four States—Arkansas, North Carolina, Maine, and Ohio—are currently using biological criteria to define aquatic life use classifications and enforce water quality standards. These states have made biological criteria an integral part of comprehensive water quality programs.

■ **Arkansas** rewrote its aquatic life use classifications for each of the State's ecoregions. This has allowed many cities to design wastewater treatment plants to meet realistic attainable dissolved oxygen conditions as determined by the new criteria.

■ **North Carolina** developed biological criteria to assess impairment to aquatic life uses written as narratives in the State water quality standards. Biological data and criteria are used extensively to identify waters of special concern or those with exceptional water quality. In addition to the High Quality Waters (HQW) and Outstanding Resource Waters (ORW) designations, Nutrient Sensitive Waters (NSW) at risk for eutrophication are assessed using biological

criteria. Although specific biological measures are not in the regulations, strengthened use of biological monitoring data to assess water quality is being proposed for incorporation in North Carolina's water quality standards.

■ **Maine** has enacted a revised Water Quality Classification Law specifically designed to facilitate the use of biological assessments. Each of four water classes contains descriptive aquatic life conditions necessary to attain that class. Based on a statewide database of macroinvertebrate samples collected above and below outfalls, Maine is now developing a set of dichotomous keys that serve as the biological criteria. Maine's program is not expected to have a significant role in permitting, but will be used to assess the degree of protection afforded by effluent limitations.

■ **Ohio** has instituted the most extensive use of biological criteria for defining use classifications and assessing water quality. Biological criteria were developed for Ohio rivers and streams using an ecoregional reference site approach. Within each of the State's five ecoregions, criteria for three biological indices (two for fish communities and one for macroinvertebrates) were derived. Ohio successfully uses biological criteria to demonstrate attainment of aquatic life uses and discover previously unknown or unidentified environmental degradation (e.g., twice as many impaired waters were discovered using biological criteria and water chemistry together than were found using chemistry alone). The upgraded use designations based on biological criteria were upheld in Ohio courts and the Ohio EPA successfully proposed their biological criteria for inclusion in the State water quality standards regulations.

States and EPA have learned a great deal about the effectiveness of integrated biological assessments through the development of biological criteria for freshwater streams. This information is particularly valuable in providing guidance on developing biological criteria for other surface water types. As previously discussed, EPA plans to produce supporting technical guidance for biological criteria development in streams and other surface waters. Production of these guidance documents will be contingent on technical progress made on each surface water type by researchers in EPA, States and the academic community.

EPA will also be developing outreach workshops to provide technical assistance to Regions and States working toward the implementation of biological criteria programs in State water quality management programs. In the interim, States should use the technical guidance currently available in the *Technical Support Manual(s): Waterbody Surveys and Assessments for Conducting Use Attainability Analysis* (U.S. EPA 1983b, 1984a,b).

During the next triennium, State effort will be focused on developing narrative biological criteria. Full implementation and integration of biological criteria will require several years. Using available guidance, States can complement the adoption of narrative criteria by developing implementation plans that include:

1. Defining program objectives, developing research protocols, and setting priorities;

2. Determining the process for establishing reference conditions, which includes developing a process to evaluate habitat characteristics;

3. Establishing biological survey protocols that include justifications for surface water classifications and selected aquatic community components to be evaluated; and

4. Developing a formal document describing the research design, quality assurance and quality control protocols, and required training for staff.

Whether a State begins with narrative biological criteria or moves to fully implement numeric criteria, the shift of the water quality program focus from source control to resource management represents a natural progression in the evolution from the technology-based to water quality-based approaches in water quality management. The addition of a biological perspective allows water quality programs to more directly address the objectives of the Clean Water Act and to place their efforts in a context that is more meaningful to the public.

Future Directions

Biological criteria now focus on resident aquatic communities in surface waters. They have the potential to expand in scope toward greater ecological integration. Ecological criteria may encompass the ambient aquatic communities in surface waters, wildlife species that use the same aquatic resources, and the aquatic community inhabiting the gravel and sediments underlying the surface waters and adjacent land (hyporheic zone); specific criteria may apply to physical habitat. These areas may represent only a few possible options for biological criteria in the future.

Many wildlife species depend on aquatic resources. If aquatic population levels decrease or if the distribution of species changes, food sources may be sufficiently altered to cause problems for wildlife species using aquatic resources. Habitat degradation that impairs aquatic species will often impact important wildlife habitat as well. These kinds of impairments are likely to be detected using biological criteria as currently formulated. In some cases, however, uptake of contaminants by resident aquatic organisms may not result in altered structure and function of the aquatic community. These impacts may go undetected by biological criteria, but could result in wildlife impairments because of bioaccumulation. Future expansion of biological criteria to include wildlife species that depend on aquatic resources could provide a more integrative ecosystem approach.

Rivers may have a subsurface flood plain extending as far as two kilometers from the river channel. Preliminary mass transport calculations made in the Flathead River basin in Montana indicate that nutrients discharged from this subsurface flood plain may be crucial to biotic productivity in the river channel (Stanford and Ward 1988). This is an unexplored dimension in the ecology of gravel river beds and potentially in other surface waters.

As discussed in Chapter 1, physical integrity is a necessary condition for biological integrity. Establishing the reference condition for biological criteria requires evaluation of habitat. The rapid bioassessment protocol provides a good example of the importance of habitat for interpreting biological assessments (Plafkin et al. 1989). However, it may be useful to more fully integrate habitat characteristics into the regulatory process by establishing criteria based on the necessary physical structure of habitats to support ecological integrity.

Part II

The Implementation Process

The implementation of biological criteria requires: (1) selection of unimpaired (minimal impact) surface waters to use as the reference condition for each designated use, (2) measurement of the structure and function of aquatic communities in reference surface waters to establish biological criteria, and (3) establishment of a protocol to compare the biological criteria to biota in impacted waters to determine whether impairment has occurred. These elements serve as an interactive network that is particularly important during early development of biological criteria where rapid accumulation of information is effective for refining both designated uses and developing biological criteria values. The following chapters describe these three essential elements.

Chapter 5

The Reference Condition

A key step in developing values for supporting narrative and creating numeric biological criteria is to establish reference conditions; it is an essential feature of environmental impact evaluations (Green 1979). Reference conditions are critical for environmental assessments because standard experimental controls are rarely available. For most surface waters, baseline data were not collected prior to an impact, thus impairment must be inferred from differences between the impact site and established references. Reference conditions describe the characteristics of waterbody segments least impaired by human activities and are used to define attainable biological or habitat conditions.

Wide variability among natural surface waters across the country resulting from climatic, landform, and other geographic differences prevents the development of nationwide reference conditions. Most States are also too heterogeneous for single reference conditions. Thus, each State, and when appropriate, groups of States, will be responsible for selecting and evaluating reference waters within the State to establish biological criteria for a given surface water type or category of designated use. At least seven methods for estimating attainable conditions for streams have been identified (Hughes et al. 1986). Many of these can apply to other surface waters. References may be established by defining models of attainable conditions based on historical data or unimpaired habitat (e.g., streams in old growth forest). The reference condition established as before-after comparisons or concurrent measures of the reference water and impact sites can be based on empirical data (Hall et al. 1989).

Reference conditions should be established by measuring resident biota in unimpaired surface waters.

Currently, two principal approaches are used for establishing the reference condition. A State may opt to (1) identify site-specific reference sites for each evaluation of impact or (2) select ecologically similar regional reference sites for comparison with impacted sites within the same region. Both approaches depend on evaluations of habitats to ensure that waters with similar habitats are compared. The designation of discrete habitat types is more fully developed for streams and rivers. Development of habitat types for lakes, wetlands, and estuaries is ongoing.

Site-Specific Reference Condition

A site-specific reference condition, frequently used to evaluate the impacts from a point discharge, is best for surface waters with a strong directional flow such as in streams and rivers (the upstream-downstream approach). However, it can also be used for other surface waters where gradients in contaminant concentration occur based on proximity to a source (the near field-far field approach). Establishment of a site-specific reference condition requires the availability of comparable habitat within the same waterbody in both the reference location and the impacted area.

A site-specific reference condition is difficult to establish if (1) diffuse nonpoint source pollution contaminates most of the water body; (2) modifications to the channel, shoreline, or bottom substrate are extensive; (3) point sources occur at multiple locations on the waterbody; or (4) habitat characteristics differ significantly between possible reference locations and the impact site (Hughes et al. 1986; Plafkin et al. 1989). In these cases, site-specific reference conditions could result in underestimates of impairment. Despite limitations, the use of site-specific reference conditions is often the method of choice for point source discharges and certain waterbodies, particularly when the relative impairments from different local impacts need to be determined.

The Upstream-Downstream Reference Condition

The upstream-downstream reference condition is best applied to streams and rivers where the habitat characteristics of the waterbody above the point of discharge are similar to the habitat characteristics of the stream below the point of discharge. One standard procedure is to characterize the biotic condition just above the discharge point (accounting for possible upstream circulation) to establish the reference condition. The condition below the discharge is also measured at several sites. If significant differences are found between these measures, impairment of the biota from the discharge is indicated. Since measurements of resident biota taken in any two sites are expected to differ because of natural variation, more than one biological assessment for both upstream and downstream sites is often needed to be confident in conclusions drawn from these data (Green, 1979). However, as more data are collected by a State, and particularly if regional characteristics of the waterbodies are incorporated, the basis for determining impairment from site-specific upstream-downstream assessments may require fewer individual samples. The same measures made below the "recovery zone" downstream from the discharge will help define where recovery occurs.

The upstream-downstream reference condition should be used with discretion since the reference condition may be impaired from impacts upstream from the point source of interest. In these cases it is important to discriminate between individual point source impact versus overall impairment of the system. When overall impairment occurs, the resident biota may be sufficiently impaired to make it impossible to detect the effect of the target point source discharger.

The approach can be cost effective when one biological assessment of the upstream reference condition adequately reflects the attainable condition of the impacted site. However, routine comparisons may require assessments of several upstream sites to adequately describe the natural variability of reference biota. Even so, measuring a series of site-specific references will likely continue to be the method of choice for certain point source discharges, especially where the relative impairments from different local impacts need to be determined.

The Near Field-Far Field Reference Condition

The near field-far field reference condition is effective for establishing a reference condition in surface waters other than rivers and streams and is particularly applicable for unique waterbodies (e.g., estuaries such as Puget Sound may not have comparable estuaries for comparison). To apply this method, two variables are measured (1) habitat characteristics, and (2) gradient of impairment. For reference waters to be identified within the same waterbody, sufficient size is necessary to separate the reference from the impact area so that a gradient of impact exists. At the same time, habitat characteristics must be comparable.

Although not fully developed, this approach may provide an effective way to establish biological criteria for estuaries, large lakes, or wetlands. For example, estuarine habitats could be defined and possible reference waters identified using physical and chemical variables like those selected by the Chesapeake Bay Program (U.S. EPA 1987a, e.g., substrate type, salinity, pH) to establish comparable subhabitats in an estuary. To determine those areas least impaired, a "mussel watch" program like that used in Narragansett Bay (i.e., captive mussels are used as indicators of contamination, (Phelps 1988)) could establish impairment gradients. These two measures, when combined, could form the basis for selecting specific habitat types in areas of least impairment to establish the reference condition.

Regional Reference Conditions

Some of the limitations of site-specific reference conditions can be overcome by using regional reference conditions that are based on the assumption that surface waters integrate the character of the land they drain. Waterbodies within the same watershed in the same region should be more similar to each other than to those within watersheds in different regions. Based on these assumptions, a distribution of aquatic regions can be developed based on ecological features that directly or indirectly relate to water quality and quantity, such as soil type, vegetation (land cover), land-surface form, climate, and land use. Maps that incorporate several of these features will provide a general purpose broad scale ecoregional framework (Gallant et al. 1989).

Regions of ecological similarity are based on hydrologic, climatic, geologic, or other relevant geographic variables that influence the nature of biota in surface waters. To establish a regional reference condition, surface waters of similar habitat type are identified in definable ecological regions. The biological integrity of these reference waters is determined to establish the reference condition and develop biological criteria. These criteria are then used to assess impacted surface waters in the same watershed or region. There are two forms of regional reference conditions: (1) paired watersheds and (2) ecoregions.

Paired Watershed Reference Conditions

Paired watershed reference conditions are established to evaluate impaired waterbodies, often impacted by multiple sources. When the majority of a waterbody is impaired, the upstream-downstream or near field-far field reference condition does not provide an adequate representation of the unimpaired condition of aquatic communities for the waterbody. Paired watershed reference conditions are established by identifying unimpaired surface waters within the same or very similar local watershed that is of comparable type and habitat. Variables to consider when selecting the watershed reference condition include absence of human disturbance, waterbody size and other physical characteristics, surrounding vegetation, and others as described in the "Regional Reference Site Selection" feature.

This method has been successfully applied (e.g., Hughes 1985) and is an approach used in Rapid Bioassessment Protocols (Plafkin et al. 1989). State use of this approach results in good reference conditions that can be used immediately in current programs. This approach has the added benefit of promoting the development of a database on high quality waters in the State that could form the foundation for establishing larger regional references (e.g., ecoregions.)

Ecoregional Reference Conditions

Reference conditions can also be developed on a larger scale. For these references, waterbodies of similar type are identified in regions of ecological similarity. To establish a regional reference condition, a set of surface waters of similar habitat type are identified in each ecological region. These sites must represent similar habitat type and be representative of the region. As with other reference conditions, the biological integrity of selected reference waters is determined to establish the reference. Biological criteria can then be developed and used to assess impacted surface waters in the same region. Before reference conditions may be established, regions of ecological similarity must be defined.

Regional Reference Site Selection

To determine specific regional reference sites for streams, candidate watersheds are selected from the appropriate maps and evaluated to determine if they are typical for the region. An evaluation of level of human disturbance is made and a number of relatively undisturbed reference sites are selected from the candidate sites. Generally, watersheds are chosen as regional reference sites when they fall entirely within typical areas of the region. Candidate sites are then selected by aerial and ground surveys. Identification of candidate sites is based on: (1) absence of human disturbance, (2) stream size, (3) type of stream channel, (4) location within a natural or political refuge, and (5) historical records of resident biota and possible migration barriers.

Final selection of reference sites depends on a determination of minimal disturbance derived from habitat evaluation made during site visits. For example, indicators of good quality streams in forested ecoregions include: (1) extensive, old, natural riparian vegetation; (2) relatively high heterogeneity in channel width and depth; (3) abundant large woody debris, coarse bottom substrate, or extensive aquatic or overhanging vegetation, (4) relatively high or constant discharge; (5) relatively clear waters with natural color and odor; (6) abundant diatom, insect, and fish assemblages; and (7) the presence of piscivorous birds and mammals.

One frequently used method is described by Omernik (1987) who combined maps of land-surface form, soil, potential natural vegetation, and land use within the conterminous United States to generate a map of aquatic ecoregions for the country. He also developed more detailed regional maps. The ecoregions defined by Omernik have been evaluated for streams and small rivers in Arkansas (Rohm et al. 1987), Ohio (Larsen et al. 1986; Whittier et al. 1987), Oregon (Whittier et al. 1988), Colorado (Gallant et al. 1989), and Wisconsin (Lyons 1989) and for lakes in Minnesota (Heiskary et al. 1987). State ecoregion maps were developed for Colorado (Gallant et al. 1989) and Oregon (Clarke et al. mss). Maps for the national ecoregions and six multi-state maps of more detailed ecoregions are available from the U.S. EPA Environmental Research Laboratory, Corvallis, Oregon.

Ecoregions such as those defined by Omernik (1987) provide only a first step in establishing regional reference sites for development of the reference condition. Field site evaluation is required to account for the inherent variability within each ecoregion. A general method for selecting reference sites for streams has been described (Hughes et al. 1986). These are the same variables used for comparable watershed reference site selection. Regional and on-site evaluations of biological factors help determine specific sites that best represent typical but unimpaired surface water habitats within the region. Details on this approach for streams is described in the "Regional Reference Site Selection" feature. To date, the regional approach has been tested on streams, rivers, and lakes. The method appears applicable for assessing other inland ecosystems. To apply this approach to wetlands and estuaries will require additional evaluation based on the relevant ecological features of these ecosystems (e.g. Brooks and Hughes, 1988).

Ideally, ecoregional reference sites should be as little disturbed as possible, yet represent waterbodies for which they are to serve as reference waters. These sites may serve as references for a large number of similar waterbodies (e.g., several reference streams may be used to define the reference condition for numerous physically separate streams if the reference streams contain the same range of stream morphology, substrate, and flow of the other streams within the same ecological region).

An important benefit of a regional reference system is the establishment of a baseline condition for the least impacted surface waters within the dominant land use pattern of the region. In many areas a return to pristine, or presettlement, conditions is impossible, and goals for waterbodies in extensively developed regions could reflect this. Regional reference sites based on the least impacted sites within a region will help water quality programs restore and protect the environment in a way that is ecologically feasible.

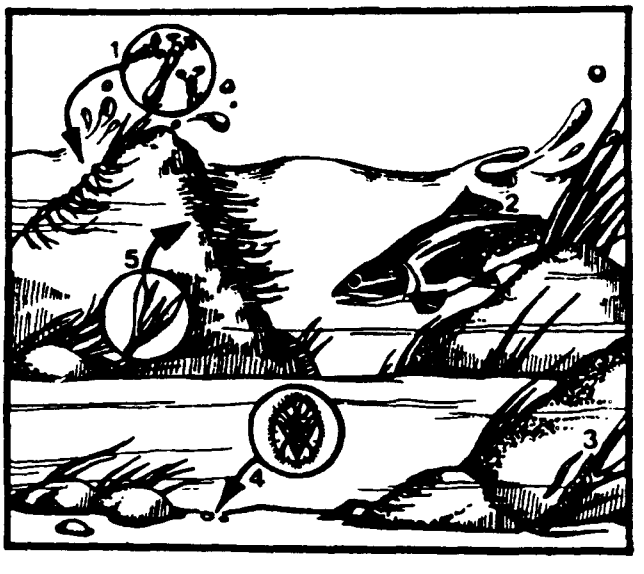
This approach must be used with caution for two reasons. First, in many urban, industrial, or heavily developed agricultural regions, even the least impacted sites are seriously degraded. Basing standards or criteria on such sites will set standards too low if these high levels of environmental degradation are considered acceptable or adequate. In such degraded regions, alternative sources for the regional reference may be needed (e.g., measures taken from the same region in a less developed neighboring State or historical records from the region before serious impact occurred). Second, in some regions the minimally-impacted sites are not typical of most sites in the region and may have remained unimpaired precisely because they are unique. These two considerations emphasize the need to select reference sites very carefully, based on solid quantitative data interpreted by professionals familiar with the biota of the region.

Each State, or groups of States, can select a series of regional reference sites that represent the attainable conditions for each region. Once biological criteria are established using this approach, the cost for evaluating local impairments is often lower than a series of measures of site-specific reference sites. Using paired watershed reference conditions immediately in regulatory programs will provide the added benefit of building a database for the development of regions of ecological similarity.

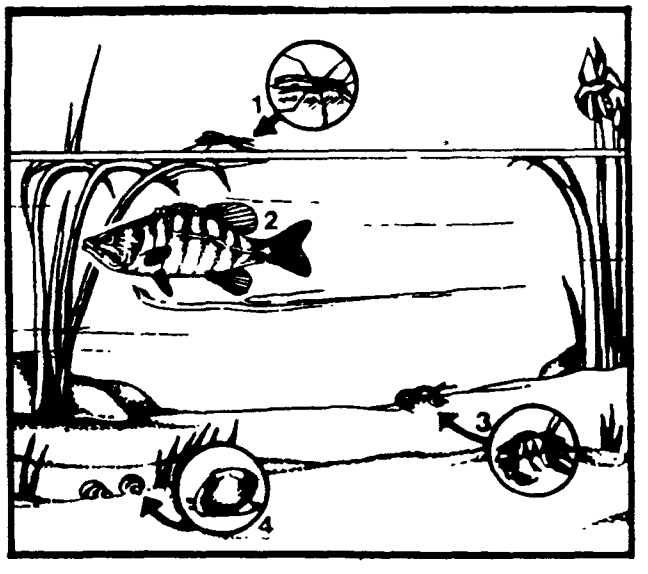
Chapter 6

The Biological Survey

A critical element of biological criteria is the characterization of biological communities inhabiting surface waters. Use of biological data is not new; biological information has been used to assess impacts from pollution since the 1890s (Forbes 1928), and most States currently incorporate biological information in their decisions about the quality of surface waters. However, biological information can be obtained through a variety of methods, some of which are more effective than others for characterizing resident aquatic biota. Biological criteria are developed using biological surveys; these provide the only direct method for measuring the structure and function of an aquatic community.



Different subhabitat within the same surface water will contain unique aquatic community components. In fast-flowing stream segments species such as (1) black fly larva; (2) brook trout; (3) water penny; (4) crane fly larva; and (5) water moss occur.



However, in slow-flowing stream segments, species like (1) water strider; (2) smallmouth bass; (3) crayfish; and (4) fingernail clams are abundant.

Biological survey study design is of critical importance to criteria development. The design must be scientifically rigorous to provide the basis for legal action, and be biologically relevant to detect problems of regulatory concern. Since it is not financially or technically feasible to evaluate all organisms in an entire ecosystem at all times, careful selection of community components, the time and place chosen for assessments, data gathering methods used, and the consistency with which these variables are applied will determine the success of the biological criteria program. Biological surveys must therefore be carefully planned to meet scientific and legal requirements, maximize information, and minimize cost.

Biological surveys can range from collecting samples of a single species to comprehensive evaluations of an entire ecosystem. The first approach is difficult to interpret for community assessment; the second approach is expensive and impractical. A balance between these extremes can meet program needs. Current approaches range between detailed ecological surveys, biosurveys of targeted community components, and biological indicators (e.g., keystone species). Each of these biosurveys has advantages and limitations. Additional discussion will be provided in technical guidance under development.

No single type of approach to biological surveys is always best. Many factors affect the value of the approach, including seasonal variation, waterbody size, physical boundaries, and other natural characteristics. Pilot testing alternative approaches in State waters may be the best way to determine the sensitivity of specific methods for evaluating biological integrity of local waters. Due to the number of alternatives available and the diversity of ecological systems, individuals responsible for research design should be experienced biologists with expertise in the local and regional ecology of target surface waters. States should develop a data management program that includes data analysis and evaluation and standard operating procedures as part of a Quality Assurance Program Plan.

When developing study designs for biological criteria, two key elements to consider include (1) selecting aquatic community components that will best represent the biological integrity of State surface waters and (2) designing data collection protocols to ensure the best representation of the aquatic community. Technical guidance currently available to aid the development of study design include: *Water Quality Standards Handbook* (U.S. EPA 1983a), *Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses* (U.S. EPA 1983b); *Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses, Volume II: Estuarine Systems* (U.S. EPA 1984a); and *Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses, Volume III: Lake Systems* (U.S. EPA 1984b). Future technical guidance will build on these documents and provide specific guidance for biological criteria development.

Selecting Aquatic Community Components

Aquatic communities contain a variety of species that represent different trophic levels, taxonomic groups, functional characteristics, and tolerance ranges. Careful selection of target taxonomic groups can provide a balanced assessment that is sufficiently broad to describe the structural and functional condition of an aquatic ecosystem, yet be sufficiently practical to use on a daily basis (Plafkin et al. 1989; Lenat 1988). When selecting community components to include in a biological assessment, primary emphasis should go toward including species or taxa that (1) serve as effective indicators of high biological integrity (i.e., those likely to live in unimpaired waters), (2) represent a range of pollution tolerances, (3) provide predictable, repeatable results, and (4) can be readily identified by trained State personnel.

Fish, macroinvertebrates, algae, and zooplankton are most commonly used in current bioassessment programs. The taxonomic groups chosen will vary depending on the type of aquatic ecosystem being assessed and the type of expected impairment. For example, benthic macroinvertebrate and fish communities are taxonomic groups often chosen for flowing fresh water. Macroinvertebrates and fish both provide valuable ecological information while fish correspond to the regulatory and public perceptions of water quality and reflect cumulative environmental stress over longer time frames. Plants are often used in wetlands, and algae are useful in lakes and estuaries to assess eutrophication. In marine systems, benthic macroinvertebrates and submerged aquatic vegetation may provide key community components. Amphipods, for example, dominate many aquatic communities and are more sensitive than other invertebrates such as polychaetes and molluscs to a wide variety of pollutants including hydrocarbons and heavy metals (Reich and Hart 1979; J.D. Thomas, pers. comm.).

It is beneficial to supplement standard groups with additional community components to meet specific goals, objectives, and resources of the assessment program. Biological surveys that use two or three taxonomic groups (e.g., fish, macroinvertebrates, algae) and, where appropriate, include different trophic levels within each group (e.g., primary, secondary, and tertiary consumers) will

provide a more realistic evaluation of system biological integrity. This is analogous to using species from two or more taxonomic groups in bioassays. Impairments that are difficult to detect because of the temporal or spatial habits or the pollution tolerances of one group may be revealed through impairments in different species or assemblages (Ohio EPA 1988a).

Selection of aquatic community components that show different sensitivities and responses to the same perturbation will aid in identifying the nature of a problem. Available data on the ecological function, distribution, and abundance of species in a given habitat will help determine the most appropriate target species or taxa for biological surveys in the habitat. The selection of community components should also depend on the ability of the organisms to be accurately identified by trained State personnel. Attendent with the biological criteria program should be the development of identification keys for the organisms selected for study in the biological survey.

Biological Survey Design

Biological surveys that measure the structure and function of aquatic communities will provide the information needed for biological criteria development. Elements of community structure and function may be evaluated using a series of metrics. Structural metrics describe the composition of a community, such as the number of different species, relative abundance of specific species, and number and relative abundance of tolerant and intolerant species. Functional metrics describe the ecological processes of the community. These may include measures such as community photosynthesis or respiration. Function may also be estimated from the proportions of various feeding groups (e.g., omnivores, herbivores, and insectivores, or shredders, collectors, and grazers). Biological surveys can offer variety and flexibility in application. Indices currently available are primarily for freshwater streams. However, the approach has been used for lakes and can be developed for estuaries and wetlands.

Selecting the metric

Several methods are currently available for measuring the relative structural and functional well-being of fish assemblages in freshwater streams, such as the Index of Biotic Integrity (IBI); Karr 1981; Karr et al. 1986; Miller et al. 1988) and the Index of Well-being (IWB; Gammon 1976, Gammon et al. 1981). The IBI is one of the more widely used assessment methods. For additional detail, see the "Index of Biotic Integrity" feature.

Index of Biotic Integrity

The Index of Biotic Integrity (IBI) is commonly used for fish community analysis (Karr 1981). The original IBI was comprised of 12 metrics:

- *six metrics evaluate species richness and composition*
  - *number of species*
  - *number of darter species*
  - *number of sucker species*
  - *number of sunfish species*
  - *number of intolerant species*
  - *proportion of green sunfish*
- *three metrics quantify trophic composition*
  - *proportion of omnivores*
  - *proportion of insectivorous cyprinids*
  - *proportion of piscivores*
- *three metrics summarize fish abundance and condition information*
  - *number of individuals in sample*
  - *proportion of hybrids*
  - *proportion of individuals with disease*

Each metric is scored 1 (worst), 3, or 5 (best), depending on how the field data compare with an expected value obtained from reference sites. All 12 metric values are then summed to provide an overall index value that represents relative integrity. The IBI was designed for midwestern streams; substitute metrics reflecting the same structural and functional characteristics have been created to accommodate regional variations in fish assemblages (Miller et al. 1988).

Several indices that evaluate more than one community characteristic are also available for assessing stream macroinvertebrate populations. Taxa richness, EPT taxa (number of taxa of the insect orders Ephemeroptera, Plecoptera, and Tricoptera), and species pollution tolerance values are a few of several components of these macroinvertebrate assessments. Example indices include the Invertebrate Community Index (ICI; Ohio EPA, 1988) and Hilsenhoff Biotic Index (HBI; Hilsenhoff, 1987).

Within these metrics specific information on the pollution tolerances of different species within a system will help define the type of impacts occurring in a waterbody. Biological indicator groups (intolerant species, tolerant species, percent of diseased organisms) can be used for evaluating community biological integrity if sufficient data have been collected to support conclusions drawn from the indicator data. In marine systems, for example, amphipods have been used by a number of researchers as environmental indicators (McCall 1977; Botton 1979; Mearns and Word 1982).

Sampling design

Sampling design and statistical protocols are required to reduce sampling error and evaluate the natural variability of biological responses that are found in both laboratory and field data. High variability reduces the power of a statistical test to detect real impairments (Sokal and Rohlf, 1981). States may reduce variability by refining sampling techniques and protocol to decrease variability introduced during data collection, and increase the power of the evaluation by increasing the number of replications. Sampling techniques are refined, in part, by collecting a representative sample of resident biota from the same component of the aquatic community from the same habitat type in the same way at sites being compared. Data collection protocols should incorporate (1) spatial scales (where and how samples are collected) and (2) temporal scales (when data are collected) (Green, 1979):

- **Spatial Scales** refer to the wide variety of subhabitats that exist within any surface water habitat. To account for subhabitats, adequate sampling protocols require selecting (1) the location within a habitat where target groups reside and (2) the method for collecting data on target groups. For example, if fish are sampled only from fast flowing riffles within stream A, but are sampled from slow flowing pools in stream B, the data will not be comparable.

- **Temporal Scales** refer to aquatic community changes that occur over time because of diurnal and life-cycle changes in organism behavior or development, and seasonal or annual changes in the environment. Many organisms go through seasonal life-cycle changes that dramatically affect their presence and abundance in the aquatic community. For example, macroinvertebrate data collected from stream A in March and stream B in May, would not be comparable because the emergence of insect adults after March would significantly alter the abundance of subadults found in stream B in May. Similar problems would occur if algae were collected in lake A during the dry season and lake B during the wet season.

Field sampling protocols that produce quality assessments from a limited number of site visits greatly enhance the utility of the sampling technique. Rapid bioassessment protocols, recently developed for assessing streams, use standardized techniques to quickly gather physical, chemical, and biological quantitative data that can assess changes in biological integrity (Plafkin et al. 1989). Rapid bioassessment methods can be cost-effective biological assessment approaches when they have been verified with more comprehensive evaluations for the habitats and region where they are to be applied.

Biological survey methods such as the IBI for fish and ICI for macroinvertebrates were developed in streams and rivers and have yet to be applied to many ecological regions. In addition, further research is needed to adapt the approach to lakes, wetlands, and estuaries, including the development of alternative structural or functional endpoints. For example, assessment methods for algae (e.g. measures of biomass, nuisance bloom frequency, community structure) have been used for lakes. Assessment metrics appropriate for developing biological criteria for lakes, large rivers, wetlands, and estuaries are being developed and tested so that a multi-metric approach can be effectively used for all surface waters.

Chapter 7

Hypothesis Testing: Biological Criteria and the Scientific Method

Biological criteria are applied in the standards program by testing hypotheses about the biological integrity of impacted surface waters. These hypotheses include the null hypothesis—the designated use of the waterbody is not impaired—and alternative hypotheses such as the designated use of the waterbody is impaired (more specific hypotheses can also be generated that predict the type(s) of impairment). Under these hypotheses specific predictions are generated concerning the kinds and numbers of organisms representing community structure and function expected or found in unimpaired habitats. The kinds and numbers of organisms surveyed in unimpaired waters are used to establish the biological criteria. To test the alternative hypotheses, data collection and analysis procedures are used to compare the criteria to comparable measures of community structure and function in impacted waters.

Multiple impacts in the same surface water such as discharges of effluent from point sources, leachate from landfills or dumps, and erosion from habitat degradation each contribute to impairment of the surface water. All impacts should be considered during the diagnosis process.

Hypothesis Testing

To detect differences of biological and regulatory concern between biological criteria and ambient biological integrity at a test site, it is important to establish the sensitivity of the evaluation. A 10 percent difference in condition is more difficult to detect than a 50 percent difference. For the experimental/survey design to be effective, the level of detection should be predetermined to establish sample size for data collection (Sokal and Rohlf 1981). Knowledge of expected natural variation, experimental error, and the kinds of detectable differences that can be expected will help determine sample

size and location. This forms the basis for defining data quality objectives, standardizing data collection procedures, and developing quality assurance/ quality control standards.

Once data are collected and analyzed, they are used to test the hypotheses to determine if characteristics of the resident biota at a test site are significantly different from established criteria values for a comparable habitat. There are three possible outcomes:

1. The use is impaired when survey design and data analyses are sensitive enough to detect differences of regulatory importance, and significant differences were detected. The next step is to diagnose the cause(s) and source(s) of impairment.

2. The biological criteria are met when survey design and data analyses are sensitive enough to detect differences of regulatory significance, but no differences were found. In this case, no action is required by States based on these measures. However, other evidence may indicate impairment (e.g., chemical criteria are violated; see below).

3. The outcome is indeterminate when survey design and data analyses are not sensitive enough to detect differences of regulatory significance, and no differences were detected. If a State or Region determines that this is occurring, the development of study design and evaluation for biological criteria was incomplete. States must then determine whether they will accept the sensitivity of the survey or conduct additional surveys to increase the power of their analyses. If the sensitivity of the original survey is accepted, the State should determine what magnitude of difference the survey is capable of detecting. This will aid in re-evaluating research design and desired detection limits. An indeterminate outcome may also occur if the test site and the reference conditions were not comparable. This variable may also require re-evaluation.

As with all scientific studies, when implementing biological criteria, the purpose of hypothesis testing is to determine if the data support the conclusion that the null hypothesis is false (i.e., the designated use is not impaired in a particular waterbody). Biological criteria cannot prove attainment. This reasoning provides the basis for emphasizing independent application of different assessment methods (e.g., chemical verses biological criteria). No type of criteria can "prove" attainment; each type of criteria can disprove attainment.

Although this discussion is limited to the null and one alternative hypothesis, it is possible to generate multiple working hypotheses (Popper, 1968) that promote the diagnosis of water quality problems when they exist. For example, if physical habitat limitations are believed to be causing impairment (e.g., sedimentation) one alternative hypothesis could specify the loss of community components sensitive to this impact. Using multiple hypotheses can maximize the information gained from each study. See the Diagnosis section for additional discussion.

Diagnosis

When impairment of the designated use is found using biological criteria, a diagnosis of probable cause of impairment is the next step for implementation. Since biological criteria are primarily designed to detect water quality impairment, problems are likely to be identified without a known cause. Fortunately the process of evaluating test sites for biological impairment provides significant information to aid in determining cause.

During diagnostic evaluations, three main impact categories should be considered: chemical, physical, and biological. To begin the diagnostic process two questions are posed:

- What are the obvious causes of impairment?
- If no obvious causes are apparent, what possible causes do the biological data suggest?

Obvious causes such as habitat degradation, point source discharges, or introduced species are often identified during the course of a normal field biological assessment. Biomonitoring programs normally provide knowledge of potential sources of impact and characteristics of the habitat. As such, diagnosis is partly incorporated into many existing State field-oriented bioassessment programs. If more than one impact source is obvious, diagnosis

will require determining which impact(s) is the cause of impairment or the extent to which each impact contributes to impairment. The nature of the biological impairment can guide evaluation (e.g., chemical contamination may lead to the loss of sensitive species, habitat degradation may result in loss of breeding habitat for certain species).

Case studies illustrate the effectiveness of biological criteria in identifying impairments and possible sources. For example, in Kansas three sites on Little Mill Creek were assessed using Rapid Bioassessment Protocols (Plafkin et al. 1989; see Fig. 4). Based on the results of a comparative analysis, habitats at the three sites were comparable and of high quality. Biological impairment, however, was identified at two of the three sites and directly related to proximity to a point source discharge from a sewage treatment plant. The severely impaired Site (STA 2) was located approximately 100 meters downstream from the plant. The slightly impaired Site (STA 3) was located between one and two miles downstream from the plant. However, the unimpaired Site (STA 1(R)) was approximately 150 meters upstream from the plant (Plafkin et al. 1989). This simple example illustrates the basic principles of diagnosis. In this case the treatment plant appears responsible for impairment of the resident biota and the discharge needs to be evaluated. Based on the biological survey the results are clear. However, impairment in resident populations of macroinvertebrates probably would not have been recognized using more traditional methods.

In Maine, a more complex problem arose when effluents from a textile plant met chemical-specific and effluent toxicity criteria, yet a biological survey of downstream biota revealed up to 80 percent reduction in invertebrate richness below plant outfalls. Although the source of impairment seemed clear, the cause of impairment was more difficult to determine. By engaging in a diagnostic evaluation, Maine was able to determine that the discharge contained chemicals not regulated under current programs and that part of the toxicity effect was due to the sequential discharge of unique effluents (tested individually these effluents were not toxic; when exposure was in a particular sequence, toxicity occurred). Use of biological criteria resulted in the detection and diagnosis of this toxicity problem, which allowed Maine to develop workable alternative operating procedures for the textile industry to correct the problem (Courtemanch 1989, and pers. comm.).

During diagnosis it is important to consider and discriminate among multiple sources of impairment. In a North Carolina stream (see Figure 5) four sites were evaluated using rapid bioassessment techni-

Figure 4.—Kansas: Benthic Bioassessment of Little Mill Creek (Little Mill Creek = Site-Specific Reference) Relationship of Habitat and Bioassessment

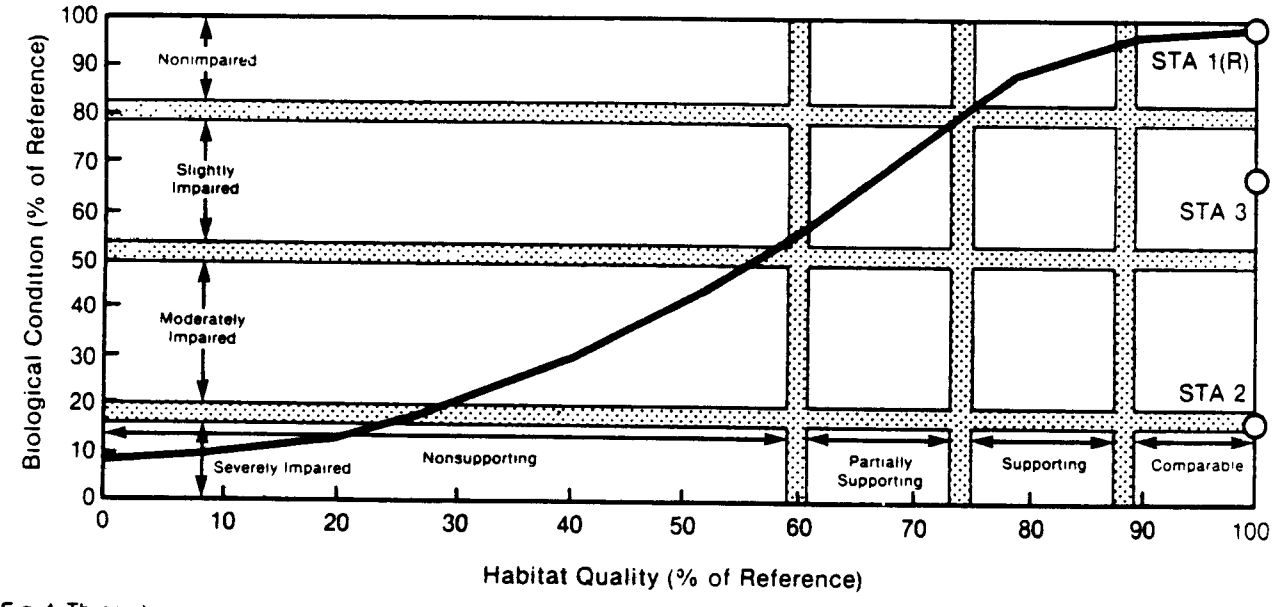


Fig. 4: Three stream segments sampled in a stream in Kansas using Rapid Bioassessment Protocols (Plafkin et al. 1989) revealed significant impairments at sites below a sewage treatment plant.

Figure 5.—The Relationship Between Habitat Quality and Benthic Community Condition at the North Carolina Pilot Study Site.

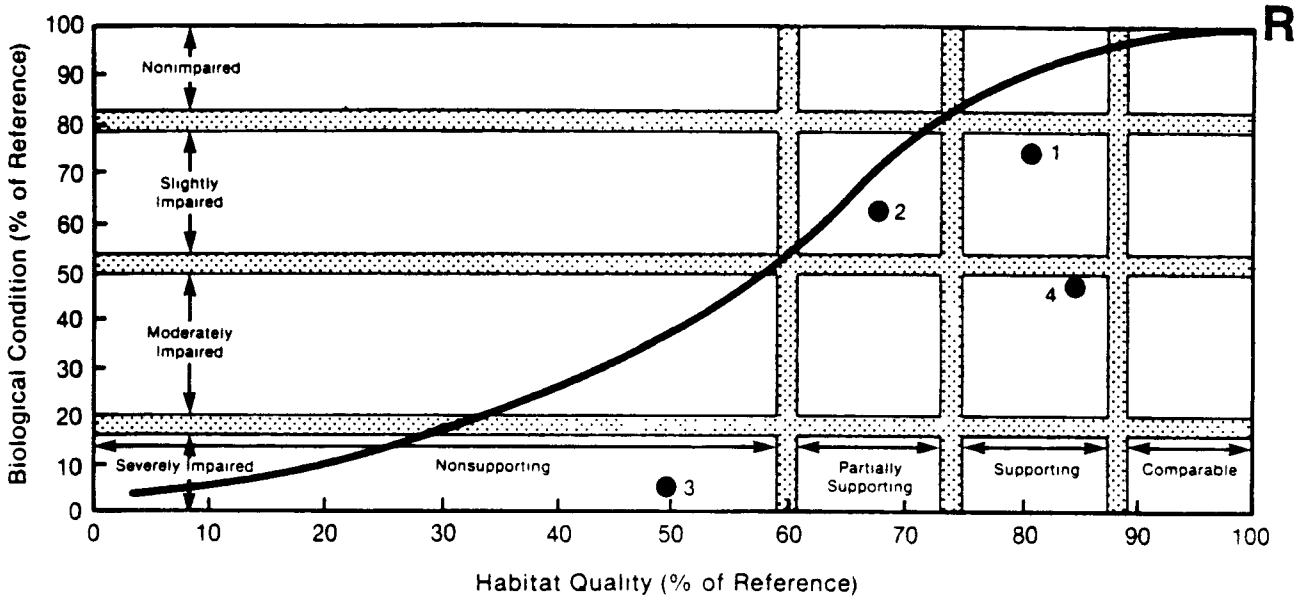


Fig. 5: Distinguishing between point and nonpoint sources of impairment requires an evaluation of the nature and magnitude of different sites in a surface water. (Plafkin, et al. 1989)

ques. An ecoregional reference site (R) established the highest level of biological integrity for that stream type. Site (1), well upstream from a local town, was used as the upstream reference condition. Degraded conditions at Site (2) suggested nonpoint source problems and habitat degradation because of proximity to residential areas on the upstream edge of town. At Site (3) habitat alterations, nonpoint runoff, and point source discharges combined to severely degrade resident biota. At this site, sedimentation and toxicity from municipal sewage treatment effluent appeared responsible for a major portion of this degradation. Site (4), although several miles downstream from town, was still impaired despite significant improvement in habitat quality. This suggests that toxicity from upstream discharges may still be occurring (Barbour, 1990 pers. comm.). Using these kinds of comparisons, through a diagnostic procedure and by using available chemical and biological assessment tools, the relative effects of impacts can be determined so that solutions can be formulated to improve water quality.

When point and nonpoint impact and physical habitat degradation occur simultaneously, diagnosis may require the combined use of biological, physical, and chemical evaluations to discriminate between these impacts. For example, sedimentation of a stream caused by logging practices is likely to result in a decrease in species that require loose gravel for spawning but increase species naturally adapted to fine sediments. This shift in community components correlates well with the observed impact. However, if the impact is a point source discharge or nonpoint runoff of toxicants, both species types are likely to be impaired whether sedimentation occurs or not (although gravel breeding species can be expected to show greater impairment if sedimentation occurs). Part of the diagnostic process is derived from an understanding of organism sensitivities to different kinds of impacts and their habitat requirements. When habitat is good but water quality is poor, aquatic community components sensitive to toxicity will be impaired. However, if both habitat and water quality degrade, the resident community is likely to be composed of tolerant and opportunistic species.

When an impaired use cannot be easily related to an obvious cause, the diagnostic process becomes investigative and iterative. The iterative diagnostic process as shown in Figure 6 may require additional time and resources to verify cause and source. Initially, potential sources of impact are identified and mapped to determine location relative

Figure 6.—Diagnostic Process

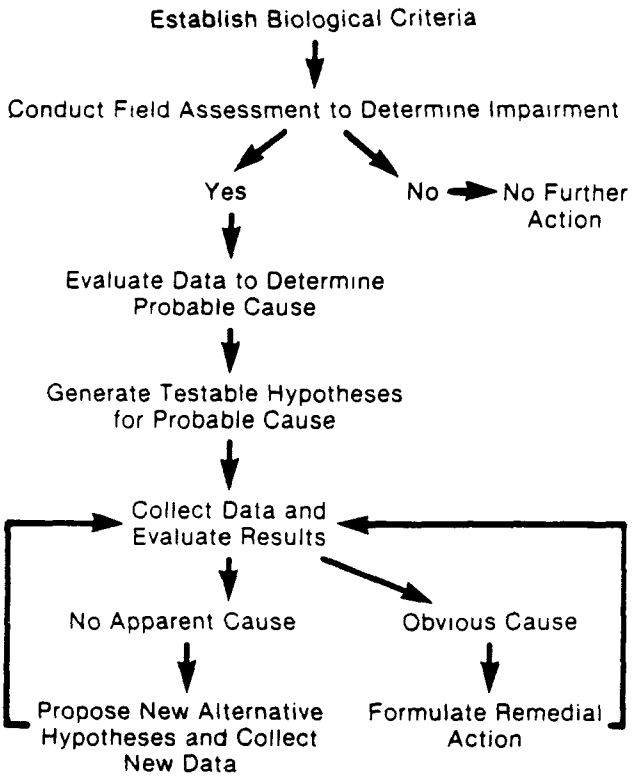


Fig. 6. The diagnostic process is a stepwise process for determining the cause of impaired biological integrity in surface waters It may require multiple hypotheses testing and more than one remedial plan

to the area suffering from biological impairment. An analysis of the physical, chemical, and biological characteristics of the study area will help identify the most likely sources and determine which data will be most valuable. Hypotheses that distinguish between possible causes of impairment should be generated. Study design and appropriate data collection procedures need to be developed to test the hypotheses. The severity of the impairment, the difficulty of diagnosis, and the costs involved will determine how many iterative loops will be completed in the diagnostic process.

Normally, diagnoses of biological impairment are relatively straightforward. States may use biological criteria as a method to confirm impairment from a known source of impact. However, the diagnostic process provides an effective way to identify unknown impacts and diagnose their cause so that corrective action can be devised and implemented.

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Appendix A

Common Questions and Their Answers

Q. *How will implementing biological criteria benefit State water quality programs?*

A. State water quality programs will benefit from biological criteria because they:

a) directly assess impairments in ambient biota from adverse impacts on the environment;

b) are defensible and quantifiable;

c) document improvements in water quality resulting from agency action;

d) reduce the likelihood of false positives (i.e., a conclusion that attainment is achieved when it is not);

e) provide information on the integrity of biological systems that is compelling to the public.

Q. *How will biological criteria be used in a permit program?*

A. When permits are renewed, records from chemical analyses and biological assessments are used to determine if the permit has effectively prevented degradation and led to improvement. The purpose for this evaluation is to determine whether applicable water quality standards were achieved under the expiring permit and to decide if changes are needed. Biological surveys and criteria are particularly effective for determining the quality of waters subject to permitted discharges. Since biosurveys provide ongoing integrative evaluations of the biological integrity of resident biota, permit writers can make informed decisions on whether to maintain or restrict permit limits.

Q. *What expertise and staff will be needed to implement a biological criteria program?*

A. Staff with sound knowledge of State aquatic biology and scientific protocol are needed to coordinate a biological criteria program. Actual field monitoring could be accomplished by summer-hire biologists led by permanent staff aquatic biologists. Most States employ aquatic biologists for monitoring trends or issuing site-specific permits.

Q. *Which management personnel should be involved in a biologically-based approach?*

A. Management personnel from each area within the standards and monitoring programs should be involved in this approach, including permit engineers, resource managers, and field personnel.

Q. *How much will this approach cost?*

A. The cost of developing biological criteria is a State-specific question depending upon many variables. However, States that have implemented a biological criteria program have found it to be cost effective (e.g., Ohio). Biological criteria provide an integrative assessment over time. Biota reflect multiple impacts. Testing for impairment of resident aquatic communities can actually require less monitoring than would be required to detect many impacts using more traditional methods (e.g., chemical testing for episodic events).

Q. *What are some concerns of dischargers?*

A. Dischargers are concerned that biological criteria will identify impairments that may be erroneously attributed to a discharger who is not responsible. This is a legitimate concern that the discharger and State must address with careful evaluations and diagnosis of cause of impairment. However, it is particularly important to ensure that waters used for the reference condition are not already impaired as may occur when conducting site-specific upstream-downstream evaluations. Although a discharger may be contributing to surface water degradation, it may be hard to detect using biosurvey methods if the waterbody is also impaired from other sources. This can be evaluated by testing the possible toxicity of effluent-free reference waters on sensitive organisms.

Dischargers are also concerned that current permit limits may become more stringent if it is determined that meeting chemical and whole-effluent permit limits are not sufficient to protect aquatic life from discharger activities. Alternative forms of regulation may be needed; these are not necessarily financially burdensome but could involve additional expense.

Burdensome monitoring requirements are additional concerns. With new rapid bioassessment protocols available for streams, and under development for other surface waters, monitoring resident biota is becoming more straightforward. Since resident biota provide an integrative measure of environmental impacts over time, the need for continual biomonitoring is actually lower than chemical analyses and generally less expensive. Guidance is being developed to establish acceptable research protocols, quality assurance/quality control programs and training opportunities to ensure that adequate guidance is available.

Q. *What are the concerns of environmentalists?*

A. Environmentalists are concerned that biological criteria could be used to alter restrictions on dischargers if biosurvey data indicate attainment of a designated use even though chemical criteria and/or whole-effluent toxicity evaluations predict impairment. Evidence suggests that this occurs infrequently (e.g., in Ohio, 6 percent of 431 sites evaluated using chemical-specific criteria and biosurveys resulted in this disagreement). In those cases where evidence suggests more than one conclusion, independent application applies. If biological criteria suggest impairment but chemical-specific and/or whole-effluent toxicity implies attainment of the use, the cause for impairment of the biota is to be evaluated and, where appropriate, regulated. If whole effluent and/or chemical-specific criteria imply impairment but no impairment is found in resident biota, the whole-effluent and/or chemical-specific criteria provide the basis for regulation.

Q. *Do biological criteria have to be codified in State regulations?*

A. State water quality standards require three components: (1) designated uses, (2) protective criteria, and (3) an antidegradation clause. For criteria to be enforceable they must be codified in regulations. Codification could involve general narrative statements of biological criteria, numeric criteria, and/or criteria accompanied by specific testing procedures. Codifying general narratives provides the most flexibility—specific methods for data collection the least flexibility—for incorporating new data and improving data gathering methods as the biological criteria program develops. States should carefully consider how to codify these criteria.

Q. *How will biocriteria fit into the agency's method of implementing standards?*

A. Resident biota integrate multiple impacts over time and can detect impairment from known and unknown causes. Biocriteria can be used to verify improvement in water quality in response to regulatory efforts and detect continuing degradation of waters. They provide a framework for developing improved best management practices for nonpoint source impacts. Numeric criteria can provide effective monitoring criteria for inclusion in permits.

Q. *Who determines the values for biological criteria and decides whether a waterbody meets the criteria?*

The process of developing biological criteria, including refined use classes, narrative criteria, and numeric criteria, must include agency managers, staff biologists, and the public through public hearings and comment. Once criteria are established, determining attainment\nonattainment of a use re-

quires biological and statistical evaluation based on established protocols. Changes in the criteria would require the same steps as the initial criteria: technical modifications by biologists, goal clarification by agency managers, and public hearings. The key to criteria development and revision is a clear statement of measurable objectives.

Q. *What additional information is available on developing and using biological criteria?*

A. This program guidance document will be supplemented by the document *Biological Criteria Development by States* that includes case histories of State implementation of biological criteria as narratives, numerics, and some data procedures. The purpose for the document is to expand on material presented in Part I. The document will be available in October 1990.

A general *Biological Criteria Technical Reference Guide* will also be available for distribution during FY 1991. This document outlines basic approaches for developing biological criteria in all surface waters (streams, rivers, lakes, wetlands, estuaries). The primary focus of the document is to provide a reference guide to scientific literature that describes approaches and methods used to determine biological integrity of specific surface water types.

Over the next triennium more detailed guidance will be produced that focuses on each surface water type (e.g., technical guidance for streams will be produced during FY 91). Comparisons of different biosurvey approaches will be included for accuracy, efficacy, and cost effectiveness.

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APPENDIX D

National Guidance: Water Quality Standards for Wetlands

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

United States
Environmental Protection
Agency

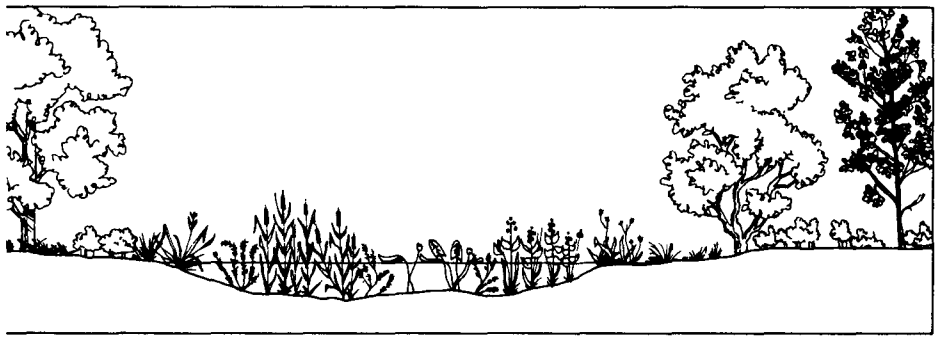
Office of Water
Regulations and Standards (WH-585)
Washinton, DC 20460

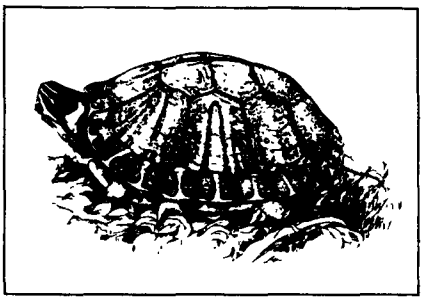
EPA 440/S-90-011
July 1990

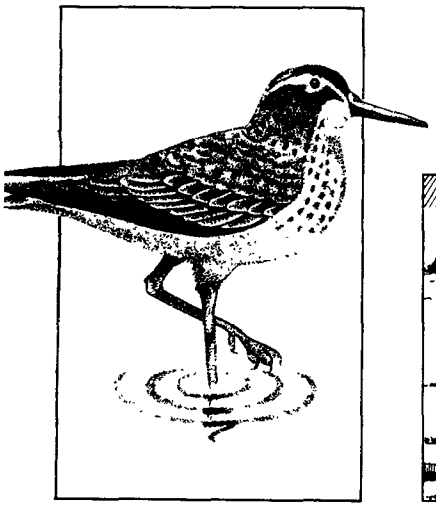
EPA

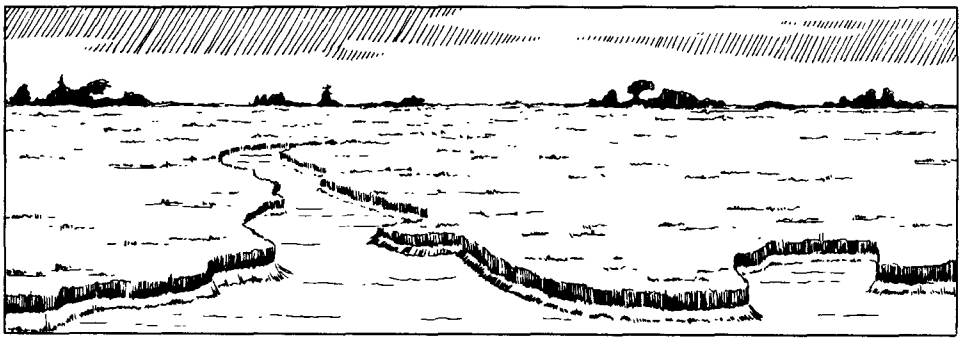
Water Quality Standards for Wetlands

National Guidance









WATER QUALITY STANDARDS FOR WETLANDS

National Guidance

July 1990

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.

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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.

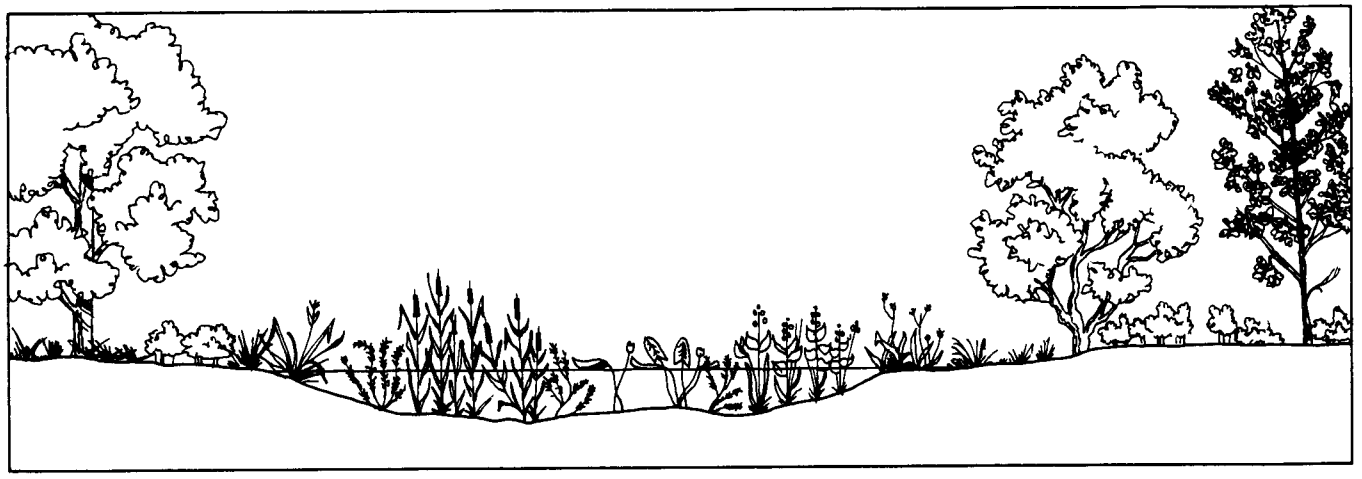
Future Directions

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

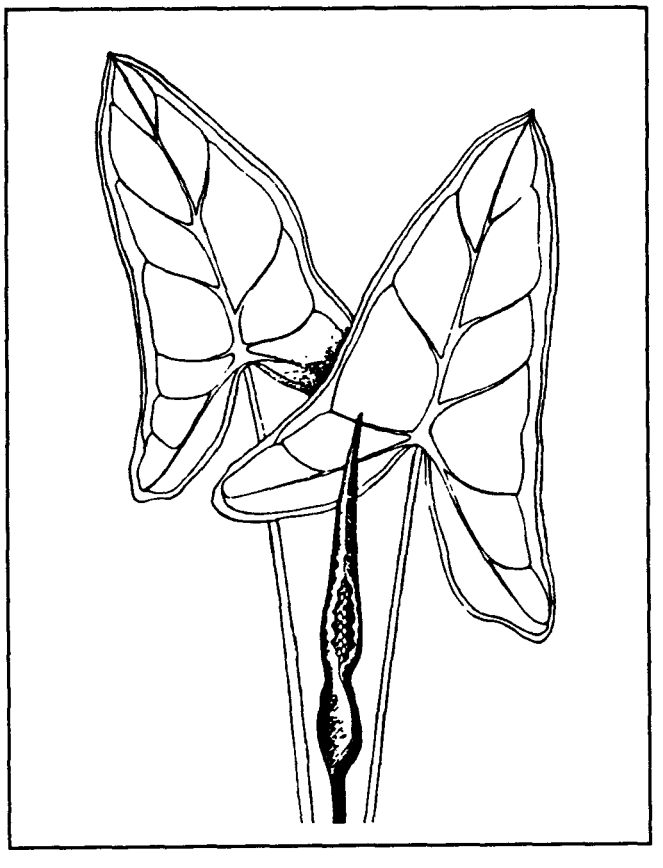
The Clean Water Act requires States to develop water quality standards, which include designated uses and criteria to support those uses, for "navigable waters." CWA Section 502(7) defines "navigable waters" as "waters of the U.S." "Waters of the U.S." are, in turn, defined in Federal regulations developed 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."

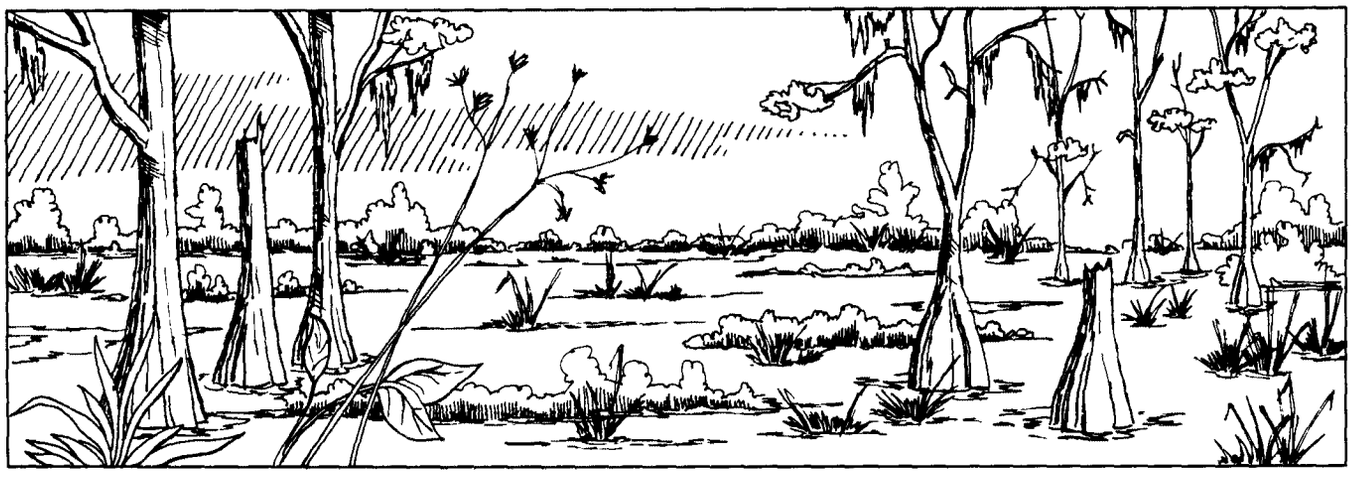
Created wastewater treatment wetlands[1] designed, built, and operated solely as wastewater treatment systems are generally not considered to be waters of the U.S. Water quality standards that apply to natural wetlands generally do not apply to such created wastewater treatment wetlands. Many created 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:

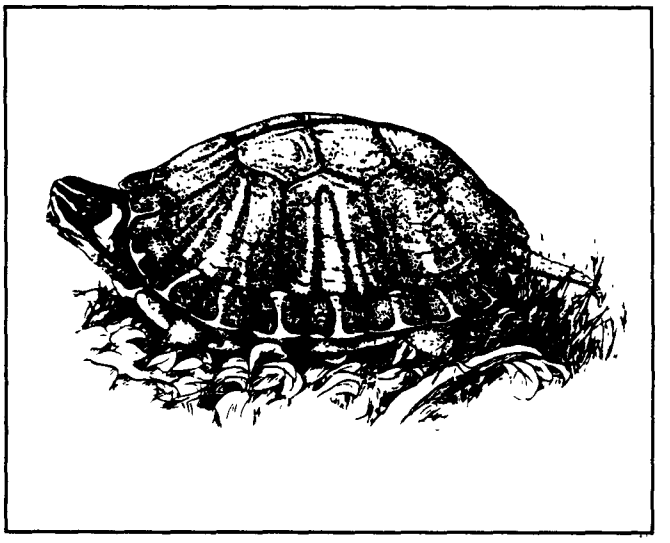
> *...The flood plain of free flowing waters determined by the Department...on the basis of the 100-year flood frequency.*

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.*

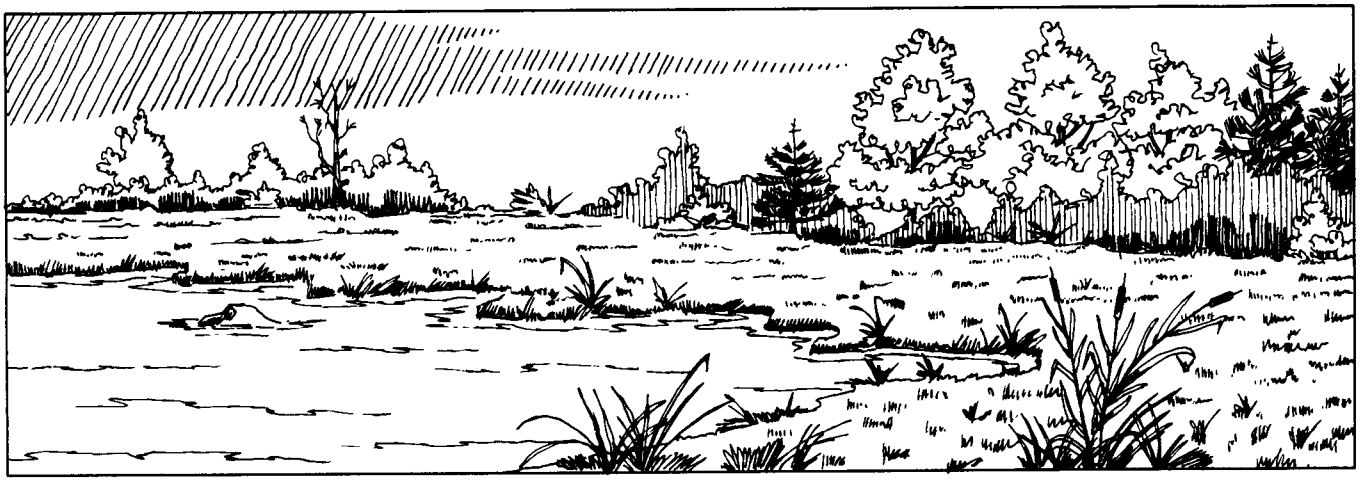
And in a third State, the antidegradation protection for high-quality waters provides that:

> 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

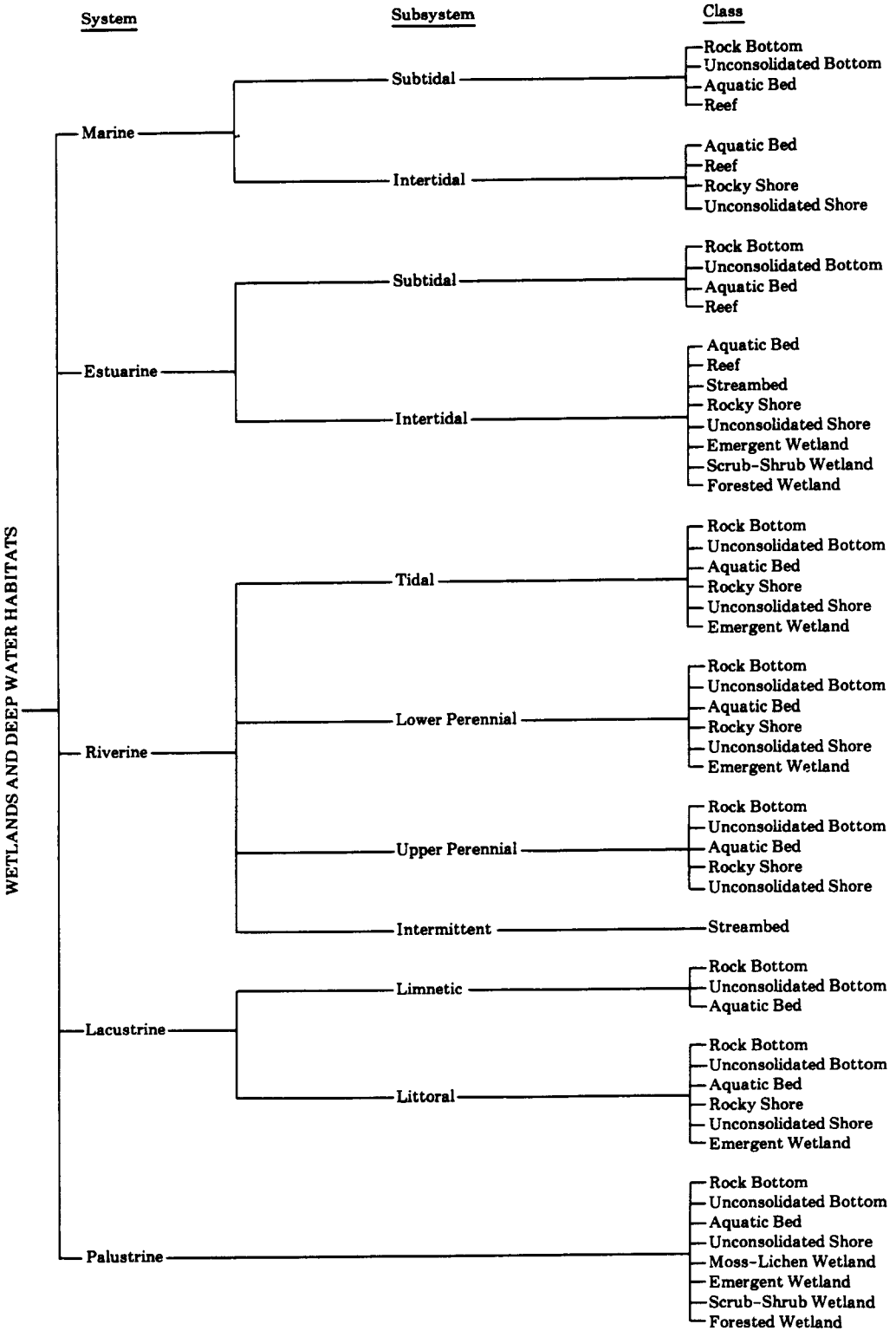


Figure 1. Classification hierarchy of wetlands and deepwater habitats, showing Systems, Subsystems, and Classes. The Palustrine System does not include deepwater habitats (from Cowardin et al., 1979).

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.

BENEFICIAL USE	WETLAND TYPE (Cowardin) 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

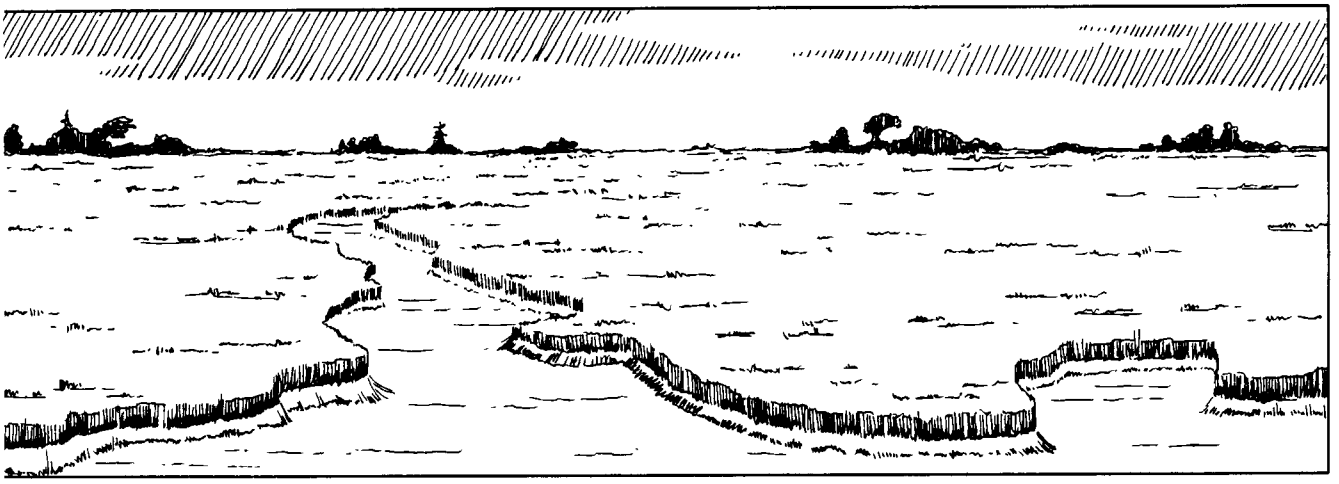
Figure 2. Example Existing and Potential Uses of Wetlands

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

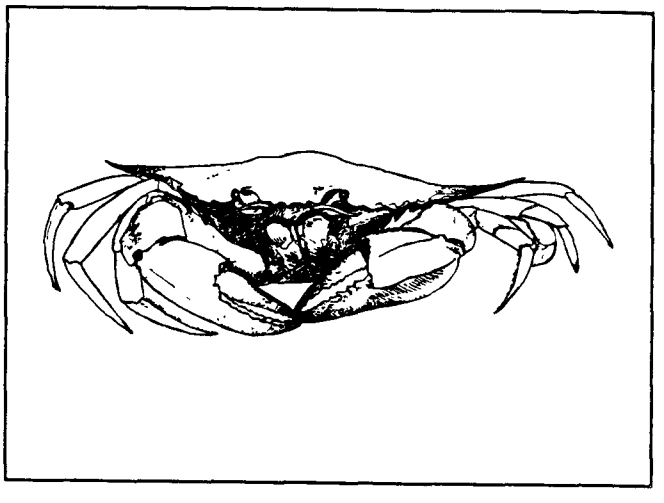
and saltwater aquatic life. These criteria may be divided into two basic categories: (1) chemicals that cause toxicity to aquatic life such as metals, ammonia, chlorine, and organics; and (2) other water quality characteristics such as dissolved oxygen, alkalinity, salinity, pH, and temperature. These 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.

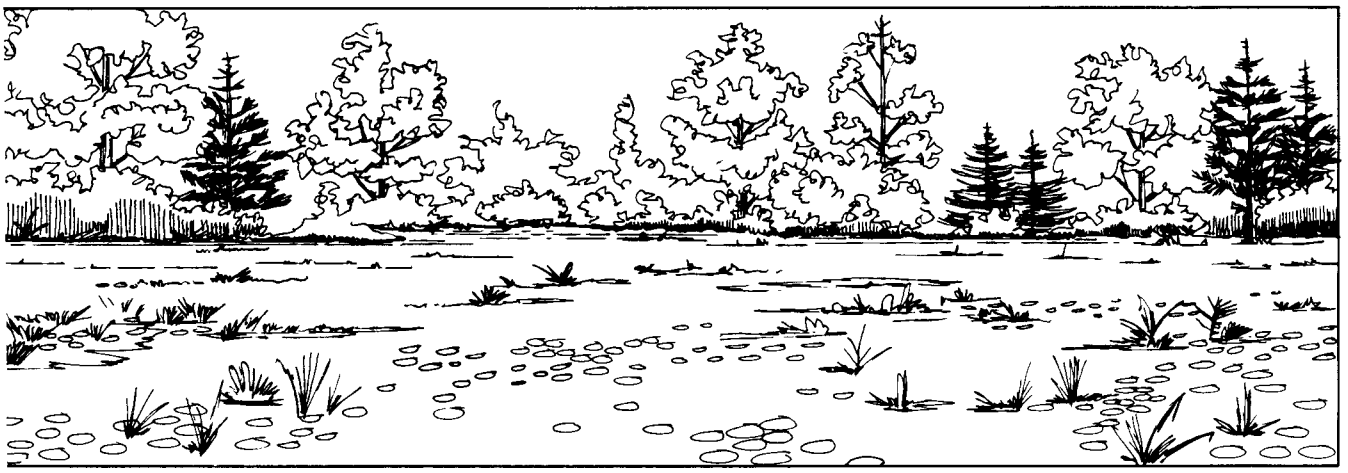
Many of EPA's aquatic life criteria are based on equations that take into account salinity, pH, temperature and/or hardness. These may be directly applied to wetlands in the same way as other water types with adjustments in the criteria to reflect these water quality characteristics. However, two national 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)(l) 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)(l) 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.

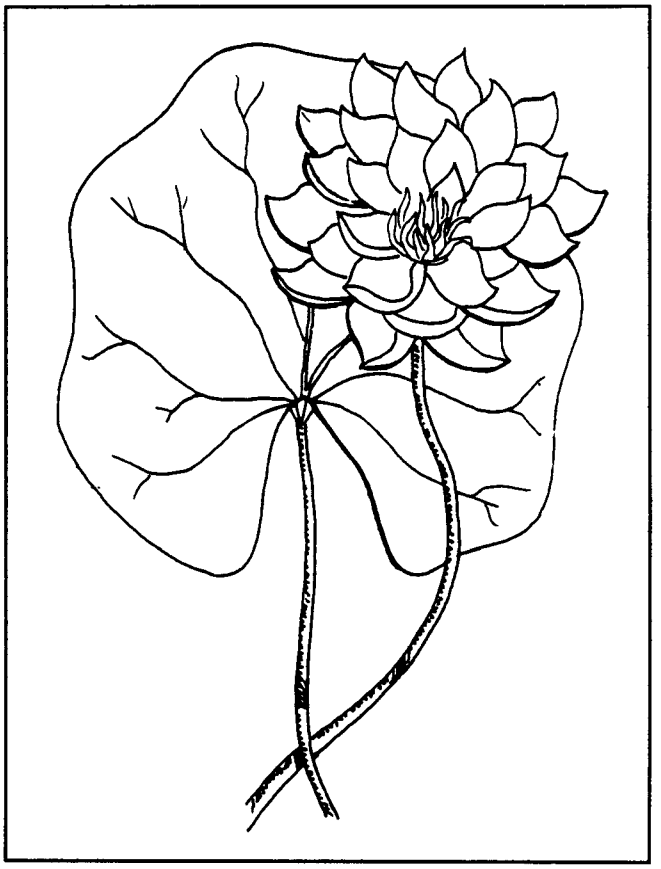
5.3 Protection of Outstanding Wetlands

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.

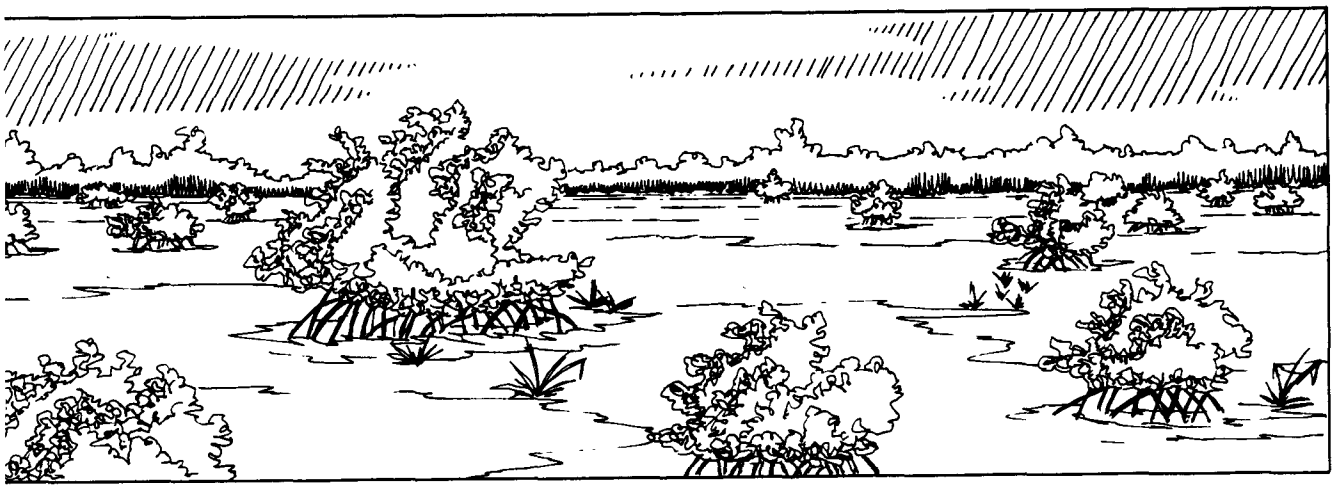
- Parks, wildlife management areas, refuges, wild and scenic rivers, and estuarine sanctuaries;
- Wetlands adjacent to ONRWs or other high-quality waters (e.g., lakes, estuaries shellfish beds);
- Priority wetlands identified under the Emergency Wetlands Resources Act of 1986 through Statewide Outdoor 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.

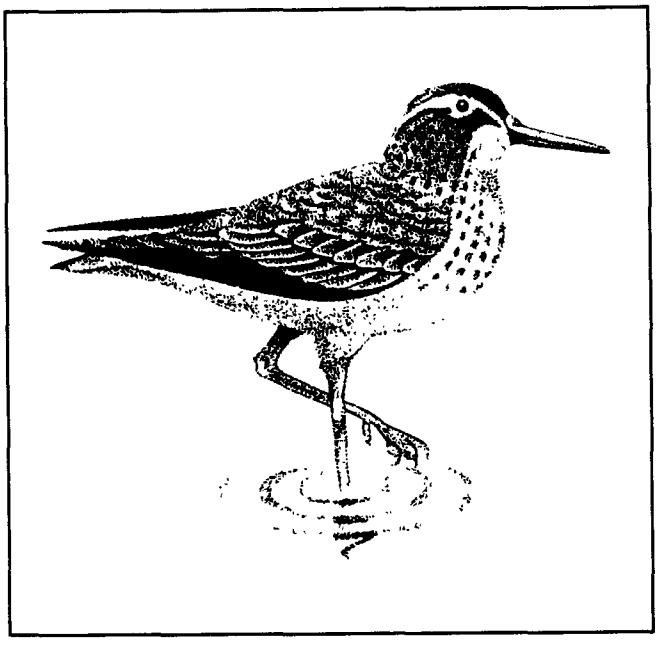
EPA has developed guidance on the reporting of wetland conditions for the Section 305(b) program entitled *Guidelines for the Preparation of the 1990 State Water Quality Assessment 305(b) Report* (USEPA 1989b). When assessing individual specific wetlands, assessment information should be managed in an 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.

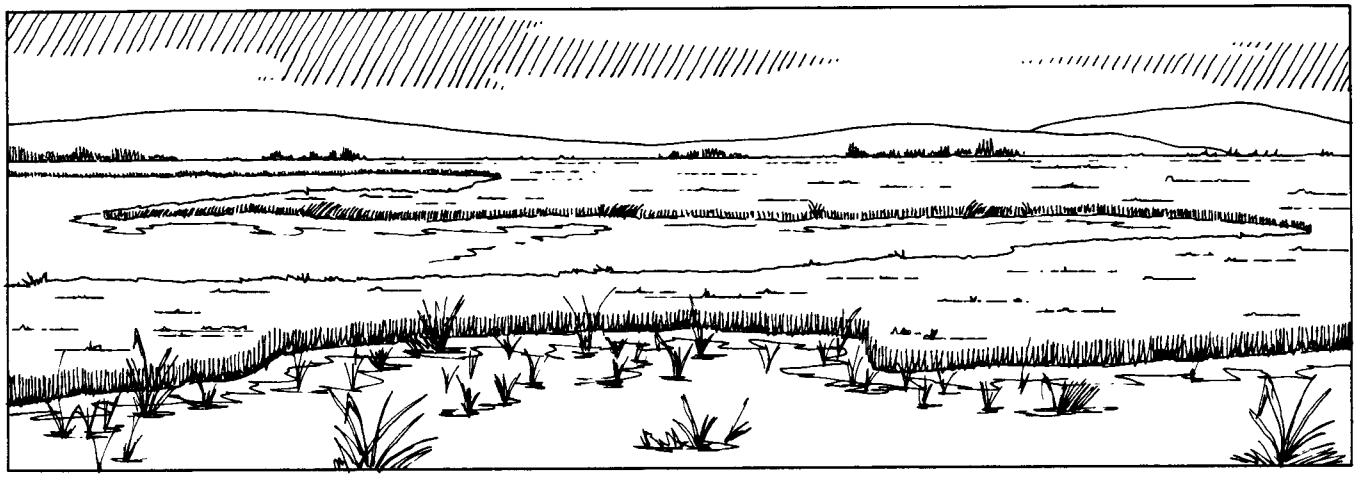
5 Florida Department of Environmental Regulations; State Regulations Part I, "Domestic Wastewater Facilities," Subpart C, "Design/Performance Considerations," 17-6.055, "Wetlands Applications."

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.

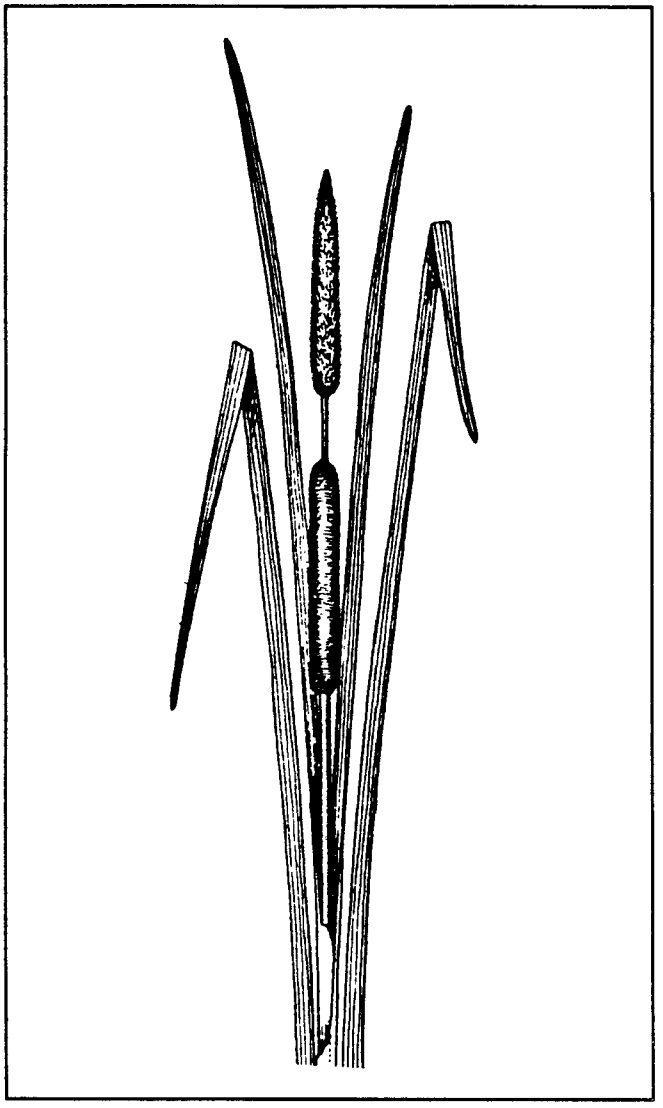
During the next 3 years, the Office of Water Regulations and Standards is reviewing aquatic life water quality criteria to determine whether adjustments in the criteria and/or alternative forms of criteria (e.g., tissue concentration criteria) are needed to adequately protect wildlife species using wetland 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).



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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
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8 USEPA, Office of Research and Development
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9 USEPA, Office of Municipal Pollution Control
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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 non-prime 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.

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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."

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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.

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- 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).

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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

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.

APPENDIX E

An Approach for Evaluating Numeric Water Quality Criteria for Wetlands Protection

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

AN APPROACH FOR EVALUATING NUMERIC WATER QUALITY CRITERIA FOR WETLANDS PROTECTION

by

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DU: BIOL
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ABSTRACT

Extension of the national numeric aquatic life criteria to wetlands has been recommended as part of a program to develop standards and criteria for wetlands. This report provides an overview of the need for standards and criteria for wetlands and a description of the numeric aquatic life criteria. The numeric aquatic life criteria are designed to be protective of aquatic life and their uses for surface waters, and are probably applicable to most wetland types. This report provides a possible approach, based on the site-specific guidelines, for detecting wetland types that might not be protected by direct application of national numeric criteria. The evaluation can be simple and inexpensive for those wetland types for which sufficient water chemistry and species assemblage data are available, but will be less useful for wetland types for which these data are not readily available. The site-specific approach is described and recommended for wetlands for which modifications to the numeric criteria are considered necessary. The results of this type of evaluation, combined with information on local or regional environmental threats, can be used to prioritize wetland types (and individual criteria) for further site-specific evaluations and/or additional data collection. Close coordination among regulatory agencies, wetland scientists, and criteria experts will be required.

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

JUL 19 1991

OFFICE OF WATER

MEMORANDUM

SUBJECT: Numeric Water Quality Criteria for Wetlands

FROM: William R. Diamond, Director William R Diamond
Standards and Applied Science Division
Office of Science and Technology

TO: Water Management Division Directors (Regions I-X)
Environmental Services Division Directors (Regions I-X)

State Water Pollution Control Agency Directors

The purpose of this memorandum is to provide you with a copy of a report entitled "An Approach for Evaluation of Numeric Water Quality Criteria for Wetlands Protection", prepared by EPA's Environmental Research Laboratory in Duluth, Minnesota. This report was requested in the early stages of planning for wetland water quality standards to assess the applicability of EPA's existing numeric aquatic life criteria methodology for wetlands. This report was prepared by the Wetlands Research Program and is part of the Agency's activities to assist States with developing water quality standards for wetlands.

The report evaluates EPA's numeric aquatic life criteria to determine how they can be applied to wetlands. Numeric aquatic life criteria are designed to be protective of aquatic life for a wide range of surface water types. The report suggests that most numeric aquatic life criteria are applicable to most wetland types.

However, there are some wetland types where EPA's criteria are not appropriate. This report presents an approach that States may use as a screening tool to detect those wetland types that may be under- or overprotected by EPA's criteria. The proposed approach relies on data readily available from EPA's 304(a) criteria documents, as well as species assemblages and water quality data from individual wetland types. The results of this type of simple evaluation can be used to prioritize wetland types where further evaluation may be needed prior to setting criteria. Two example analyses of the approach are included in the report. EPA's site-specific criteria development guidelines can then be used to modify criteria if appropriate.

This report compiles existing information from EPA's 304(a) criteria guidance documents and site-specific criteria methodologies and does not contain new guidance or policy. The report has been peer reviewed by ERL/Duluth scientists who develop EPA's 304 criteria. The report also has been reviewed by the Standards and Applied Science Division and the Wetlands Division.

If you have additional questions on the information contained in this report or its applications, contact the following persons: David Sabock, Water Quality Standards Branch, at 202-475-7315 regarding designated uses and water quality standards policies; Bob April, Ecological Risk Assessment Branch, at 202-475-7315, regarding EPA's aquatic life criteria; or Bill Sanville, Environmental Research Laboratory/Duluth, at 218-720-5500, regarding the research for this report.

Attachment

cc: Water Quality Branch Chiefs (Regions I-X)
Water Quality Standards Coordinators (Regions I-X)
Wetlands Coordinators (Regions I-X)
David Sabock
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SECTION 1

INTRODUCTION

NEED FOR STANDARDS FOR WETLANDS

Wetlands have been studied and appreciated for a relatively short time in relation to other types of aquatic systems. The extent of their value in the landscape has only recently been recognized; in fact, a few decades ago government policies encouraged wetland drainage and conversion. Wetlands traditionally have been recognized as important fish and wildlife habitats, and it is estimated that over one-third of U.S. endangered species require wetland habitat for their continued existence. Some of their many other values, however, have become apparent only recently. These include attenuation of flood flows, groundwater recharge, shoreline and stream bank stabilization, filtering of pollutants from point and nonpoint sources, unique habitats for both flora and fauna, and recreational and educational opportunities.[1]

Impacts to Wetlands

Despite new appreciation of the valuable functions that wetlands perform in the landscape, they continue to be destroyed and altered at a rapid pace. Since pre-settlement times over half of the wetlands in the continental U.S. have been destroyed, and losses over the last few decades have remained high.[2] These figures only represent actual loss of acreage and do not account for alterations to or contamination of still-extant wetlands. The causes of wetland destruction and degradation include:[3]

* Urbanization - Resulting in drainage and filling, contamination, and ecological isolation of wetlands.

* Agriculture Conversion - Drainage, cropping, and grazing which change or destroy wetland structure and ecological function.

* Water Resource Development - Water flow alterations to wetlands from diking, irrigation diversions, alterations to rivers for navigation, diversions for

water supply, and groundwater pumping. These result in changes in the hydrology that sustains the wetland system.

* Chemical Pollution - From point and nonpoint sources, hazardous waste sites, mining, and other activities. These can overwhelm the assimilative capacity of wetlands or be toxic to wetland organisms.

* Biological Disturbances - Introduction or elimination of plant and animal species that affect ecosystem processes.

Gaps in Federal Regulatory Programs

Existing Federal regulatory programs intended to reduce some of the impacts described above leave major gaps in the protection of wetlands. Section 404 of the Clean Water Act (CWA) requires a permit to be obtained from the Army Corps of Engineers, in cooperation with the U.S. Environmental Protection Agency (EPA), before dredged material or fill can be discharged into waters of the United States. Alterations such as drainage, water diversion, and chemical contamination are not covered by Section 404 unless material will be discharged into the wetland in association with such alterations. The Resource Conservation and Recovery Act, which regulates the disposal of hazardous wastes, and the CWA, which regulates contamination from waste-water discharges and nonpoint-source pollution, could provide protection from certain impacts, but they have not been used consistently to regulate impacts to wetlands. Programs designed to protect endangered species, migratory birds, and marine mammals have also been used to reduce impacts to wetlands, but "the application of these programs also has been uneven."[4]

Gaps in State Regulatory Programs

Wetland regulations vary greatly among States. Some States are now developing narrative standards for wetlands (e.g. Wisconsin, Rhode Island, and others). On the other hand, although wetlands are included in the Federal definition of "waters of the United States" and are protected by Section 101(a) of the CWA, not all States include them as "waters of the State" in their definitions. A review conducted in 1989 by the EPA Office of Wetlands Protection and the Office of Water Regulations and Standards found that only 27 of 50 States mentioned wetlands in definitions of State waters. The review verified that there generally is a lack of consideration given to water quality standards for wetlands.[5]

Effective Use of Existing Regulatory Options

Although some impacts (e.g. excavation, most drainage, and destruction of vegetation) are not addressed by the current implementation of existing regulations and programs, much of the chemical contamination of wetlands could be controlled through existing Federal and State water pollution control laws.[4] The National Wetlands Policy Forum recommended that EPA and State water pollution control agencies review the implementation of their water quality programs to ensure that the chemical integrity of wetlands is adequately protected. The Forum stressed the need to develop water quality standards designed to protect sensitive wetlands.[4]

Under Section 401 of the CWA, States have authority to authorize, condition, or deny all Federal permits or licenses in order to comply with State water quality standards, including, but not limited to, Sections 402 and 404 of the CWA, Sections 9 and 10 of the Rivers and Harbors Act, and Federal Energy Regulatory Commission licenses. States with water quality standards that apply to or are specifically designed for wetlands can use 401 certification much more effectively as a regulatory tool.

As wetlands receive more recognition as important components of State water resources, the need for testing the applicability of some existing guidelines and standards to wetlands regulation becomes more apparent.

PROPOSED APPROACH TO DEVELOPMENT OF WETLAND STANDARDS

The EPA Office of Water Regulations and Standards and Office of Wetlands Protection recently completed a document entitled, "National Guidance: Water Quality Standards for Wetlands."[6] It recommends a two-phased approach for the development of water quality standards for wetlands. In the first 3-year phase of this program, standards for wetlands would be developed using existing information in order to provide protection to wetlands consistent with the protection afforded other State waters. Technical support for this initial phase will be provided through documents such as this one, which focuses on the application of existing numeric criteria to wetlands. These criteria are widely used. Applying them to wetlands requires a small amount of effort and can be accomplished quickly.

The development of narrative biocriteria is also required in the initial phase of standards development. The long-term goal (3-10 years) of this program is to develop numeric biocriteria for wetlands. It is anticipated that both narrative and numeric

biocriteria can provide a more integrative estimate of whole-wetland health and better identification of impacts and trends than can be attained by traditional numeric chemical criteria. Field-based, community-level biosurveys can be implemented to complement, and help validate, laboratory-based conclusions. Results of such surveys can be used to monitor wetlands for degradation and establish narrative or numeric biocriteria or guidance which take into account "real world" biological interactions and the interactions of multiple stressors.

More information on the development of numeric biocriteria will be available in a guidance document in coming years. Technical guidance to support the development of biological criteria for wetlands has also been prepared.[7] This guidance provides a synthesis of technical information on field studies of inland wetland biological communities.

PURPOSE OF THIS DOCUMENT

A number of steps are needed to develop wetland standards. The document, "National Guidance: Water Quality Standards for Wetlands," mentioned above, provides general guidelines to the States for each of the following steps: the inclusion of wetlands in definitions of State waters, the relationship between wetland standards and other water-related programs, use classification systems for wetlands, the definition of wetland functions and values, the applicability of existing narrative and numeric water quality criteria to wetlands, and the application of antidegradation policies to wetlands.

The technical document for biological criteria[7] and this report are companions to the guidance document described above. This report is directed primarily toward wetland scientists unfamiliar with water quality regulation and is intended to provide a basis for dialogue between wetland scientists and criteria experts regarding adapting numeric aquatic life criteria to wetlands. More specifically:

1) It provides background information and an overview of water quality standards and numeric chemical criteria, including application to wetlands.

2) The need for evaluating numeric water quality criteria is discussed. The site-specific guidelines are introduced and discussed in two contexts: a) as an initial screening tool to ensure that water quality in extreme wetland types is adequately protected by criteria, and b) in terms of using the site-specific guidelines to modify criteria for wetlands where criteria might be over or underprotective.

3) An approach is described that uses information available from criteria documents and is designed to: a) detect wetland types where water quality is not clearly protected by existing criteria, and b) help prioritize further evaluations and research efforts.

4) A simple test of the approach is presented with two examples. Results are not considered conclusive and are presented only as an example of the procedure.

Most of the data and examples are based on the freshwater acute criteria. A similar approach should be equally applicable to the saltwater acute criteria and to both saltwater and freshwater chronic criteria.

SECTION 2

CURRENT SURFACE WATER STANDARDS AND CRITERIA

This section describes how criteria are used in State standards, how national numeric criteria are derived, and what options are currently available for modifying national aquatic life criteria.

DESCRIPTION OF STANDARDS AND CRITERIA

Surface waters are protected by Section 101(a) of the CWA with the goal: "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." State water quality standards are developed to meet this goal.

State Standards

There are two main components to establishing a standard: 1) The level of water quality attainable for a particular waterbody, or the designated use of that waterbody (e.g. recreational, fishery, etc.) is determined; 2) Water quality criteria (usually a combination of narrative and numeric) are established to protect that designated use. Water quality standards also contain an antidegradation policy "to maintain and protect existing uses and water quality, to provide protection for higher quality waters, and to provide protection for outstanding national resource waters."[8] State standards for a particular waterbody must be met when discharging wastewaters. The "National Guidance: Water Quality Standards for Wetlands"[6] outlines a basic program to achieve these goals for wetlands.

Aquatic Criteria

Narrative Criteria--

Narrative criteria are statements, usually expressed in a "free from ..." format. For example, all States have a narrative statement in their water quality standards which requires that their waters not contain "toxic substances in toxic amounts." Narrative criteria are typically applied at the State level when combinations of pollutants must be controlled or when pollutants are present which are not listed in State water quality

standards.[8] States must document the process by which they propose to implement these narrative criteria in their standards.

Numeric Criteria--

Pollutant-specific numeric criteria are used by the States when it is necessary to control individual pollutants in order to protect the designated use of a waterbody. Fate and transport models commonly are used to translate these criteria into permit limits for individual dischargers. Some criteria apply State-wide and others are specific to particular designated uses or waterbodies.

National numeric criteria are developed by EPA based on best available scientific information. They serve as recommendations to assist States in developing their own criteria and to assist in interpreting narrative criteria.[9] These include human health and aquatic life pollutant-specific criteria and whole effluent toxicity criteria. Sediment criteria are now being developed. States can adopt national numeric criteria directly. Alternatively, site-specific criteria may be developed using EPA-specified guidelines, and State-specific criteria can be derived using procedures developed by the State.[8]

DEVELOPMENT OF NATIONAL AQUATIC LIFE NUMERIC CRITERIA

National aquatic life criteria are usually derived using single-species laboratory toxicity tests. Tests are repeated with a wide variety of aquatic organisms for each chemical. The criteria are designed to protect against unacceptable effects to aquatic organisms or their uses caused by exposures to high concentrations for short periods of time (acute effects), to lower concentrations for longer periods of time (chronic effects), and to combinations of both.[9] EPA criteria are composed of 1) magnitude (what concentration of a pollutant is allowable); 2) duration of exposure (the period of time over which the in-stream concentration is averaged for comparison with criteria concentrations); and 3) frequency (how often the criterion can be exceeded without unacceptably affecting the community).[10] Separate criteria are determined for fresh water and salt water. Field data are used when appropriate.

All acceptable data regarding toxicity to fish and invertebrates are evaluated for inclusion in the criteria. Data on toxicity to aquatic plants are evaluated to determine whether concentrations of the chemical that do not cause unacceptable effects to aquatic animals will cause unacceptable effects to plants. Bioaccumulation data are examined to determine if residues in the organisms might exceed FDA action levels or cause known effects on the wildlife that consume them. For a complete

description of the procedures for deriving ambient criteria, consult the "National Guidelines" (1985).[9]

Numeric water quality criteria are designed to protect most of the species inhabiting a site.[9] A wide variety of taxa with a range of sensitivities are required for deriving criteria. Guidelines are followed to determine the availability of sufficient experimental data from enough appropriate taxa to derive a criterion. For example, to derive a freshwater Final Acute Value for a chemical, results of acute tests with at least one species of freshwater animal in at least eight different families are required. Acute and chronic values can be made to be a function of a water quality characteristic such as Ph, salinity, or hardness, when it is determined that these characteristics impact toxicity, and enough data exist to establish the relationship. Table 1 lists the chemicals for which freshwater aquatic life criteria have been developed and indicates which of those criteria are pH, hardness, or temperature dependent.

SITE-SPECIFIC GUIDELINES

An option for modifying national aquatic life water quality criteria to reflect local conditions is presented in the site-specific guidelines. States may develop site-specific criteria by modifying the national criteria for sites where 1) water quality characteristics, such as pH, hardness, temperature, etc., that might impact toxicity of the pollutants of concern differ from the laboratory water used in developing the criterion; or 2) the types of organisms at the site differ from, and may be more or less sensitive than, those used to calculate the criterion; or 3) both may be true. Site-specific criteria take local conditions into account to provide an appropriate level of protection. They can also be used to set seasonal criteria when there is high temporal variability.[8]

A testing program can be used to determine whether site-specific modifications to criteria are necessary. This program may include water quality sampling and analysis, a biological survey, and acute and chronic toxicity tests.[11] If site-specific modifications are deemed necessary, 3 separate procedures are available for using site-specific guidelines to modify criteria values, including the recalculation procedure, the indicator species procedure, and the resident species procedure. These will be discussed more fully in the next section.

SECTION 3

THE NEED FOR EVALUATING NUMERIC WATER QUALITY CRITERIA: USE OF THE SITE-SPECIFIC GUIDELINES

OVERALL RELEVANCE OF CRITERIA TO WETLANDS

The national aquatic life criteria have been developed to provide guidance to the States for the protection of aquatic life and their uses in a variety of surface waters. They are designed to be conservative and "... have been developed on the theory that effects which occur on a species in appropriate laboratory tests will generally occur on the same species in comparable field situations. All North American bodies of water and resident aquatic species and their uses are meant to be taken into account, except for a few that may be too atypical ..."[9] A wide variety of taxonomic groups sensitive to many materials are used in testing, including many taxa common to both wetlands and other surface waters. In order to ensure that criteria are appropriately protective, water used for testing is low in particulate matter and organic matter, because these substances can reduce availability and toxicity of some chemicals. For these reasons, the "National Guidance: Water Quality Standards for Wetlands" states that, in most cases, criteria should be protective of wetland biota.[6]

Although the water quality criteria are probably generally protective of wetlands and provide the best currently available tool for regulating contamination from specific pollutants, there are many different types of wetlands with widely variable conditions. There might be some wetland types where the resident biota or chemical and physical conditions are substantially different from what the criteria were designed to protect. These differences could result in underprotection or overprotection of the wetland resource. This section discusses the use of site-specific guidelines for wetland types for which certain criteria might be over or underprotective, but its primary focus is to provide a mechanism to identify wetland types that might be underprotected by certain criteria and that might require further research.

WETLAND VARIABILITY

Wetlands are usually located at the interface between terrestrial systems and truly aquatic systems, and so combine attributes of both.[12] They are intermediate between terrestrial and aquatic systems in the amount of water they store and process and are very sensitive to changes in hydrology.[12] Their chemical and physical properties, such as nutrient availability, degree of substrate anoxia, soil salinity, sediment properties, and pH are influenced greatly by hydrologic conditions. Attendees at a Wetlands Water Quality Workshop (held in Easton, Maryland in August, 1988) listed the most common ways in which wetlands differ from "typical" surface waters: higher concentrations of organic carbon and particulate matter, more variable and generally lower pH, more variable and generally lower dissolved oxygen, more variable temperatures, and more transient availability of water.[13]

There is also high variability among wetland types. Wetlands, by definition, share hydrophytic vegetation, hydric soils, and a water table at or near the surface at some time during the growing season. Beyond these shared features, however, there is tremendous hydrological, physical, chemical, and biological variability. For example, an early classification system for wetlands, "Circular 39", listed 20 distinctly different wetland types[14], and the present "Cowardin" system lists 56 classes of wetlands.[15] This variability makes it important to evaluate different wetland types individually.

USE OF THE SITE-SPECIFIC GUIDELINES FOR WETLANDS

The site-specific guidelines outlined in Section 2 are designed to address the chemical and biological variability described above. Determining the need for site-specific modifications to criteria requires a comparison of the aquatic biota and chemical conditions at the site to those used for establishing the criterion. This comparison is useful for identifying wetland types that might require additional evaluation. The three site-specific options are discussed in the context of their general relevance to wetlands and are used in this discussion to provide a framework for evaluating the protectiveness of criteria for wetlands.

In most cases, because of the conservative approach used in the derivation of the criteria, use of the site-specific guidelines to modify criteria results in no change or in their relaxation, provided that an adequate number of species are used in the calculations. However, criteria can also become more

restrictive. Newly tested species could be especially sensitive to certain pollutants, or extreme water conditions found in some surface waters or wetland types might not reduce the toxicity of a chemical. Disease, parasites, predators, other pollutants, contaminated or insufficient food, and fluctuating and extreme conditions might all affect the ability of organisms to withstand toxic pollutants.[9]

Appropriateness of Testing Organisms: Recalculation Procedure

The first option given in the site-specific guidelines is the recalculation procedure.[8,11] This approach is designed to take into account differences between the sensitivity of resident species and those used to calculate a criterion for the material of concern. It involves eliminating data from the criterion database for species that are not resident at that site. It could require additional resident species testing in laboratory water if the number of species remaining for recalculating the criterion drops below the minimum data requirements. "Resident" species include those that seasonally or intermittently exist at a site.[11,16]

Use of the recalculation procedure will not necessarily result in a higher acute criterion value (less restrictive), even if sensitive species are eliminated from the dataset and minimum family requirements are met. The number of families used to calculate Final Acute Values is important. If a number of non-wetland species are dropped out of the calculation without adding a sufficient number of new species, a lower (more restrictive) Final Acute Value can result, because data are available for fewer species.[11]

Similarity of Required Taxa and Typical Wetland Species--

The variety of test species required to establish the national numeric criteria was chosen to represent a wide range of taxa having a wide range of habitat requirements and sensitivity to toxicants. Establishment of a freshwater Final Acute Value for a chemical requires a minimum of 8 different types of families to be tested. These include: 1) the family Salmonidae; 2) a second family of fish, preferably a warmwater species; 3) a third family in the phylum Chordata (fish, amphibian, etc.); 4) a planktonic crustacean; 5) a benthic crustacean; 6) an insect; 7) a family in a phylum other than Arthropoda or Chordata; and 8) a family in any order of insect or phylum not already represented.[9]

When a required type of family does not exist at a site, the guidelines for the recalculation procedure specify that substitutes from a sensitive family, resident in the site, should be added to meet the minimum family data requirement. Should it happen that all resident families have been tested and the

minimum data requirements still have not been met, the acute toxicity value from the most sensitive resident family that has been tested should be used as the site-specific value.

Most of the required families are probably well-represented in most wetland types. Some types of wetlands, however, seldom or never contain fish, and most wetland types do not support salmonids or aquatic insects requiring flowing water.

General Evaluation of Species Suitability--

Table 2 presents six criterion chemicals chosen as examples and the eight taxonomic groups required to establish criteria. The chemicals include two organochlorines: polychlorinated biphenyls (PCBs - used in industrial applications, environmentally-persistent, bioaccumulate) and pentachlorophenol (widely used fungicide and bactericide); one organophosphate: parathion (insecticide); two metals: zinc and chromium(VI); and cyanide.

The species used for acute toxicity testing for each of the six chemicals have been broken down by taxonomic group and evaluated based on the likelihood that those species can be found in wetlands. Except for the unsuitability of the Salmonidae to most wetland types, most of the taxonomic groups are well-represented for the six chemicals used as examples. Wetland species were not present in the list of species used to calculate the Final Acute Value for the "non-arthropod/non-chordate" and "another insect or new phylum" groups for a few of the criteria. This is not because these groups are not represented in wetlands. These are very general classifications. For example, the "non-arthropod/non-chordate" group can include rotifers, annelids, and mollusks among other phyla, all of which should have many representatives in most types of wetlands. There is a large degree of variation in the total number of species tested for the six chemicals used as examples, ranging from 10 fish and invertebrates for polychlorinated biphenyls (PCBs) to 45 for zinc (Table 7). Criteria based on smaller numbers of species are less likely to include a sufficient number of wetland species to fulfill the minimum family requirements. Additional toxicity testing, using laboratory water and wetland species from the missing families, can be done to fill these gaps.

While the general taxonomic groups required for toxicity testing are fairly well represented in wetlands, the similarity between the genera and species inhabiting individual wetland types and those used for criteria testing varies widely among criteria and wetland types. Species chosen for toxicity testing were seldom or never chosen with wetlands in mind. In addition, relatively little is known about species assemblages in some types of wetlands (particularly in those lacking surface waters,

such as wet meadows or bogs). Defining typical wetland taxa is difficult. For example, while most types of wetlands do not support salmonids, Coho salmon are highly dependent on wetlands in Alaska, where there is a higher percentage and acreage of wetlands than in any other State. Part of the utility of the evaluation proposed here is in identifying where significant gaps in data exist.

Influence of Cofactors: Indicator Species Procedure

The second of the three site-specific procedures, the indicator species procedure, accounts for differences in biological availability and/or toxicity of a material caused by physical and/or chemical characteristics of the site water, or cofactors. For the acute test, the effect of site water is compared to the effect of laboratory water, using at least two resident species or acceptable non-resident species (one fish and one invertebrate) as indicators. A ratio is determined, which is used to modify the Final Acute Value. See Carlson et al. (1984) for information and guidelines for determination of site-specific chronic values.[11]

Suitability of Standard Testing Conditions--

Standard aquatic toxicity tests are performed using natural or reconstituted dilution water that should not of itself affect the results of toxicity tests. For example, organic carbon and particulate matter are required to be low to avoid sorption or complexation of toxicants, which might lower the toxicity or availability of some criterion chemicals. Recommended acute test conditions for certain water quality characteristics of fresh and salt water are listed in Table 3. Wetlands, as well as some types of surface waters, can have values far outside the ranges used for standard testing for some of these characteristics (most notably total organic carbon, particulate matter, pH, and dissolved oxygen). Wetland types can be evaluated to identify these extremes.

Wetland Cofactors--

Many water quality characteristics can 1) act as cofactors to affect the toxicity of pollutants (e.g. alkalinity/acidity, hardness, ionic strength, organic matter, temperature, dissolved oxygen, suspended solids); 2) can be directly toxic to organisms (e.g. un-ionized ammonia, high or low pH, hydrogen sulfide, low dissolved oxygen); or 3) can interfere mechanically with feeding and reproduction (e.g. suspended solids). The criteria for some of these water quality characteristics can be naturally exceeded in many wetland types, as well as in some lakes and streams.

Hardness, pH, and temperature adjustments built into a few of the criteria account for effects from these cofactors in a few

cases, but no other cofactors are now included in the criteria, despite some known effects. For example, alkalinity, salinity, and suspended solids, in addition to pH and hardness, are known to affect the toxicities of heavy metals and ammonia. These cofactors are not included in the criteria primarily because there are insufficient data.[9] For example, most toxicity tests have been performed under conditions of low or high salinity, so that estuaries, where salinity values can vary greatly, may require salinity-dependent site-specific criteria for some metals.[11] An initial evaluation of the adequacy of protection provided to a wetland type by a criterion should take possible cofactor effects into account.

Combination: Resident Species Procedure

The resident species procedure accounts for differences in both species sensitivity and water quality characteristics.[11] This procedure is costly, because it requires that a complete minimum dataset be developed using site water and resident species. It is designed to compensate concurrently for differences in the sensitivity range of species represented in the dataset used to derive the criterion and for site water differences which may markedly affect the biological availability and/or toxicity of the chemical.[11]

AQUATIC PLANTS

One of the most notable differences between wetlands and other types of surface waters is the dominance (and importance) of aquatic macrophytes and other hydrophytic vegetation in wetlands. Aquatic plants probably constitute the majority of the biomass in most wetland types.

Few data concerning toxicity to aquatic plants are currently required for deriving aquatic life criteria. Traditionally, procedures for aquatic toxicity tests on plants have not been as well developed as for animals. Although national numeric criteria development guidelines state that results of a test with a freshwater alga or vascular plant "should be available" for establishing a criterion, they do not require that information.[9] The Final Plant Value is the lowest (most sensitive) result from tests with important aquatic plant species (vascular plant or alga), in which the concentrations of test material were measured and the endpoint was biologically important. Plant values are compared to animal values to determine the relative sensitivities of aquatic plants and animals. If plants are "among the aquatic organisms that are most sensitive to the material," results of a second test with a plant from another phylum are included.[9]

Results of tests with plants usually indicate that criteria which protect aquatic animals and their uses also protect aquatic plants and their uses.[9] As criteria are evaluated for their suitability for wetlands, however, plant values should be examined carefully. Additional plant testing may be advisable in some cases. If site-specific adjustments are made to some criteria, they could result in less restrictive acute and chronic values for animals. Some plant values could then be as sensitive or more sensitive than the animal values. Chemicals with fairly sensitive plant values include: aluminum, arsenic(III), cadmium, chloride, chromium(VI), cyanide, and selenium(VI). For example, fish are generally much more sensitive to cyanide than invertebrates. If the recalculation procedure was used to develop a site-specific cyanide criterion for a wetland type containing no fish, values for these sensitive species would be replaced in the calculation, possibly by less sensitive species. A less restrictive criterion could result, possibly making the plant value more sensitive than the animal value. Therefore, additional consideration should be given to plant toxicity data for wetland systems.

SECTION 4

EVALUATION PROGRAM

The direct application of existing aquatic life criteria to wetlands is assumed to be reasonable in most cases. It provides a practical approach towards protecting the biological integrity of wetlands. The following evaluation program offers a possible strategy to identify extreme wetland types that might be underprotected by some criteria, to prioritize wetland types and criterion chemicals for further testing or research, and to identify gaps in available data. The approach can be helpful for identifying those instances where modifications to existing criteria might be advisable. The proposed evaluation program offers a screening tool to begin to answer the following questions: 1) Are there some wetland types for which certain criteria are underprotective? 2) For criteria in wetland types that cannot be applied directly, can site-specific guidelines be used to modify the criteria to protect the wetland? 3) Will additional toxicity testing under wetland conditions and with wetland species be necessary in some cases in order to establish site-specific criteria?

The proposed approach relates species and water quality characteristics of individual wetland types to species and water quality characteristics important in deriving each criterion. It involves identifying wetland types of concern, identifying cofactors possibly affecting toxicity for the criteria of interest, gathering data on the biota and water quality characteristics of the wetland type, and comparing to data used to derive the criterion.

CLASSIFICATION

The proposed program for the evaluation of the suitability of aquatic life criteria discussed in this section can be done separately for individual wetland types. These can be defined in the classification process, which is the first step in developing standards for wetlands. The classification process requires the identification of the various structural types of wetlands and identification of their functions and values.[6] The classification should provide groups of wetlands that are similar

enough structurally and functionally so that they can reasonably be expected to respond in kind to inputs of toxic chemicals.

EVALUATING THE APPROPRIATENESS OF DIRECT APPLICATION OF CRITERIA

Information Needed

1. Identification of cofactors. Cofactors potentially affecting mobility and biological availability for each criterion chemical should be identified. Cofactors known to affect each criterion chemical are listed in individual national criteria documents and are summarized in Table 4. The absence of a relationship between a cofactor and a chemical on Table 4 does not ensure that no relationship exists, merely that none was discussed in the criteria document. The chemistry of the effects of the cofactors on the chemicals is often very complicated, and limited data are available regarding some of the relationships. The approach presented here is simplistic and is geared toward directing further efforts. Other sources of information, in addition to the criteria documents, should be consulted when actually applying this approach. Criteria that include hardness- or pH-dependent correction factors (Table 1) should apply directly to wetlands unless the wetland type has extremes of pH or hardness well outside the ranges used in toxicity testing. For example, the pH of acid bogs can be as low as 3.5, well below the 6.5 lower limit for toxicity testing (Table 3).

2. Comparison to wetland water chemistry. Natural levels and variability of those cofactors should be identified as well as possible for each major wetland type of interest. Wetlands-related information can be accumulated through consultation with wetland researchers, through literature searches, and from monitoring agencies.

3. Comparison of species lists. Species lists of fish, invertebrates, and plants should be compiled for each wetland type and compared to lists of species used for testing each criterion. Lists should be evaluated on two levels: a) Species level - Are the species used for toxicity testing representative (the same species or genera, or "similar" in terms of sensitivity to toxicants) of the species found in the wetland type? b) Family level - Does the wetland contain suitable representatives for each of the families listed in the minimum family requirements?[8,11] Consultation with fish and invertebrate specialists, plant ecologists, and wetlands expe s will be necessary to do this comparison.

Adoption of Existing Water Quality Criterion

The existing water quality criterion should be suitable for that wetland type if the following are true:

1. Important cofactor levels are not naturally exceeded in the wetland to a degree that might seriously affect toxicity or availability of the chemical. Would toxicity likely be higher, lower, or not influenced by typical levels or extremes of a particular cofactor in a particular wetland type?

2. Sufficient species or genera used for aquatic toxicity testing are found in the wetland type so that the minimum family requirements can be met by resident wetland species. Consultation between wetland scientists and criteria experts will be necessary in many cases to make judgements on how well-represented some wetland types are.

3. The criterion itself is not naturally exceeded in the wetland.

DEVELOPING SITE-SPECIFIC CRITERIA

When one or more of these stipulations is not true or when insufficient data are available, more evaluation is advisable. Again, consultation between wetland scientists and criteria experts might be helpful in prioritizing those wetland types for which additional protection, or additional research, might be needed for some chemicals. Once a priority list for further evaluation is established, an approach to obtaining the additional required data can be determined. It might be possible to group wetlands by type, and possibly by designated use, and then develop site-specific criteria for all wetlands of that type in the State.

SECTION 5

EXAMPLE ANALYSES

Evaluations of the applicability of the six criteria listed in Table 2 will be made for two sets of wetland data, including shallow marshes and prairie potholes. The analyses in these examples were made with limited data for each wetland type and are preliminary. They have been compiled to be used only as illustrations of the usefulness of this approach.

EXAMPLE 1

The first example is based on a wetland study taking place in southcentral Minnesota. The wetlands are being studied to evaluate the effects of disturbance on water quality, as well as the effects of pesticides on wetland communities. Therefore chemical and biological data have been collected.[18]

Classification

The wetland study sites are primarily shallow marshes (freshwater palustrine, persistent emergent, semi-permanently or seasonally-flooded, according to Cowardin[15]), dominated by Phalaris (reed canary grass) and Typha (cattails), but also include a small number of wet meadow/seasonally-flooded wetlands, deep marsh, shrub/scrub + woody wetlands, and ponds.

Steps 1 and 2: Identification of Cofactors and Comparison to Wetland Water Chemistry

Cofactors are identified for criteria chemicals in Table 4. Some water quality characteristics averaged for 5 seasons for the Minnesota wetlands are summarized in Table 5.

Although some water chemistry conditions in the shallow marshes were within the ranges of the aquatic toxicity testing conditions, others were exceeded (Table 3). Wetland values for pH were well within the 6.5-9.0 range allowed for testing, so criteria having pH as a possible cofactor affecting toxicity and/or biological availability should not be underprotective because of pH effects. As Table 4 shows, PCP, chromium(VI), zinc, and cyanide can be more toxic at low pH values, so a very

acidic wetland might require additional evaluation in regard to pH. The PCP criterion has an adjustment factor for pH, which indicates that enough suitable data are available to allow this relationship to be incorporated into the criterion.

Hardness values were not available for these marshes, but were probably fairly low since alkalinity was low. Table 4 lists hardness as a cofactor for zinc and chromium(VI). Table 1 reveals that the zinc criterion has an adjustment factor for hardness, so any effect of hardness on zinc toxicity and/or biological availability is already included in the criterion and does not have to be considered further. Chromium(VI) is more toxic at low alkalinity and hardness, but the criterion was derived using soft water and should be protective for the wetlands.

Total organic carbon (TOC) was highly variable in the wetlands and generally well above the 5 mg/L limit for toxicity testing. However parathion and zinc, the two criteria with TOC cofactor effects, have reduced toxicity and/or biological availability at high levels of organic matter (Table 4), so criteria should be protective.

Dissolved oxygen (DO) was highly variable in the wetlands and reached very low levels in late summer. The shallow waters of the marshes were extremely warm on hot summer days. Toxicity and/or biological availability is increased by low DO and high temperatures for PCBs, PCP, and cyanide. These relationships will require further evaluation.

Step 3: Comparisons of Species Lists

In Step 3, fish, invertebrates, and plants inhabiting the wetlands are compared to species used in testing each criterion. For these examples, only the acute toxicity lists have been consulted. A list of genera common to both the marshes and to the toxicity tests was compiled for each criterion. When identical species were not found, species from the same genus were compared to determine whether habitat requirements are suitable enough to include them as representative species for these wetlands. The shortened list of marsh species the same as or similar to, species used for toxicity testing was examined to determine whether the minimum family requirements for acute toxicity tests could be met for each criterion. Table 6 contains a list of marsh genera that could be used to fulfill minimum family requirements for each criterion. Appendix A contains a list of the sources that have been consulted in making this comparison.

The aquatic species found in the Minnesota wetlands were fairly well-represented by the acute toxicity test species for the six chemicals used in this example. The percentages of total species tested that have not been found in these wetlands were below 50% for all six criteria (Table 7). Except for PCBs, for which no plant value is available, plant species tested overlapped with species occurring in the wetlands. The absence of salmonids in wetlands was the only consistent omission.

Of all the species tested, the salmonids are the most sensitive to PCP and cyanide and are much more sensitive than most invertebrate species. The inclusion of highly sensitive salmonid data in the criteria calculations probably ensures that these two criteria are adequately protective when applied to wetlands not containing this sensitive family (not considering cofactor effects). It would perhaps be more important to consider the effects of the absence of salmonids in Minnesota marshes for criteria where salmonids are among the least sensitive species, including parathion and chromium(VI). In this case, the presence of salmonid toxicity data in the criterion calculation, despite their absence from the wetlands, could possibly cause the criterion to be less restrictive than is appropriate for the wetland.

Salmonids do not occur in the wetlands included in this example. Three criteria were missing an additional required taxonomic group (from Table 6: PCBs, chromium(VI), and cyanide). There are certainly representatives of this taxonomic group (nonarthropod/nonchordate) inhabiting the wetlands, but the genera used for toxicity tests did not correspond to the wetland genera. These three criteria have the least species on the acute toxicity list, so there are less species to compare to, in relation to the other criteria (Table 7). Toxicity experts and wetland biologists might be able to fill some of these data gaps by reaching conclusions on the suitability of wetland species to fulfill the minimum family requirements.

EXAMPLE 2

This example is based on data for a number of oligosaline prairie pothole wetlands in southcentral North Dakota.[19,20] Oligosaline is defined as ranging from 0.5-5 g/kg salinity, or specific conductance of 800-8,000 μS/cm at 25°C.[15] The chemical types of the majority of wetlands used in this example include magnesium bicarbonate, magnesium sulfate, and sodium sulfate.[20]

Classification

Wetlands included in this example are semipermanent (cover type 4 of the classification system developed by Stewart and Kantrud for the glaciated prairie region)[21], containing wet meadow, shallow marsh, and deep marsh. Classification of these wetlands based on the Cowardin system can be found in Kantrud et al.[20]

Steps 1 and 2: Identification of Cofactors and Comparison to Wetland Water Chemistry

Cofactors are identified for criteria chemicals in Table 4. Water quality data for the prairie pothole wetlands are summarized in Table 8. A comparison of water chemistry conditions for the prairie potholes with standard toxicological testing conditions (Table 3) reveals a number of differences.

These wetlands are extremely alkaline and saline compared to water used for freshwater toxicity testing. Salinity (reported as specific conductance) can vary greatly over the year and is concentrated by the high rates of evaporation and transpiration that take place in the summer. A number of the wetlands have pH values above the 6.5-9.0 range that the criteria are designed to protect. No data were available for total organic carbon (TOC), but dissolved organic carbon values from other prairie pothole systems were generally well above the TOC limit of 5 mg/L used for toxicity testing.[22] As in Example 1, hardness can be eliminated from consideration as a cofactor, because toxicity and/or biological availability is decreased as hardness increases. Similarly, the probable high TOC levels would decrease toxicity and/or biological availability for zinc and chromium(VI). The high pH values should cause decreased toxicity and/or biological availability. Bioavailability of zinc is reduced in high ionic strength waters such as these.

Dissolved oxygen (DO) levels drop in the winter and in middle to late summer, allowing anoxic conditions to develop. Although no aquatic temperature data were available, the Dakotas have moderately hot summers (mean July temperature of 22.3°C).[20] The shallow waters of the prairie potholes probably become very warm in late summer, corresponding with low DO levels. Toxicity and/or biological availability is increased by low DO and high temperatures for PCBs, PCP, and cyanide. These relationships will require further evaluation.

Step 3: Comparisons of Species Lists

Semi-permanent prairie pothole wetlands are generally shallow and eutrophic. Water levels fluctuate greatly, as does

salinity. The cold winters can cause some of the wetlands to freeze to the bottom. Both winterkill and summerkill, caused by the effects of lack of oxygen, can occur. Fish can survive only in semipermanent wetlands that have connections to deeper water habitat. The only native fishes known to occur in semi-permanent prairie potholes are fathead minnow (Pimephales promelas) and brook stickleback (Culaea inconstans).[20]

The invertebrate taxa of prairie potholes are typical of other eutrophic, alkaline systems in the United States. Macroinvertebrate species assemblages are highly influenced by hydroperiod and salinity in these systems, and species diversity drops as salinity increases.[20] Care must be taken in aggregating large salinity ranges into one wetland type (i.e. "oligosaline" may be too broad a class in terms of species representativeness). Comparisons of species typical of the wetlands with the criteria species lists reveals some major differences. For example, a large proportion of the aquatic insects tested for each criterion are found in flowing water, and therefore might not be characteristic of prairie pothole aquatic insects. Although many species of aquatic insects are found in these wetlands[20], there are not many suitable aquatic insects on the criteria species lists to compare to resident wetland species. Prairie pothole wetlands do not harbor Decapods (crayfish and shrimp), another common group for testing. Eubranchiopods (fairy, tadpole, and clam shrimp) are commonly found in prairie pothole wetlands[20], but only one representative of this group has been used to establish criteria, and that species was not on the list for any of the criteria used as examples here. Except for PCBs, for which no plant value is available, plant species tested do overlap with species occurring in the wetlands. Appendix B contains sources used in making comparisons.

The above discussion has obvious implications for determining applicability of criteria based on suitability of species. As Table 7 shows, the percentages of species tested for each criterion that have not been found in prairie potholes are rather high (up to 67%). There are more gaps in the minimum family requirements for fish and chordates (Table 9) than were found for the Minnesota marsh example. The lack of fish in these wetlands dictates that amphibians or other chordates be used to fill these family requirements. The paucity of fish in these wetlands again has relevance to the protectiveness of the criteria. Fish are the most sensitive group tested for PCP and cyanide, so these criteria may have an added "buffer" of protection (in relation to the other criteria used as examples) when applied with no modifications to this wetland type.

SUMMARY OF THE EXAMPLE ANALYSES

The conclusions discussed below should be considered as examples only. They should not be considered final for these wetland types.

Cofactor Effects

Based on this simple analysis, the only cofactors that potentially could cause criteria to be underprotective were DO and temperature. The low DO and high temperatures common in both wetland types in mid to late summer could cause increased toxicity and/or biological availability for PCBs, PCP, and cyanide. Cofactor effects for chromium(VI), zinc, and parathion were either not important under the chemical conditions encountered in these wetlands or should result in criteria being more, rather than less, protective for the wetland biota. Based on water quality characteristics, it can be concluded that chromium(VI), zinc, and parathion criteria are probably adequately protective of these wetland types with no acute modification.

The importance of the DO and temperature relationship requires further evaluation for PCBs, PCP, and cyanide. Chemists and wetlands experts should be consulted and further literature reviews should be completed to evaluate the need for additional toxicity tests. If it is determined that a modification to a criterion is warranted, seasonal site-specific criteria might be appropriate in this case. The indicator species procedure could be used, requiring toxicity tests using site water on one fish and one invertebrate. The tests could be done at the high temperatures and low DO found in late summer in the wetlands.

Species Comparisons

The Salmonidae are a required family group for establishing a Final Acute Value and yet are not present in either of the wetland types used as examples. This evaluation is most concerned with ensuring that criteria are adequately protective, so the absence of this family in the wetlands should only be considered a problem if the unmodified criterion (which includes the Salmonidae) might be underprotective. This would most likely be true for parathion and chromium(VI).

For several criteria, some family requirements are not fulfilled because the available toxicity data for that taxonomic group do not include wetland species or genera ("NT" in Tables 6 and 9). While this document made comparisons at the genus level, others have made comparisons at the family level to determine if the species listed in the criteria document is a member of a

family that exists at the site.[16] Issues related to species comparisons should be addressed through discussion with criteria experts and wetlands ecologists and through further literature review.

The absence of fish in prairie potholes to fill the "other chordates" category for cyanide, zinc, chromium(VI), and PCBs may warrant additional toxicity tests and site-specific modifications. The only other fish likely to be present in these wetlands is the brook stickleback (Culaea inconstans)[20] which was not tested for any of the six criteria. No non-fish chordates were tested either, so no evaluation of the probable sensitivity of other chordates to these criteria can be made based on the criteria documents.

If it is decided upon more rigorous evaluation that these differences in taxonomic groups warrant additional efforts and development of site-specific criteria, the recalculation procedure can be used. A suitable family, resident in the wetlands, can be added to the list to replace the Salmonidae and/or other missing groups, either through additional toxicity tests or by including additional available data.

Further Evaluation

This approach helps to prioritize wetland types and criteria for further evaluation. It was concluded that zinc, chromium(VI), and parathion criteria require no modification with regard to cofactor effects. PCBs, PCP, and cyanide, however, should be evaluated further in regard to the effects of high temperatures and low DO on toxicity, for both wetland types. The absence of salmonids may be most important for parathion and chromium(VI) in both wetland types. Further consideration should be given to the need for additional tests with chordates from prairie pothole wetlands for cyanide, zinc, chromium(VI) and PCBs, although there is no evidence to suggest that the absence of representative wetland chordates from the test species will result in underprotective criteria.

This type of evaluation, done for a number of wetland types and criteria, can be combined with information on the types of pollutants that threaten particular wetland types. In this way wetland types requiring additional evaluation and perhaps eventually some additional toxicity testing for particular pollutants can be prioritized based on adequacy of existing criteria, potential threats to the system, and resources available for testing. These examples illustrate the need for wetland scientists to work closely with criteria experts. Expert judgement is needed to evaluate the significance of the gaps in the available data.

SECTION 6

CONCLUSIONS

The efficient use of limited resources dictates that criteria and standards for wetlands be developed by making good use of the wealth of data that has been accumulated for other surface waters. This report focused on the application of numeric aquatic life criteria to wetlands. The numeric aquatic life criteria are designed to protect aquatic life and their uses. The criteria are conservative, and for most wetland types are probably protective or overprotective.

A simple, inexpensive evaluation technique has been proposed in this document for detecting wetland types that might be underprotected for some chemicals by existing criteria. The approach relies on information contained in criteria documents, data regarding species composition and water quality characteristics for the wetland types of interest, and consultation with experts. It is intended to be used as a screening tool for prioritizing those wetland types that require additional evaluations and research.

Two tests of the approach demonstrated that it can be used to identify cases in which criteria might be underprotective, but further evaluation and close coordination among regulatory agencies, wetland scientists, and criteria experts are needed to determine when actual modifications to the criteria are necessary.

Site-specific guidelines for modifying the numeric criteria should be appropriate for use on wetlands in cases where additional evaluations reveal that modifications are needed. The approach described in this document can be used to compile lists of the most commonly under-represented species and the most frequently encountered chemicals. Aquatic toxicity tests can then be conducted which would apply to a number of wetland types.

Information obtained with this approach can be used to prioritize further evaluations and research, identify gaps in data, and make further testing more efficient, but has some limitations. It does not adequately address the importance of plants in wetland systems and applies only to the aquatic component of wetlands. It relies on species assemblage and water

quality data that are not available for some wetland types. For these reasons, a meeting of wetland scientists and criteria experts is recommended to discuss the need for this type of evaluation, the utility of this approach, and possible alternative approaches.

The application of numeric criteria to wetlands is just one part of a large effort to develop wetland standards and criteria. The development of biocriteria, sediment criteria, and wildlife criteria will help to ensure that all components of the wetland resource are adequately protected.

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APPENDIX A

SOURCES USED IN SPECIES HABITAT IDENTIFICATION FOR MINNESOTA MARSHES

Fishes:

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Nelson, J.S. 1984. Fishes of the World. 2nd edition. New York: John Wiley and Sons.

Niering, W.A. 1987. Wetlands. New York: Alfred A. Knopf.

Personal Communications:
P. DeVore and C. Richards of the Natural Resources Research Institute, Duluth, Minnesota.
G. Montz, Minnesota Dept. of Natural Resources.

Macroinvertebrates:

Niering, W.A. 1987. Wetlands. New York: Alfred A. Knopf.

Pennak, R.W. 1978. Fresh-water Invertebrates of the United States. 2nd edition. New York: John Wiley and Sons.

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Personal Communications:
P. DeVore and A. Hershey of the Natural Resources Research Institute, Duluth, Minnesota.
P. Mickelson of the University of Minnesota, Duluth.

APPENDIX B

SOURCES USED IN SPECIES HABITAT IDENTIFICATION FOR PRAIRIE POTHOLES

Fishes:

Kantrud, H.A., G.L. Krapu, and G.A. Swanson. 1989. Prairie Basin Wetlands of the Dakotas: A Community Profile. U.S. Fish and Wildlife Service Biological Report 85(7.28).

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TABLE 1. FRESHWATER NUMERIC AQUATIC LIFE CRITERIA*

Chemical	H, T, or pH** Dependent	Chemical	H, T, or pH** Dependent
Organochlorines:		Metals:	
Aldrin		Aluminum	
Chlordane		Arsenic(III)	
DDT		Cadmium	H
Dieldrin		Chromium(III)	H
Endosulfan		Chromium(VI)	
Endrin		Copper	H
Heptachlor		Lead	H
Lindane		Mercury	
PCBs		Nickel	H
Pentachlorophenol	pH	Selenium	
		Silver	H
Organophosphates:		Zinc	H
Chlorpyrifos			
Parathion		Others:	
		Ammonia	pH, T
		Chloride	
		Chlorine	
		Cyanide	
		Dissolved oxygen	T

* Summarized from individual criteria documents. Chemicals that have adjustment factors built into the criteria are indicated.

** H = Hardness, T = Temperature.

TABLE 2. SUITABILITY OF WETLAND SPECIES TO FILL MINIMUM FAMILY REQUIREMENTS FOR SIX CRITERION CHEMICALS

Required Taxonomic Group	PCBs	Para-thion	PCP	Cyanide	Zinc	Chrom-ium(VI)
Salmonid	NP*	NP	NP	NP	NP	NP
Other Fish	Y**	Y	Y	Y	Y	Y
Other Chordate	Y	Y	Y	Y	Y	Y
Planktonic Crustacean	Y	Y	Y	Y	Y	Y
Benthic Crustacean	Y	Y	Y	Y	Y	Y
Insect	Y	Y	Y	Y	Y	Y
Nonarthropod-Nonchordate	NT***	Y	Y	Y	Y	Y
Another Insect or New Phylum	Y	Y	Y	NT	Y	Y

*NP Not present: Taxonomic group not present in most wetland types.
**Y Wetland genera represented adequately.
***NT Not tested: Available toxicity data does not include sufficient wetland species.

TABLE 3. SOME CONDITIONS RECOMMENDED FOR DILUTION WATER FOR WATER QUALITY CRITERIA TESTING[17]

Characteristic	Freshwater	Saltwater
Total organic carbon	<5 mg/L	<20 mg/L[a]
Particulate matter	<5 mg/L	<20 mg/L[a]
pH	6.5-9.0	Stenohaline 8.0 Euryhaline 7.7 Range <0.2
Hardness (mg/L as $CaCO_3$)	Soft water 40-48 Range <5 mg/L[b]	
Salinity		Stenohaline 34 g/kg Euryhaline 17 g/kg Range <2 g/kg[c]
Dissolved oxygen	60-100% saturation[d]	60-100% saturation[d]
Temperature	+/- 5 °C of water of origin[e]	

[a] <5 mg/L for tests other than saltwater bivalve molluscs.
[b] Or 10% of average, whichever is higher.
[c] Or 20% of average, whichever is higher.
[d] For flow-through tests (40-100% for static tests).
[e] For invertebrates only.

TABLE 4. EFFECTS OF COFACTORS ON CRITERION CHEMICAL TOXICITY

	COFACTORS: Effect of Greater Value								
	pH	TOC	TURB	TEMP	DO	H	IONIC S		NUTR/ORG
Organochlorines:									
Aldrin									
Chlordane									
DDT		+					+	+	
Dieldrin									
Endrin									
Heptachlor									
Lindane									
Endosulfan				+		O			
PCBs				+	-				
Pentachlorophenol	-			+	-				
Toxaphene		-		+					
Organophosphates:									
Parathion		-							
Chlorpyrifos									
Metals:									
Arsenic (III)		-		+	+				
ium		-		?	0	-	-	-	?
nium (VI)	-					-			
C. mium (III)						-			
Copper	-	-		+		-			
Lead		-?	-			-			
Mercury	-			+	-	0			
Nickel	-			+		-		-	
Selenium		-		-		-			
Silver		-				-			
Zinc	-	-			+	-	-	+	
Aluminum	-	-							-
Other:									
Chlorine	0					0	?		
Cyanide	-			±	-		0		
Ammonia	+			+	-		-		
Chloride				+?		-?	0		
DO									

+: increased toxicity/mobility
O: no effect on toxicity/mobility
-: decreased toxicity/mobility
TOC: total organic carbon
TURB: turbidity
C: ionic strength/cations
?: tested and found inconclusive
: not discussed in criteria document
±: short-term increase/long-term decr
DO: dissolved oxygen H: hardness
NUTR/ORG: nutrients/organic acids
S: salinity

TABLE 5. WATER CHEMISTRY FOR SELECTED MINNESOTA MARSHES*

Water Quality Characteristic	Mean Value	Range	Comparison with Standard Testing Conditions
pH (pH units)	7.1	6.1 - 7.6	Within range
Total organic carbon (mg/L)	20	5 - 60	High
Dissolved oxygen (mg/L)	8.2	0.4 - 15.4	Seasonally low
Hardness (mg/L as $CaCO_3$)	No data	-	-
Alkalinity (mg/L as $CaCO_3$)	8	4 - 14	-
Temperature (°C)	11.9	0.3 - 31.0	Seasonal extremes
Turbidity (NTU)	33	1 - 412	-

* Data taken from Detenbeck (1990), n=42 wetlands.[18]

TABLE 6. COMPARISON OF TEST SPECIES WITH MINNESOTA MARSH BIOTA FOR SIX CRITERIA

Required Taxonomic Group	PCBs	Parathion	PCP
Salmonid	NP[d]	NP	NP
Other Fish[a]	Micropterus	Lepomis	Micropterus
Other Chordate	Pimephales	Pimephales	Rana
Planktonic Crustacean	Daphnia	Daphnia	Daphnia
Benthic Crustacean	unknown amphipod	Orconectes	Orconectes
Insect	Ishnura[b]	Chironomus	Tanytarsus
Nonarthropod-Nonchordate	NT[e]	unknown[c] nematodes/ annelids	unknown[c] nematodes/ annelids
Another Insect or New Phylum	Tanytarsus	Ishnura	unknown amphipod/ isopod
Aquatic Plant	NT	alga	Lemna

continued

TABLE 6, CONTINUED

Required Taxonomic Group	Cyanide	Zinc	Chromium(VI)
Salmonid	NP	NP	NP
Other Fish[a]	Perca	Lepomis	Lepomis
Other Chordate	Lepomis	Pimephales	Pimephales
Planktonic Crustacean	Daphnia	Daphnia	Daphnia
Benthic Crustacean	unknown[c] amphipod/ isopod	unknown[c] amphipod/ isopod	Orconectes
Insect	Tanytarsus	Argia[b]	Chironomus
Nonarthropod-Nonchordate	Physa	Physa	Physa
Another Insect or New Phylum	NT	unknown[c] annelid/ nematode	NT
Aquatic Plant	Lemna	Lemna	alga

a Fish were sampled in water bodies associated with some of the wetlands, not in the wetlands themselves.
b Probable or seen as an adult.
c Unknown species from these taxa found in wetlands. May or may not be similar in terms of habitat requirements, etc. to species used in toxicity tests.
d Not present: Taxonomic group not present in wetland type.
e Not tested: Available toxicity data does not include sufficient wetland species.

TABLE 7. NUMBER OF SPECIES TESTED FOR ACUTE CRITERIA AND PERCENTAGE OF TEST SPECIES THAT ARE NOT FOUND IN MINNESOTA MARSHES OR OLIGOSALINE PRAIRIE POTHOLES*

Chemical	Species Used to Establish FAV** (Total Number)	Not Present in Marshes (Per cent)	Not Present in Prairie Potholes (Per cent)
PCBs	10	30%	40%
Parathion	37	43%	64%
PCP	37	22%	43%
Cyanide	17	29%	65%
Zinc	45	45%	67%
Chromium(VI)	33	27%	64%

* Remainder of percentage includes both those species that are known to occur in these wetlands and those species that may occur in the wetlands, but insufficient data are available.

** Final Acute Value.

TABLE 8. WATER QUALITY CHARACTERISTICS FOR OLIGOSALINE PRAIRIE POTHOLES[a]

Water Quality Characteristic	Mean Value	Range	Comparison with Standard Testing Conditions
pH (pH units)	8.9	7.4 - 10.3[b]	High
Total organic carbon (mg/L)	No data[c]	-	-
Dissolved oxygen (ppm)	No data[d]	-	-
Hardness (mg/L as $CaCO_3$)	No data[e]	-	-
Alkalinity (mg/L as $CaCO_3$)	650	230 - 1300	High
Temperature (°C)	No data[f]	-	-
Specific conductance (μS/cm at 25°C)	3568	750 - 8000	-

a Data summarized from Swanson et al. (1988).[19]
b N=27 wetlands.
c Dissolved organic carbon data for Manitoba prairie potholes ranged from 0.4-102 mg/L, and for Nebraska, from 20-60 mg/L in one study and 139-440 mg/L in another study.[22]
d Winterkill, caused by low dissolved oxygen under ice, occurs in many of these lakes.
e An estimate of hardness based on alkalinity values gives a mean of 760 mg/L as $CaCO_3$.
f Region is characterized by very cold winters and warm summers.

TABLE 9. COMPARISON OF TEST SPECIES WITH PRAIRIE POTHOLE BIOTA FOR SIX CRITERIA

Required Taxonomic Group	PCBs	Parathion	PCP
Salmonid	NP	NP	NP
Other Fish	Pimephales	Pimephales	Pimephales
Other Chordate	NT	Pseudacris[a]	Rana[a]
Planktonic Crustacean	Daphnia	Daphnia	Daphnia
Benthic Crustacean	Gammarus[a]	Gammarus[a]	Hyalella
Insect	damselfly[b]	Peltodytes	Tanytarsus[b]
Nonarthropod-Nonchordate	NT	tubificid worm[b]	tubificid worm[b]
Another Insect or New Phylum	Tanytarsus[b]	Chironomus	Physa
Aquatic Plant	NT	Microcystis	Lemna

TABLE 9, CONTINUED

Required Taxonomic Group	Cyanide	Zinc	Chromium(VI)
Salmonid	NP	NP	NP
Other Fish	Pimephales	Pimephales	Pimephales
Other Chordate	NT	NT	NT
Planktonic Crustacean	Daphnia	Daphnia	Daphnia
Benthic Crustacean	Gammarus[a]	Gammarus[a]	Hyalella
Insect	Tanytarsus[b]	Argia[b]	Chironomus[a]
Nonarthropod-Nonchordate	Physa[a]	Physa[a]	Physa[a]
Another Insect or New Phylum	NT	tubificid worm[b]	damselfly[b]
Aquatic Plant	Lemna	Lemna	Nitzschia

a Genus is present in the wetlands; may not be same species.
b Species representative of that taxonomic group from criteria testing lists probably present in prairie potholes, but no actual data available.

APPENDIX F

COORDINATION BETWEEN THE
ENVIORNMENTAL PROTECTION AGENCY,
FISH AND WILDLIFE SERVICE AND NATIONAL
MARINE FISHERIES SERVICE REGARDING
DEVELOPMENT OF WATER QUALITY CRITERIA AND
WATER QUALITY STANDARDS UNDER
THE CLEAN WATER ACT

July 27, 1992

Signed by:

Ralph Morgenweck, Assistant Director
Fish and Wildlife Enhancement
U.S. Fish and Wildlife Service

Dr. Tudor Davies, Director
Office of Science and Technology
U.S. Environmental Protection Agency

Dr. Nancy Foster, Director
Office of Protected Resources
National Marine Fisheries Service

Coordination Between the Environmental Protection Agency, the Fish and Wildlife Service and the National Marine Fisheries Service Regarding the Development of Water Quality Criteria and Water Quality Standards Under the Clean Water Act

PURPOSE

This memorandum sets forth the procedures to be followed by Fish and Wildlife Service (FWS), the National Marine Fisheries Service (NMFS), and the Environmental Protection Agency (EPA) to insure compliance with Section 7 of the ESA in the development of water quality criteria published pursuant to Section 304(a) of the Clean Water Act (CWA) and the adoption of water quality standards under Section 303(c) of the CWA. Consultation will be conducted pursuant to 50 C.F.R. Part 402. Regional Offices of EPA and the Services may establish agreements, consistent with these procedures, specifying how they will implement this Memorandum.

I. BACKGROUND

A. Guiding Principles

The agencies recognize that EPA's water quality criteria and standards program has the express goal of ensuring the protection of the biological integrity of U.S. waterbodies and associated aquatic life. The agencies also recognize that implementation of the CWA in general, and the water quality standards program in particular, is primarily the responsibility of states. EPA's role in this program is primarily to provide scientific guidance to states to aid in their development of water quality standards and to oversee state adoption and revision of standards to insure that they meet the requirements of the CWA.

In view of the decentralized nature of EPA's water quality standards program responsibilities, and the agencies' desire to carry out their respective statutory obligations in the most efficient manner possible, the agencies believe that consultation should occur, to the maximum extent possible, at the national level. Should additional coordination be necessary on the regional level, the procedures outlined below are designed to insure that the Services are integrated early into EPA's oversight of the states' standards adoption process so that threatened and endangered species concerns can be addressed in the most efficient manner possible.

B. Legal Authorities

1. Section 7 of the ESA

Section 7 of the ESA contains several provisions which require federal agencies to take steps to conserve endangered and threatened species, and which impose the responsibility on agencies to insure, in consultation with the appropriate Service, that certain actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of their critical habitat. Section 7 also requires agencies to confer with the appropriate Service regarding actions affecting species or critical habitat that have been proposed for listing or designation under section 4, but for which no final rule has been issued.

In particular, section 7(a)(1) provides that federal agencies shall "utilize their authorities in furtherance of the purposes of [the ESA] by carrying out programs for the conservation of endangered species and threatened species . . ." Section 7(a)(2) requires federal agencies to insure, in consultation with the appropriate Service, that actions which they authorize, fund or carry out are "not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined . . . to be critical." Section 7(a)(4) requires a conference for actions that are "likely to jeopardize the continued existence" of species proposed for listing or that are likely to "result in the destruction or adverse modification" of proposed critical habitat.

The procedures for consultation between federal agencies and the Services under section 7 of the ESA are contained in 50 C.F.R. Part 402. Section 402.14 of these regulations requires that agencies engage in formal consultation with the appropriate Service where any action of that agency may affect listed species or critical habitat. Formal consultation is not required if the action agency prepares a biological assessment or consults informally with the appropriate Service and obtains the written concurrence of the Service that the action is not likely to adversely affect listed species or critical habitat. Formal consultation culminates in the issuance of a biological opinion by the Service which concludes whether the agency action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical

habitat.[1] If the Service makes a jeopardy finding, the opinion shall include reasonable and prudent alternatives, if any, to avoid jeopardy. If the Service anticipates that an action would result in an incidental take of a listed species (defined in 50 C.F.R. 402.02), the Service shall include an incidental take statement and reasonable and prudent measures that the Director considers necessary or appropriate to minimize such impact. Such measures cannot alter the basic design, location, scope, duration or timing of the action and may involve only minor changes.

Evaluation of the potential effects of an agency action on listed species or their habitat is to be based upon the best scientific and commercial data available or which can be obtained prior to or during the consultation. 50 C.F.R. 402.14(d).

2. Water Quality Standards Development Under the CWA

Section 303 of the Clean Water Act provides for the development by states of water quality standards which are designed to protect the public health or welfare, enhance the quality of water and serve the purposes of the CWA. Such standards consist of designated uses of waterways (e.g., protection and propagation of fish, shellfish, and wildlife) and criteria which will insure the protection of designated uses.

Under the CWA, the development of water quality standards is primarily the responsibility of States. However, pursuant to section 304(a) of the CWA, EPA from time to time publishes water quality criteria which serve as scientific guidance to be used by states in establishing and revising water quality standards. These EPA criteria are not enforceable requirements, but are recommended criteria levels which states may adopt as part of their legally enforceable water quality standards; states may adopt other scientifically defensible criteria in lieu of EPA's recommended criteria. See 40 C.F.R. 131.11(b).

Standards adopted by states constitute enforceable requirements with which permits issued by States or EPA under section 402 of the Clean Water Act must assure compliance. CWA section 301(b)(1)(C). Under section 303(c) of the CWA, EPA must review water quality standards adopted by states and either approve them if the standards meet the requirements of the CWA or disapprove them if the standards fail to do so. However, EPA's disapproval of state water quality standards does not alter the enforceable requirements with which CWA section 402 permits must comply, because the state standards remain in full force and

[1] Any reference in this document to "jeopardy" for purposes of section 7 of the ESA is intended also to include the concept of destruction or adverse modification of critical habitat.

effect under state law. The state-adopted standards remain effective for all purposes of the CWA until they are revised by the state or EPA promulgates federal water quality standards applicable to the state.

II. PROCEDURES

A. Development of Water Quality Criteria Guidance Under Section 304(a) of the CWA

EPA will integrate the Services into its criteria development process by consulting with the Services regarding the effect EPA's existing aquatic life criteria (and any new or revised criteria) may have on listed endangered or threatened species. References below to endangered or threatened species include species proposed to be listed by the Services. In addition, EPA will include the Service(s) on the aquatic life criteria guidelines revision committee which is currently revising the methodological guidelines that will form the technical basis for future criteria adopted by EPA.

1. Consultation on Existing Criteria

EPA has developed and published aquatic life criteria documents explaining the scientific basis for aquatic life criteria that EPA has published. EPA will consult with the appropriate Service regarding the aquatic life criteria as described below.

Step 1: Services' Identification of Species that May Be Affected By Water Quality Degradation

The Services and EPA will request their regional offices to identify the endangered and threatened species within their jurisdictions that may be affected by degraded water quality. Each Service will provide EPA with a consolidated list of these species. To facilitate this process, the initial species list will include information identifying the areas where such species are located, a description of the pollutants causing the water quality problems affecting the species (if known) and any other relevant information provided by the Services' regional offices. In future consultations, the Services will provide a species list, as required in 50 C.F.R. Part 402, and access to any relevant data concerning identified species.

Step 2: EPA Initiation of Informal Consultation and Performance of Biological Assessment

Based upon a review of information provided by the Services under Step 1, above, and any other information available to EPA (as described by 50 C.F.R. 402.12(f)(1)-(5)), EPA will determine what species may be affected by the aquatic life criteria and will request informal consultation with the appropriate Service regarding such species. EPA will submit to the appropriate Service a biological assessment that evaluates the potential effects of the criteria levels on those species. The biological assessment will be developed in an iterative process between EPA and the Service (initially involving submission of a "pilot" assessment addressing 2 or 3 chemicals), and is expected to contain the information listed in the Appendix of this Memorandum.

Step 3: Further steps Based on Results of Biological Assessment

Based upon the findings made by EPA in the Biological Assessment, the consultation will proceed as follows (see 50 C.F.R. 402.12(k)):

- For those criteria/species where EPA determines that there is no effect, EPA will not initiate formal consultation.

- For those criteria/species where there is a "may affect" situation, and EPA determines that the species is not likely to be adversely affected, the appropriate Service will either concur or nonconcur with this finding under Step 4, below.

- Where EPA finds that a species is likely to be adversely affected, formal consultation will occur between the agencies under Step 5, below.

Step 4: Service Reviews Biological Assessment and Responds to EPA

Within 30 days after EPA submits a complete biological assessment to the Service, the Service will provide EPA with a written response that concurs or does not concur with any findings by EPA that species are not likely to be adversely affected by EPA's criteria. For those species/criteria where the Service concurs in EPA's finding, consultation is concluded and no formal consultation will be necessary. For any species/criteria where the Service does not concur in EPA's finding, formal consultation on the criteria/species will occur under step 5, below (see 50 C.F.R. 402.14).

Step 5: Formal Consultation

Formal consultation will occur between the agencies (coordinated by the agencies' headquarters' offices) beginning on the date the Service receives a written consultation request from EPA regarding those species where EPA or the Service believe there is likely to be an adverse affect, as determined under steps 3 and 4, above. The consultation will be based on the information supplied by EPA in the biological assessment and other relevant information that is available or which can feasibly be collected during the consultation period (see 50 C.F.R 402.14(d)). The Service will issue a biological opinion regarding whether any of the species are likely to be jeopardized by the pollutant concentrations contained in EPA's criteria. Any jeopardy conclusion will specify the specific pollutant(s), specie(s) and geographic area(s) which the Service believes is covered by such conclusion. If the Service makes a jeopardy finding, it will identify any available reasonable and prudent alternatives, which may include, but are not limited to, those specified below. EPA will notify the Service of its action regarding acceptance and implementation of all reasonable and prudent alternatives.

1. EPA works with the relevant State during its pending triennial review period to insure adoption (or revision) of water quality standards for the specific pollutants and water bodies that will avoid jeopardy. Such adoption or revision may include adoption of site-specific criteria in accordance with EPA's site-specific criteria guidance, or other basis for establishing more stringent criteria.

2. EPA disapproves relevant portions of state water quality standards (see 40 C.F.R. 131.21) and initiates promulgation of federal standards for the relevant water body (see 40 C.F.R. 131.22) that will avoid jeopardy. Where appropriate, EPA will promulgate such standards on an expedited basis.

2. Service Participation in Committee Revising Criteria's Methodological Guidelines

An EPA committee is currently charged with revising and updating the methodological guidelines which will in the future be followed by EPA when it issues new 304(a) water quality criteria. The Service(s) will become a member of the workgroup as an observer/advisor to insure that the methodological guidelines take into account the need to protect endangered and threatened species. The guidelines will be subject to peer review and public notice and comment prior to being finalized. During the public comment period, the Services will provide the agencies' official position on the guidelines.

3. Consultation with the Services on New or Revised Aquatic Life Criteria and New Wildlife and Sediment Criteria

When EPA develops and publishes new or revised aquatic life criteria and new wildlife and sediment criteria under section 304(a), EPA will request consultation with the Services on such criteria, which will proceed in accordance with the procedures outlined in section II.A.1 of this Memorandum.

B. EPA Review of State Water Quality Standards Under Section 303 of the CWA

In order to insure timely resolution of issues related to protection of endangered or threatened species, EPA and the Services will coordinate in the following manner with regard to state water quality standards that are subject to EPA review and approval under section 303(c) of the CWA.

1. Participation of the Services in EPA/State Planning Meetings

Unless other procedures ensuring adequate coordination are agreed to by the regional offices of EPA and the Service(s), EPA regional offices will request in writing that the Services attend EPA/state meetings where the state's plan for reviewing and possibly revising water quality standards is discussed. The invitation will include any preliminary plans submitted by the state and any suggestions offered by EPA to the state that will be discussed at the planning meeting, as well as a request for the Services to suggest any additional topics of concern to them.

Service staff will attend the planning session and be prepared to identify areas where threatened and endangered species that may be affected by the proposed action may be present in the state and to provide access to any data available to the Services in the event additional discussions will need to occur. If the Service does not intend to attend the planning meeting, it will notify the EPA regional office in writing. If threatened and endangered species may be present in the waters subject to the standards, such notice will include a species list.

2. Consultation on EPA Review of State Water Quality Standards Where Federally Listed Species Are Present

Except in those cases where the Service's Director, at the Washington Office level, requests consultation, EPA may complete its review and approval of state water quality standards without requesting consultation where (1) the state's criteria are as stringent as EPA's section 304(a) aquatic life criteria and consultation between EPA and the appropriate Service on EPA's

criteria has resulted in a Service concurrence with an EPA finding of "not likely to adversely affect," a "no jeopardy" biological opinion (or EPA's implementation of a reasonable and prudent alternative contained in the Service's "jeopardy" biological opinion), and EPA's adherence to the terms and conditions of any incidental take statement and (2) the state has designated use classifications for the protection and propagation of fish and shellfish.

However, if a State adopts water quality standards consistent with the provisions of the preceding paragraph, but the Service believes that consultation may be necessary in either of the circumstances described below, only the Service's Director, at the Washington Office level, may request consultation with EPA. Such consultation may be necessary (1) where review of a state water quality standard identifies factors not considered during the relevant water quality criterion review under this Memorandum which indicate that the standard may affect an endangered or threatened species, or (2) where new scientific information not available during the earlier consultation indicates that the criterion, as implemented through the state water quality standard, may affect endangered or threatened species in a manner or to an extent not considered in the earlier consultation.

If a state submits water quality standards containing aquatic life criteria that are less stringent than EPA's section 304(a) aquatic life criteria, or use designations that do not provide for the protection and propagation of fish and shellfish, EPA will consult with the appropriate Service regarding the state's standards. EPA's request for formal or informal consultation (as appropriate) shall be made as early as possible in the standards development process (e.g., when standards regulation are under development by the state). The EPA region should not wait until standards are formally submitted by the state to request such consultation.

If a state water quality standard under review by EPA relates to specie(s), pollutant(s) and geographic area(s) that were the subject of a jeopardy opinion issued by the Service under section II.A. of this Memorandum, EPA will consider the opinion (and any reasonable and prudent alternatives specified by the Service) and take action that, in EPA's judgment, will insure that water quality standards applicable to the state are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of species' critical habitat. EPA will notify the Service that issued the biological opinion of its action, in accordance with 50 C.F.R. 402.15.

Except in those cases where the Service's Director, at the Washington Office level, requests consultation, EPA may take

action pursuant to CWA section 303(c)(4) to promulgate federal standards applicable to a water of the state without requesting consultation where (1) the aquatic life criteria promulgated by EPA are no less stringent than EPA's section 304(a) criteria guidance and consultation between EPA and the Service on EPA's criteria has resulted in a Service concurrence with an EPA finding of "not likely to adversely affect," a "no jeopardy" biological opinion (or EPA's implementation of a reasonable and prudent alternative contained in the Service's "jeopardy" biological opinion), and EPA's adherence to the terms and conditions of any incidental take statement and (2) the applicable use classifications provide for the protection and propagation of fish and shellfish.

However, if EPA promulgates water quality standards consistent with the provisions of the previous paragraph, but the Service believes that consultation may be necessary in either of the circumstances described below, only the Service's Director, at the Washington Office level, may request consultation with EPA. Such consultation may be necessary (1) where review of the water quality standard identifies factors not considered during the relevant water quality criterion review under this Memorandum which indicate that the standard may affect an endangered or threatened species, or (2) where new scientific information not available during the earlier consultation indicates that the criterion, as implemented through the water quality standard, may affect endangered or threatened species in a manner or to an extent not considered in the earlier consultation.

III. Revisions to Agreement

EPA and the Services may jointly revise the procedures agreed to in this document based upon the experience gained in the pilot consultation on EPA's aquatic life criteria or other experience in the implementation of the above procedures.

IV. Third Party Enforcement

The terms of this Memorandum are not intended to be enforceable by any party other than the signatories hereto.

V. Reservation of Agency Positions

No party to this Memorandum waives any administrative claims, positions or interpretations it may have with respect to the applicability or the enforceability of the ESA.

VI. Effective Date; Termination

This Memorandum will become effective upon signature by each of the parties hereto. Any of the parties may withdraw from this Memorandum upon 60 days' written notice to the other parties;

provided that any Section 7 consultation covered by the terms of this Memorandum that is pending at the time notice of withdrawal is received by the parties, and those activities covered by this Memorandum that begin the consultation process with the 60-day notice period, will continue to be governed by the procedures in this Memorandum.

Ralph Morgenweck, Assistant Director
Fish and Wildlife Enhancement
U.S. Fish and Wildlife Service

Date

Dr. Tudor T. Davies, Director
Office of Science and Technology
U.S Environmental Protection Agency

Date

Dr. Nancy Foster, Director
Office of Protected Resources
National Marine Fisheries Service

Date

APPENDIX
Expected Contents of EPA's Biological Assessment

I. Introduction/Overview

A. Benefits of pollution reduction relative to endangered and threatened species/description of the ESA

B. Role of Water Quality Standards under the CWA

C. Overview of water quality criteria (philosophy, objectives, methodology)

D. Discussion of comparative sensitivity of listed species (and surrogates) with criteria database

E. Description of Fact Sheet contents

- data included
- description of how specific criteria derived
- description of logic/thought processes supporting findings of effect on listed species

II. Fact Sheets

Pollutant-specific fact sheets will be compiled which evaluate the available data and reach conclusions regarding the findings of effect of the criteria on endangered and threatened species. The fact sheets will be presented largely in tabular, graph form.

A. Summary of toxicological relationships (from water quality criteria documents)

1. acute (acute lethality)
2. chronic (life processes at risk)
3. plants
4. residues
5. other key data
6. updated information through review of ACQUIRE database and other key data

B. Taxa at risk vis-a-vis listed species (through use of surrogates, where appropriate)

C. Impact of other water quality factors -- describe effects such as environmental variability, ph, hardness, temperature, etc.

D. Assessment of impact on listed species

Findings to be made regarding whether each criteria (1) "may affect" and/or (2) is likely to adversely affect, listed species.

APPENDIX G

Questions and Answers on: Antidegradation

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

United States
Environmental Protection
Agency

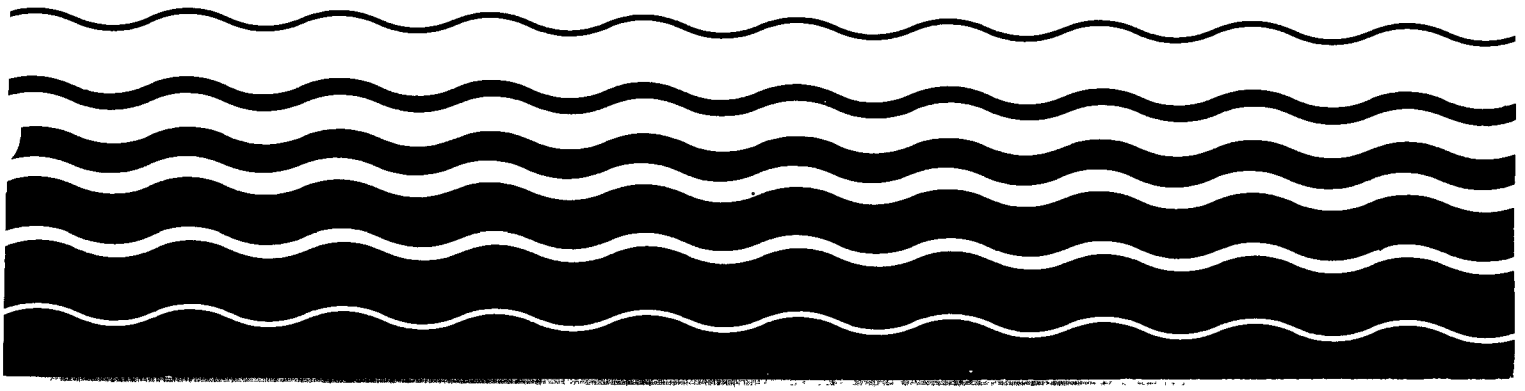
Office of Water
Regulations and Standards
Washington, DC 20460

August 1985

Water

EPA

Questions & Answers on: Antidegradation



QUESTIONS AND ANSWERS ON ANTIDEGRADATION

INTRODUCTION

This document provides guidance on the antidegradation policy component of water quality standards and its application. The document begins with the text of the policy as stated in the water quality standards regulation, 40 CFR 131.12 (40 FR 51400, November 8, 1983), the portion of the Preamble discussing the antidegradation policy, and the response to comments generated during the public comment period on the regulation.

The document then uses a question and answer format to present information about the origin of the policy, the meaning of various terms, and its application in both general terms and in specific examples. A number of the questions and answers are closely related; the reader is advised to consider the document in its entirety, for a maximum understanding of the policy, rather than to focus on particular answers in isolation. While this document obviously does not address every question which could arise concerning the policy, we hope that the principles it sets out will aid the reader in applying the policy in other situations. Additional guidance will be developed concerning the application of the antidegradation policy as it affects pollution from nonpoint sources. Since Congress is actively considering amending the Clean Water Act to provide additional programs for the control of nonpoint sources, EPA will await the outcome of congressional action before proceeding further.

EPA also has available, for public information, a summary of each State's antidegradation policy. For historical interest, limited copies are available of a Compendium of Department of the Interior Statements on Non-Degradation of Interstate Waters, August, 1968. Information on any aspect of the water quality standards program and copies of these documents may be obtained from:

David Sabock, Chief
Standards Branch (WH-585)
Office of Water Regulations and Standards
Environmental Protection Agency
401 M. Street, S.W.
Washington, D.C. 20460

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

James M. Conlon, Acting Director
Office of Water Regulations
and Standards

§ 131.12 Antidegradation policy.

(a) The State shall develop and adopt a statewide antidegradation policy and identify the methods for implementing such policy pursuant to this subpart. The antidegradation policy and implementation methods shall, at a minimum, be consistent with the following:

(1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

(2) Where the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control.

(3) Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.

(4) In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with section 316 of the Act.

Antidegradation Policy

The preamble to the proposed rule discussed three options for changing the existing antidegradation policy. Option 1, the proposed option, provided simply that uses attained would be maintained. Option 2 stated that not only would uses attained be maintained but that high quality waters, i.e. waters with quality better than that needed to protect fish and wildlife, would be maintained (that is, the existing antidegradation policy minus the "outstanding natural resource waters" provision). Option 3 would have allowed changes in an existing use if maintaining that use would effectively prevent any future growth in the community or if the benefits of maintaining the use do not bear a reasonable relationship to the costs.

Although there was support for Option 2, there was greater support for retaining the full existing policy, including the provision on outstanding National resource waters. Therefore, EPA has retained the existing antidegradation policy (Section 131.12) because it more accurately reflects the degree of water quality protection desired by the public, and is consistent with the goals and purposes of the Act.

In retaining the policy EPA made four changes. First, the provisions on maintaining and protecting existing instream uses and high quality waters were retained, but the sentences stating that no further water quality degradation which would interfere with or becon njurious to existing instream uses i lowed were deleted. The delet s were made because the terms "int ere" and "injurious" were subject to sinterpretation as precluding any tivity which might even momentarily add pollutants to the water. Moreover, we believe the deleted sentence was intended merely as a restatement of the basic policy. Since the rewritten provision, with the addition of a phrase on water quality described in the next sentence, stands alone as expressing the basic thrust and intent of the antidegradation policy, we deleted the confusing phrases. Second, in § 131.12(a)(1) a phrase was added requiring that the level of water quality necessary to protect an existing use be maintained and protected. The previous policy required only that an existing use be maintained. In § 131.12(a)(2) a phrase was added that "In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully". This means that the full use must continue to exist even if some change in water quality may be permitted. Third, in the first sentence of § 131.12(a)(2) the wording was changed from ". . . significant economic or social development . . ." to ". . . important economic or social development. . . ." In the context of t antidegradation policy the word important" strengthens the intent of protecting higher quality waters. Although common usage of the words may imply otherwise, the correct definitions of the two terms indicate that the greater degree of environmental protection is afforded by the word "important."

Fourth, § 131.12(a)(3) dealing with the designation of outstanding National resource waters (ONRW) was changed to provide a limited exception to the absolute "no degradation" requirement. EPA was concerned that waters which properly could have been designated as ONRW were not being so designated because of the flat no degradation provision, and therefore were not being given special protection. The no degradation provision was sometimes interpreted as prohibiting *any* activity (including temporary or short-term) from being conducted. States may allow some limited activities which result in temporary and short-term changes in water quality. Such activities are considered to be consistent with the intent and purpose of an ONRW. Therefore, EPA has rewritten the provision to read ". . . that water quality shall be maintained and protected," and removed the phrase "No degradation shall be allowed. . . ."

In its entirety, the antidegradation policy represents a three-tiered approach to maintaining and protecting various levels of water quality and uses. At its base (Section 131.12(a)(1)), all existing uses and the level of water quality necessary to protect those uses must be maintained and protected. This provision establishes the absolute floor of water quality in all waters of the United States. The second level (Section 131.12(a)(2)) provides protection of actual water quality in areas where the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water ("fishable/swimmable"). There are provisions contained in this subsection to allow some limited water quality degradation after extensive public involvement, as long as the water quality remains adequate to be "fishable/swimmable." Finally § 131.23(a)(3) provides special protection of waters for which the ordinary use classifications and water quality criteria do not suffice, denoted "outstanding National resource water." Ordinarily most people view this subsection as protecting and maintaining the highest quality waters of the United States: that is clearly the thrust of the provision. It does, however, also offer special protection for waters of "ecological significance." These are water bodies which are important, unique, or sensitive ecologically, but whose water quality as measured by the traditional parameters (dissolved oxygen, pH, etc.) may not be particularly high or whose character cannot be adequately described by these parameters.

Federal Register / Vol. 48, No. 217 / Tuesday, November 8, 1983 / Rules and Regulations 51409

Antidegradation Policy

EPA's proposal, which would have limited the antidegradation policy to the maintenance of existing uses, plus three alternative policy statements described in the preamble to the proposal notice, generated extensive public comment. EPA's response is described in the Preamble to this final rule and includes a response to both the substantive and philosophical comments offered. Public comments overwhelmingly supported retention of the existing policy and EPA did so in the final rule.

EPA's response to several comments dealing with the antidegradation policy, which were not discussed in the Preamble are discussed below.

Option three contained in the Agency's proposal would have allowed the possibility of exceptions to maintaining existing uses. This option was either criticized for being illegal or was supported because it provided additional flexibility for economic growth. The latter commenters believed that allowances should be made for carefully defined exceptions to the absolute requirement that uses attained must be maintained. EPA rejects this contention as being totally inconsistent with the spirit and intent of both the Clean Water Act and the underlying philosophy of the antidegradation policy. Moreover, although the Agency specifically asked for examples of where the existing antidegradation policy had precluded growth, no examples were provided. Therefore, wholly apart from technical legal concerns, there appears to be no justification for adopting Option 3.

Most critics of the proposed antidegradation policy objected to removing the public's ability to affect decisions on high quality waters and outstanding national resource waters. In attempting to explain how the proposed antidegradation policy would be implemented, the Preamble to the proposed rule stated that no public participation would be necessary in certain instances because no change was being made in a State's water quality standard. Although that statement was technically accurate, it left the mistaken impression that all public participation was removed from the discussions on high quality waters and that is not correct. A NPDES permit would have to be issued or a 208 plan amended for any deterioration in water quality to be "allowed". Both actions require notice and an opportunity for public comment. However, EPA retained the existing policy so this issue is moot. Other changes in the policy affecting ONRW are discussed in the Preamble.

QUESTIONS AND ANSWERS ON ANTIDEGRADATION

1. WHAT IS THE ORIGIN OF THE ANTIDEGRADATION POLICY?

The basic policy was established on February 8, 1968, by the Secretary of the U.S. Department of the Interior. It was included in EPA's first water quality standards regulation 40 CFR 130.17, 40 FR 55340-41, November 28, 1975. It was slightly refined and repromulgated as part of the current program regulation published on November 8, 1983 (48 FR 51400, 40 CFR §131.12). An antidegradation policy is one of the minimum elements required to be included in a State's water quality standards.

2. WHERE IN THE CLEAN WATER ACT (CWA) IS THERE A REQUIREMENT FOR AN ANTIDEGRADATION POLICY OR SUCH A POLICY EXPRESSED?

There is no explicit requirement for such a policy in the Act. However, the policy is consistent with the spirit, intent, and goals of the Act, especially the clause "... restore and maintain the chemical, physical and biological integrity of the Nation's waters" (§101(a)) and arguably is covered by the provision of 303(a) which made water quality standard requirements under prior law the "starting point" for CWA water quality requirements.

3. CAN A STATE JUSTIFY NOT HAVING AN ANTIDEGRADATION POLICY IN ITS WATER QUALITY STANDARDS?

EPA's water quality standards regulation requires each State to adopt an antidegradation policy and specifies the minimum requirements for a policy. If not included in the standards regulation of a State, the policy must be specifically referenced in the water quality standards so that the functional relationship between the policy and the standards is clear. Regardless of the location of the policy, it must meet all applicable requirements.

4. WHAT HAPPENS IF A STATE'S ANTIDEGRADATION POLICY DOES NOT MEET THE REGULATORY REQUIREMENTS?

If this occurs either through State action to revise its policy or through revised Federal requirements, the State would be given an opportunity to make its policy consistent with the regulation. If this is not done, EPA has the authority to promulgate the policy for the State pursuant to Section 303(c)(4) of the Clean Water Act.

5. WHAT COULD HAPPEN IF A STATE FAILED TO IMPLEMENT ITS ANTI-DEGRADATION POLICY PROPERLY?

If a State issues an NPDES permit which violates the required antidegradation policy, it would be subject to a discretionary EPA veto under Section 402(d) or to a citizen challenge. In addition to actions on permits, any wasteload allocations and total maximum daily loads violating the antidegradation policy are subject to EPA disapproval and EPA promulgation of a new wasteload allocation/total maximum daily load under Section 303(d) of the Act. If a significant pattern of violation was evident, EPA could constrain the award of grants or possibly revoke any Federal permitting capability that had been delegated to the State. If the State issues a §401 certification (for an EPA-issued NPDES permit) which fails to reflect the requirements of the antidegradation policy, EPA will, on its own initiative, add any additional or more stringent effluent limitations required to ensure compliance with Section 301(b)(1)(C). If the faulty §401 certification related to permits issued by other Federal agencies (e.g. a Corp of Engineers Section 404 permit), EPA could comment unfavorably upon permit issuance. The public, of course, could bring pressure upon the permit issuing agency.

6. WILL THE APPLICATION OF THE ANTIDEGRADATION POLICY ADVERSELY IMPACT ECONOMIC DEVELOPMENT?

This concern has been raised since the inception of the antidegradation policy. The answer remains the same. The policy has been carefully structured to minimize adverse effects on economic development while protecting the water quality goals of the Act. As Secretary Udall put it in 1968, the policy serves "...the dual purpose of carrying out the letter and spirit of the Act without interfering unduly with further economic development" (Secretary Udall, February 8, 1968). Application of the policy could affect the levels and/or kinds of waste treatment necessary or result in the use of alternate sites where the environmental impact would be less damaging. These effects could have economic implications as do all other environmental controls.

7. WHAT IS THE PROPER INTERPRETATION OF THE TERM "AN EXISTING USE"?

An existing use can be established by demonstrating that fishing, swimming, or other uses have actually occurred since November 28, 1975, or that the water quality is suitable to allow such uses to occur (unless there are physical problems which prevent the use regardless of water quality). An example of the latter is an area where shellfish are propagating and surviving in a biologically suitable habitat and are available and suitable for harvesting. Such facts clearly establish that shellfish harvesting is an "existing" use, not one dependent on improvements in water quality. To argue otherwise would be to say that

the only time an aquatic protection use "exists" is if someone succeeds in catching fish.

8. THE WATER QUALITY STANDARDS REGULATION STATES THAT "EXISTING USES AND THE LEVEL OF WATER QUALITY NECESSARY TO PROTECT THE EXISTING USES SHALL BE MAINTAINED AND PROTECTED." HOW FULLY AND AT WHAT LEVEL OF PROTECTION IS AN EXISTING USE TO BE PROTECTED IN ORDER TO SATISFY THE ABOVE REQUIREMENT?

No activity is allowable under the antidegradation policy which would partially or completely eliminate any existing use whether or not that use is designated in a State's water quality standards. The aquatic protection use is a broad category requiring further explanation. Species that are in the water body and which are consistent with the designated use (i.e., not aberrational) must be protected, even if not prevalent in number or importance. Nor can activity be allowed which would render the species unfit for maintaining the use. Water quality should be such that it results in no mortality and no significant growth or reproductive impairment of resident species. (See Question 16 for situation where an aberrant sensitive species may exist.) Any lowering of water quality below this full level of protection is not allowed. A State may develop subcategories of aquatic protection uses but cannot choose different levels of protection for like uses. The fact that sport or commercial fish are not present does not mean that the water may not be supporting an aquatic life protection function. An existing aquatic community composed entirely of invertebrates and plants, such as may be found in a pristine alpine tributary stream, should still be protected whether or not such a stream supports a fishery. Even though the shorthand expression "fishable/swimmable" is often used, the actual objective of the act is to "restore and maintain the chemical, physical, and biological integrity of our Nation's waters (section 101(a)).1/ The term "aquatic life" would more accurately reflect the protection of the aquatic community that was intended in Section 101(a)(2) of the Act.

9. IS THERE ANY SITUATION WHERE AN EXISTING USE CAN BE REMOVED?

In general, no. Water quality may sometimes be affected, but an existing use, and the level of water quality to protect it must be maintained (§131.12(a)(1) and (2) of the regulation). However, the State may limit or not designate such a use if the reason for such action is non-water quality related. For example, a State may wish to impose a temporary shellfishing ban to prevent overharvesting and ensure an abundant population over the long run, or may wish to restrict swimming from heavily trafficked areas. If the State chooses,

1/ Note: "Fishable/swimmable" is a term of convenience used in the standards program in lieu of constantly repeating the entire text of Section 101(a)(2) goal of the Clean Water Act. As a short-hand expression it is potentially misleading.

for non-water quality reasons, to limit use designations, it must still adopt criteria to protect the use if there is a reasonable likelihood it will actually occur (e.g. swimming in a prohibited water). However, if the State's action is based on a recognition that water quality is likely to be lowered to the point that it no longer is sufficient to protect and maintain an existing use, then such action is inconsistent with the antidegradation policy.

10. HOW DOES THE REQUIREMENT THAT THE LEVEL OF WATER QUALITY NECESSARY TO PROTECT THE EXISTING USE(S) BE MAINTAINED AND PROTECTED, WHICH APPEARS IN §131.12(a)(1),(2), AND (3) OF THE WATER QUALITY STANDARDS REGULATION, ACTUALLY WORK?

Section 131.12(a)(1), as described in the Preamble to the regulation, provides the absolute floor of water quality in all waters of the United States. This paragraph applies a minimum level of protection to all waters. However, it is most pertinent to waters having beneficial uses that are less than the Section 101(a)(2) goals of the Act. If it can be proven, in that situation, that water quality exceeds that necessary to fully protect the existing use(s) and exceeds water quality standards but is not of sufficient quality to cause a better use to be achieved, then that water quality may be lowered to the level required to fully protect the existing use as long as existing water quality standards and downstream water quality standards are not affected. If this does not involve a change in standards, no public hearing would be required under Section 303(c). However, public participation would still be provided in connection with the issuance of a NPDES permit or amendment of a 208 plan. If, however, analysis indicates that the higher water quality does result in a better use, even if not up to the Section 101(a)(2) goals, then the water quality standards must be upgraded to reflect the uses presently being attained (§131.10(i)).

Section 131.12(a)(2) applies to waters whose quality exceeds that necessary to protect the Section 101(a)(2) goals of the Act. In this case, water quality may not be lowered to less than the level necessary to fully protect the "fishable /swimmable" uses and other existing uses and may be lowered even to those levels only after following all the provisions described in §131.12(a)(2). This requirement applies to individual water quality parameters.

Section 131.12(a)(3) applies to so-called outstanding National Resource (ONRW) waters where the ordinary use classifications and supporting criteria are not appropriate. As described in the Preamble to the water quality standards regulation "States may allow some limited activities which result in temporary and short-term changes in water quality," but such changes in water quality should not alter the essential character or special use which makes the water an ONRW. (See also pages 2-14,-15 of the Water Quality Standards Handbook.)

Any one or a combination of several activities may trigger the antidegradation policy analysis as discussed above. Such activities include a scheduled water quality standards review,

the establishment of new or revised wasteload allocations NPDES permits, the demonstration of need for advanced treatment or request by private or public agencies or individuals for a special study of the water body.

11. WILL AN ACTIVITY WHICH WILL DEGRADE WATER QUALITY, AND PRECLUDE AN EXISTING USE IN ONLY A PORTION OF A WATER BODY (BUT ALLOW IT TO REMAIN IN OTHER PARTS OF THE WATER BODY) SATISFY THE ANTIDEGRADATION REQUIREMENT THAT EXISTING USES SHALL BE MAINTAINED AND PROTECTED?

No. Existing uses must be maintained in all parts of the water body segment in question other than in restricted mixing zones. For example, an activity which lowers water quality such that a buffer zone must be established within a previous shellfish harvesting area is inconsistent with the antidegradation policy. (However, a slightly different approach is taken for fills in wetlands, as explained in Question 13.)

12. DOES ANTIDEGRADATION APPLY TO POTENTIAL USES?

No. The focus of the antidegradation policy is on protecting existing uses. Of course, insofar as existing uses and water quality are protected and maintained by the policy the eventual improvement of water quality and attainment of new uses may be facilitated. The use attainability requirements of §131.10 also help ensure that attainable potential uses are actually attained. (See also questions 7 and 10.)

13. FILL OPERATIONS IN WETLANDS AUTOMATICALLY ELIMINATE ANY EXISTING USE IN THE FILLED AREA. HOW IS THE ANTIDEGRADATION POLICY APPLIED IN THAT SITUATION?

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 §131.12 (a)(1) 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)(1) 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.(a)(2)(3)), there is no difference in the way it applies to wetlands and other water bodies.

14. IS POLLUTION RESULTING FROM NONPOINT SOURCE ACTIVITIES SUBJECT TO PROVISIONS OF THE ANTIDEGRADATION POLICY?

Nonpoint source activities are not exempt from the provisions of the antidegradation policy. The language of Section 131.12 (a)(2) of the regulation: "Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best mangement practices for nonpoint source control" reflects statutory provisions of the Clean Water Act. While it is true that the Act does not establish a regulatory program for nonpoint sources, it clearly intends that the BMPs developed and approved under sections 205(j), 208 and 303(e) be agressively implemented by the States. As indicated in the introduction, EPA will be developing additional guidance in this area.

15. IN HIGH QUALITY WATERS, ARE NEW DISCHARGERS OR EXPANSION OF EXISTING FACILITIES SUBJECT TO THE PROVISIONS OF ANTIDEGRADATION?

Yes. Since such activities would presumably lower water quality, they would not be permissible unless the State finds that it is necessary to accommodate important economic or social development (Section 131.12(a)(2). In addition the minimum technology based requirements must be met, including new source performance standards. This standard would be implemented through the waste-load and NPDES permit process for such new or expanded sources.

16. A STREAM, DESIGNATED AS A WARM WATER FISHERY, HAS BEEN FOUND TO CONTAIN A SMALL, APPARENTLY NATURALLY OCCURRING POPULATION OF A COLD-WATER GAME FISH. THESE FISH APPEAR TO HAVE ADAPTED TO THE NATURAL WARM WATER TEMPERATURES OF THE STREAM WHICH WOULD NOT NORMALLY ALLOW THEIR GROWTH AND REPRODUCTION. WHAT IS THE EXISTING USE WHICH MUST BE PROTECTED UNDER SECTION 131.12(a)(1)?

Section 131.12(a)(1) states that "Existing instream water uses and level of water quality necessary to protect the existing uses shall be maintained and protected." While sustaining a small cold-water fish population, the stream does not support an existing use of a "cold-water fishery." The existing stream temperatures are unsuitable for a thriving cold-water fishery. The small marginal population is an artifact and should not be employed to mandate a more stringent use (true cold-water fishery) where natural conditions are not suitable for that use.

A use attainability analysis or other scientific assessment should be used to determine whether the aquatic life population is in fact an artifact or is a stable population requiring

water quality protection. Where species appear in areas not normally expected, some adaptation may have occurred and site-specific criteria may be appropriately developed. Should the cold-water fish population consist of a threatened or endangered species, it may require protection under the Endangered Species Act. Otherwise the stream need only be protected as a warm water fishery.

17. HOW DOES EPA'S ANTIDEGRADATION POLICY APPLY TO A WATERBODY WHERE A CHANGE IN MAN'S ACTIVITIES IN OR AROUND THAT WATERBODY WILL PRECLUDE AN EXISTING USE FROM BEING FULLY MAINTAINED?

If a planned activity will forseeably lower water quality to the extent that it no longer is sufficient to protect and maintain the existing uses in that waterbody, such an activity is inconsistent with EPA's antidegradation policy which requires that existing uses are to be maintained. In such a circumstance the planned activity must be avoided or adequate mitigation or preventive measures must be taken to ensure that the existing uses and the water quality to protect them will be maintained.

In addition, in "high quality waters", under §131.12(a)(2), before any lowering of water quality occurs, there must be: 1) a finding that it is necessary in order to accommodate important economical or social development in the area in which the waters are located, (2) full satisfaction of all intergovernmental coordination and public participation provisions and (3) assurance that the highest statutory and regulatory requirements and best management practices for pollutant controls are achieved. This provision can normally be satisfied by the completion of Water Quality Management Plan updates or by a similar process that allows for public participation and intergovernmental coordination. This provision is intended to provide relief only in a few extraordinary circumstances where the economic and social need for the activity clearly outweighs the benefit of maintaining water quality above that required for "fishable/swimmable" water, and the two cannot both be achieved. The burden of demonstration on the individual proposing such activity will be very high. In any case, moreover, the existing use must be maintained and the activity shall not preclude the maintenance of a "fishable/swimmable" level of water quality protection.

18. WHAT DOES EPA MEAN BY "...THE STATE SHALL ENSURE THAT THERE SHALL BE ACHIEVED THE HIGHEST STATUTORY AND REGULATORY REQUIREMENTS FOR ALL NEW AND EXISTING POINT SOURCES AND ALL COST EFFECTIVE AND REASONABLE BEST MANAGEMENT PRACTICES FOR NON-POINT SOURCE CONTROL" (§131.12(a)(2)?

This requirement ensures that the limited provision for lowering water quality of high quality waters down to "fishable /swimmable" levels will not be used to undercut the Clean Water Act requirements for point source and non-point source pollution control. Furthermore, by ensuring compliance

with such statutory and regulatory controls, there is less chance that a lowering of water quality will be sought in order to accommodate new economic and social development.

19. WHAT DOES EPA MEAN BY "...IMPORTANT ECONOMIC OR SOCIAL DEVELOPMENT IN THE AREA IN WHICH THE WATERS ARE LOCATED" IN 131.1 2(a)(2)?

This phrase is simply intended to convey a general concept regarding what level of social and economic development could be used to justify a change in high quality waters. Any more exact meaning will evolve through case-by-case application under the State's continuing planning process. Although EPA has issued suggestions on what might be considered in determining economic or social impacts, the Agency has no predetermined level of activity that is defined as "important".

20. IF A WATER BODY WITH A PUBLIC WATER SUPPLY DESIGNATED USE IS, FOR NON-WATER QUALITY REASONS, NO LONGER USED FOR DRINKING WATER MUST THE STATE RETAIN THE PUBLIC WATER SUPPLY USE AND CRITERIA IN ITS STANDARDS?

Under 40 CFR 131.10(h)(1), the State may delete the public water supply use designation and criteria if the State adds or retains other use designations for the waterbodies which have more stringent criteria. The State may also delete the use and criteria if the public water supply is not an "existing use" as defined in 131.3 (i.e., achieved on or after November 1975), as long as one of the §131.10(g) justifications for removal is met.

Otherwise, the State must maintain the criteria even if it restricts the actual use on non-water quality grounds, as long as there is any possibility the water could actually be used for drinking. (This is analogous to the swimming example in the preamble.)

21. WHAT IS THE RELATIONSHIP BETWEEN WASTELOAD ALLOCATIONS, TOTAL MAXIMUM DAILY LOADS, AND THE ANTIDEGRADATION POLICY?

Wasteload allocations distribute the allowable pollutant loadings to a stream between dischargers. Such allocations also consider the contribution to pollutant loadings from non-point sources. Wasteload allocations must reflect applicable State water quality standards including the antidegradation policy. No wasteload allocation can be develped or NPDES permit issued that would result in standard being violated, or, in the case of waters whose quality exceeds that necessary for the Section 101(a)(2) goals of the Act, can result a lowering of water quality unless the applicable public participation, intergovernmental review and baseline control requirements of the antidegradation policy have been met.

22. DO THE INTERGOVERNMENTAL COORDINATION AND PUBLIC PARTICIPATION REQUIREMENTS WHICH ESTABLISH THE PROCEDURES FOR DETERMINING THAT WATER QUALITY WHICH EXCEEDS THAT NECESSARY TO SUPPORT THE SECTION 101(a)(2) GOAL OF THE ACT MAY BE LOWERED APPLY TO CONSIDERING ADJUSTMENTS TO THE WASTELOAD ALLOCATIONS DEVELOPED FOR THE DISCHARGERS IN THE AREA?

Yes. Section 131.12(a)(2) of the water quality standards regulation is directed towards changes in water quality per se, not just towards changes in standards. The intent is to ensure that no activity which will cause water quality to decline in existing high quality waters is undertaken without adequate public review. Therefore, if a change in wasteload allocation could alter water quality in high quality waters, the public participation and coordination requirements apply.

23. IS THE ANSWER TO THE ABOVE QUESTION DIFFERENT IF THE WATER QUALITY IS LESS THAN THAT NEEDED TO SUPPORT "FISHABLE/SWIMMABLE" USES?

Yes. Nothing in either the water quality standards or the wasteload allocation regulations requires the same degree of public participation or intergovernmental coordination for such waters as is required for high quality waters. However, as discussed in question 10, public participation would still be provided in connection with the issuance of a NPDES permit or amendment of a 208 plan. Also, if the action which causes reconsideration of the existing wasteloads (such as dischargers withdrawing from the area) will result in an improvement in water quality which makes a better use attainable, even if not up to the "fishable/swimmable" goal, then the water quality standards must be upgraded and full public review is required for any action affecting changes in standards. Although not specifically required by the standards regulation between the triennial reviews, we recommend that the State conduct a use attainability analysis to determine if water quality improvement will result in attaining higher uses than currently designated in situations where significant changes in wasteloads are expected (see question 10).

24. SEVERAL FACILITIES ON A STREAM SEGMENT DISCHARGE PHOSPHORUS-CONTAINING WASTES. AMBIENT PHOSPHORUS CONCENTRATIONS MEET CLASS B STANDARDS, BUT BARELY. THREE DISCHARGERS ACHIEVE ELIMINATION OF DISCHARGE BY DEVELOPING A LAND TREATMENT SYSTEM. AS A RESULT, ACTUAL WATER QUALITY IMPROVES (I.E., PHOSPHORUS LEVELS DECLINE) BUT NOT QUITE TO THE LEVEL NEEDED TO MEET CLASS A (FISHABLE/SWIMMABLE) STANDARDS. CAN THE THREE REMAINING DISCHARGERS NOW INCREASE THEIR PHOSPHORUS DISCHARGE WITH THE RESULT THAT WATER QUALITY DECLINES (PHOSPHORUS LEVELS INCREASE) TO PREVIOUS LEVELS?

Nothing in the water quality standards regulation explicitly prohibits this (see answer to questions 10 and 23). Of course, changes in their NPDES permit limits may be subject to non-water quality constraints, such as BPT or BAT, which may restrict this.

25. SUPPOSE IN THE ABOVE SITUATION WATER QUALITY IMPROVES TO THE POINT THAT ACTUAL WATER QUALITY NOW MEETS CLASS A REQUIREMENTS. IS THE ANSWER DIFFERENT?

Yes. The standards must be upgraded (see answer to question 10).

26. AS AN ALTERNATIVE CASE, SUPPOSE PHOSPHORUS LOADINGS GO DOWN AND WATER QUALITY IMPROVES BECAUSE OF A CHANGE IN FARMING PRACTICES, E.G., INITIATION OF A SUCCESSFUL NON-POINT PROGRAM. ARE THE ABOVE ANSWERS THE SAME?

Yes. Whether the improvement results from a change in point or nonpoint source activity is immaterial to how any aspect of the standards regulation operates. Section 131.10(d) clearly indicates that uses are deemed attainable if they can be achieved by "... cost-effective and reasonable best management practices for nonpoint source control". Section 131.12(a)(2) of the anti-degradation policy contains essentially the same wording.

27. WHEN A POLLUTANT DISCHARGE CEASES FOR ANY REASON, MAY THE WASTELOAD ALLOCATIONS FOR THE OTHER DISCHARGES IN THE AREA BE ADJUSTED TO REFLECT THE ADDITIONAL LOADING AVAILABLE?

This may be done consistent with the antidegradation policy only under two circumstances: (1) In "high quality waters" where after the full satisfaction of all public participation and intergovernmental review requirements, such adjustments are considered necessary to accomodate important economic or social development, and the "threshold" level requirements are met; or (2) in less than "high quality waters", when the expected improvement in water quality will not cause a better use to be achieved, the adjusted loads still meet water quality standards, and the new wasteload allocations are at least as stringent as technology-based limitations. Of course, all applicable requirements of the Section 402 permit regulations would have to be satisfied before a permittee could increase its discharge.

28. HOW MAY THE PUBLIC PARTICIPATION REQUIREMENTS BE SATISFIED?

This requirement may be satisfied in several ways. The State may obviously hold a public hearing or hearings. The State may also satisfy the requirement by providing the opportunity for the public to request a hearing. Activities which may affect several water bodies in a river basin or sub-basin may be considered in a single hearing. To ease the resource burden on both the State and public, standards issues may be combined with hearings on environmental impact statements, water management plans, or permits. However, if this is done, the public must be clearly informed that possible changes in water quality standards are being considered along with other activities. In other words, it is inconsistent with the water quality standards regulation to "back-door" changes in standards through actions on EIS's, wasteload allocations, plans, or permits.

29. WHAT IS MEANT BY THE REQUIREMENT THAT, WHERE A THERMAL DISCHARGE IS INCLUDED, THE ANTIDEGRADATION POLICY SHALL BE CONSISTENT WITH SECTION 316 OF THE ACT?

This requirement is contained in Section 131.12 (a)(4) of the regulation and is intended to coordinate the requirements and procedures of the antidegadation policy with those established in the Act for setting thermal discharge limitations. Regulations implementing Section 316 may be found at 40 CFR 124.66. The statutory scheme and legislative history indicate that limitations developed under Section 316 take precedence over other requirements of the Act.

30. WHAT IS THE RELATIONSHIP BETWEEN THE ANTIDEGRADATION POLICY, STATE WATER RIGHTS USE LAWS AND SECTION 101(g) OF THE CLEAN WATER ACT WHICH DEALS WITH STATE AUTHORITY TO ALLOCATE WATER QUANTITIES?

The exact limitations imposed by section 101(g) are unclear; however, the legislative history and the courts interpreting it do indicate that it does not nullify water quality measures authorized by CWA (such as water quality standards and their upgrading, and NPDES and 402 permits) even if such measures incidentally affect individual water rights; those authorities also indicate that if there is a way to reconcile water quality needs and water quantity allocations, such accomodation should be be pursued. In other words, where there are alternate ways to meet the water quality requirements of the Act, the one with least disruption to water quantity allocations should be chosen. Where a planned diversion would lead to a violation of water quality standards (either the antidegradation policy or a criterion), a 404 permit associated with the diversion should be suitably conditioned if possible and/or additional nonpoint and/or point source controls should be imposed to compensate.

31. AFTER READING THE REGULATION, THE PREAMBLE, AND ALL THESE QUESTIONS AND ANSWERS, I STILL DON'T UNDERSTAND ANTIDEGRADATION. WHOM CAN I TALK TO?

Call the Standards Branch at: (202) 245-3042. You can also call the water quality standards coordinators in each of our EPA Regional offices.

APPENDIX H

Derivation of the 1985 Aquatic Life Criteria

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

Derivation of the 1985 Aquatic Life Critera

The following is a summary of the Guidelines for Derivation of Criteria for Aquatic Life. The complete text is found in "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses," available from National Technical Information Service – PB85-227049.

Derivation of numerical national water quality criteria for the protection of aquatic organisms and their uses is a complex process that uses information from many areas of aquatic toxicology. When a national criterion is needed for a particular material, all available information concerning toxicity to and bioaccumulation by aquatic organisms is collected, reviewed for acceptability, and sorted. If enough acceptable data on acute toxicity to aquatic animals are available, they are used to estimate the highest one-hour average concentration that should not result in unacceptable effects on aquatic organisms and their uses. If justified, this concentration is made a function of water quality characteristics such as pH, salinity, or hardness. Similarly, data on the chronic toxicity of the material to aquatic animals are used to estimate the highest four-day average concentration that should not cause unacceptable toxicity during a long-term exposure. If appropriate, this concentration is also related to a water quality characteristic.

Data on toxicity to aquatic plants are examined to determine whether plants are likely to be unacceptably affected by concentrations that should not cause unacceptable effects on animals. Data on bioaccumulation by aquatic organisms are used to determine if residues might subject edible species to restrictions by the U.S. Food and Drug Administration (FDA), or if such residues might harm wildlife that consumes aquatic life. All other available data are examined for adverse effects that might be biologically important.

If a thorough review of the pertinent information indicates that enough acceptable data exists, numerical national water quality criteria are derived for fresh water or salt water or both to protect aquatic organisms and their uses from unacceptable effects due to exposures to high concentrations for short periods of time, lower concentrations for longer periods of time, and combinations of the two.

I. Definition of Material of Concern

A. Each separate chemical that does not ionize substantially in most natural bodies of water should usually be considered a separate material, except possibly for structurally similar organic compounds that exist only in large quantities as commercial mixtures of the various compounds and apparently have similar biological, chemical, physical, and toxicological properties.

B. For chemicals that do ionize substantially in most natural waterbodies (e.g., some phenols and organic acids, some salts of phenols and organic acids, and most inorganic salts and coordination complexes of metals), all forms in chemical equilibrium should usually be considered one material. Each different oxidation state of a metal and each different non-ionizable covalently bonded organometallic compound should usually be considered a separate material.

C. The definition of the material should include an operational analytical component. Identification of a material simply, for example, as "sodium" obviously implies "total sodium" but leaves room for doubt. If "total" is meant, it should be explicitly stated. Even

"total" has different operational definitions, some of which do not necessarily measure "all that is there" in all sample. Thus, it is also necessary to reference or describe one analytical method that is intended. The operational analytical component should take into account the analytical and environmental chemistry of the material, the desirability of using the same analytical method on samples from laboratory tests, ambient water and aqueous effluents, and various practical considerations such as labor and equipment requirements and whether the method would require measurement in the field or would allow measurement after samples are transported to a laboratory.

The primary requirements of the operational analytical component are that it be appropriate for use on samples of receiving water, compatible with the available toxicity and bioaccumulation data without making overly hypothetical extrapolations, and rarely result in underprotection or overprotection of aquatic organisms and their uses. Because an ideal analytical measurement will rarely be available, a compromise measurement will usually be used. This compromise measurement must fit with the general approach: if an ambient concentration is lower than the national criterion, unacceptable effects will probably not occur (i.e., the compromise measurement must not err on the side of underprotection when measurements are made on a surface water). Because the chemical and physical properties of an effluent are usually quite different from those of the receiving water, an analytical method acceptable for analyzing an effluent might not be appropriate for analyzing a receiving water, and vice versa. If the ambient concentration *calculated* from a measured concentration in an effluent is higher than the national criterion, an additional option is to *measure* the concentration after dilution of the effluent with receiving water to determine if the measured concentration is lowered by such phenomena as complexation or sorption. A further option, of course, is to derive a site-specific criterion (1,2,3). Thus, the criterion should be based on an appropriate analytical measurement, but the criterion is not rendered useless if an ideal measurement either is not available or is not feasible.

The analytical chemistry of the material might need to be considered when defining the material or when judging the acceptability of some toxicity tests, but a criterion should not be based on the sensitivity of an analytical method. When aquatic organisms are more sensitive than routine analytical methods, the proper solution is to develop better analytical methods, not to underprotect aquatic life.

II. Collection of Data

A. Collect all available data on the material concerning toxicity to, and bioaccumulation by, aquatic animals and plants; FDA action levels (compliance Policy Guide, U.S. Food & Drug Admin. 1981) and chronic feeding studies and long-term field studies with wildlife species that regularly consume aquatic organisms.

B. All data that are used should be available in typed, dated, and signed hard copy (publication, manuscript, letter, memorandum) with enough supporting information to indicate that acceptable test procedures were used and that the results are probably reliable. In some cases, additional written information from the investigator may be needed. Information that is confidential, privileged, or otherwise not available for distribution should not be used.

C. Questionable data, whether published or unpublished, should not be used. Examples would be data from tests that did not contain a control treatment, tests in which too many organisms in the control treatment died or showed signs of stress or disease, and tests in which distilled or deionized water was used as the dilution water without addition of appropriate salts.

D. Data on technical grade materials may be used, if appropriate; but data on formulated mixtures and emulsifiable concentrates of the material may not be used.

E. For some highly volatile, hydrolyzable, or degradable materials, only use data from flow-through tests in which the concentrations of test material were measured often enough with acceptable analytical methods.

F. Data should be rejected if obtained by using:

- Brine shrimp — because they usually occur naturally only in water with salinity greater than 35 g/kg;
- Species that do not have reproducing wild populations in North America; or
- Organisms that were previously exposed to substantial concentrations of the test material or other contaminants.

G. Questionable data, data on formulated mixtures and emulsifiable concentrates, and data obtained with nonresident species or previously exposed organisms may be used to provide auxiliary information but should not be used in the derivation of criteria.

III. Required Data

A. Certain data should be available to help ensure that each of the four major kinds of possible adverse effects receives adequate consideration: results of acute and chronic toxicity tests with representative species of aquatic animals are necessary to indicate the sensitivities of appropriate untested species. However, since procedures for conducting tests with aquatic plants and interpreting the results are not as well developed, fewer data concerning toxicity are required. Finally, data concerning bioaccumulation by aquatic organisms are required only with relevant information on the significance of residues in aquatic organisms.

B. To derive a criterion for freshwater aquatic organisms and their uses, the following should be available:

1. Results of acceptable acute tests (see section IV) with at least one species of freshwater animal in at least eight different families including all of the following:
   - The family Salmonidae in the class Osteichthyes.
   - A second family in the class Osteichthyes, preferably a commercially or recreationally important warmwater species, such as bluegill or channel catfish.
   - A third family in the phylum Chordata (may be in the class Osteichthyes or may be an amphibian, etc.).
   - A planktonic crustacean such as a cladoceran or copepod.
   - A benthic crustacean (ostracod, isopod, amphipod, crayfish, etc.).
   - An insect (mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge, etc.).
   - A family in a phylum other than Arthropoda or Chordata, such as Rotifera, Annelida, Mollusca.
   - A family in any order of insect or any phylum not already represented.
2. Acute-chronic ratios (see section VI) with species of aquatic animals in at least three different families, provided that:
   - At least one is a fish;
   - At least one is an invertebrate; and
   - At least one is an acutely sensitive freshwater species (the other two may be saltwater species).
3. Results of at least one acceptable test with a freshwater alga or vascular plant (see section VIII). If the plants are among the aquatic organisms that are most sensitive to the material, test data on a plant in another phylum (division) should also be available.

4. At least one acceptable bioconcentration factor determined with an appropriate freshwater species, if a maximum permissible tissue concentration is available (see section IX).

C. To derive a criterion for saltwater aquatic organisms and their uses, the following should be available:

1. Results of acceptable acute tests (see section IV) with at least one species of saltwater animal in at least eight different families, including all of the following:
   - Two families in the phylum Chordata;
   - A family in a phylum other than Arthropoda or Chordata;
   - Either the Mysidae or Penaeidae family;
   - Three other families not in the phylum Chordata (may include Mysidae or Penaeidae, whichever was not used previously); and
   - Any other family.
2. Acute-chronic ratios (see section VI) with species of aquatic animals in at least three different families, provided that of the three species:
   - At least one is a fish;
   - At least one is an invertebrate; and
   - At least one is an acutely sensitive saltwater species (the other may be an acutely sensitive freshwater species).
3. Results of at least one acceptable test with a saltwater alga or vascular plant (see section VIII). If plants are among the aquatic organisms most sensitive to the material, results of a test with a plant in another phylum (division) should also be available.
4. At least one acceptable bioconcentration factor determined with an appropriate saltwater species, if a maximum permissible tissue concentration is available (see section IX).

D. If all required data are available, a numerical criterion can usually be derived, except in special cases. For example, derivation of a criterion might not be possible if the available acute-chronic ratios vary by more than a factor of 10 with no apparent pattern. Also, if a criterion is to be related to a water quality characteristic T (see sections V and VII), more data will be necessary.

Similarly, if all required data are not available, a numerical criterion should not be derived except in special cases. For example, even if not enough acute and chronic data are available, it might be possible to derive a criterion if the available data clearly indicate that the Final Residue Value should be much lower than either the Final Chronic Value or the Final Plant Value.

E. Confidence in a criterion usually increases as the amount of available pertinent data increases. Thus, additional data are usually desirable.

IV. Final Acute Value

A. Appropriate measures of the acute (short-term) toxicity of the material to a variety of species of aquatic animals are used to calculate the Final Acute Value. The Final Acute Value is an estimate of the concentration of the material, corresponding to a cumulative probability of 0.05 in the acute toxicity values for genera used in acceptable acute tests conducted on the material. However, in some cases, if the Species Mean Acute Value of a commercially or recreationally important species is lower than the calculated Final Acute Value, then that Species Mean Acute Value replaces the calculated Final Acute Value to protect that important species.

B. Acute toxicity tests should have been conducted using acceptable procedures (ASTM Standards E 729 and 724).

C. Except for tests with saltwater annelids and mysids, do not use results of acute tests during which test organisms were fed, unless data indicate that the food did not affect the toxicity of the test material.

D. Results of acute tests conducted in unusual dilution water (dilution water in which total organic carbon or particulate matter exceeded 5 mg/L) should not be used unless a relationship is developed between acute toxicity and organic carbon or particulate matter or unless data show that the organic carbon or particulate matter does not affect toxicity.

E. Acute values should be based on endpoints that reflect the total severe acute adverse impact of the test material on the organisms used in the test. Therefore, only the following kinds of data on acute toxicity to aquatic animals should be used:

1. Tests with daphnids and other cladocerans should be started with organisms less than 24-hours old, and tests with midges should be stressed with second- or third-instar larvae. The result should be the 48-hour EC_{50} based on percentage of organisms immobilized plus percentage of organisms killed. If such an EC_{50} is not available from a test, the 48-hour LC_{50} should be used in place of the desired 48-hour EC_{50}. An EC_{50} or LC_{50} of longer than 48 hours can be used as long as the animals were not fed and the control animals were acceptable at the end of the test.

2. The result of a test with embryos and larvae of barnacles, bivalve molluscs (clams, mussels, oysters, and scallops), sea urchins, lobsters, crabs, shrimp, and abalones should be the 96-hour EC_{50} based on the percentage of organisms with incompletely developed shells plus the percentage of organisms killed. If such an EC_{50} is not available from a test, the lower of the 96-hour EC_{50}, based on the percentage of organisms with incompletely developed shells and the 96-hour LC_{50} should be used in place of the desired 96-hour EC_{50}. If the duration of the test was between 48 and 96 hours, the EC_{50} or LC_{50} at the end of the test should be used.

3. The acute values from tests with all other freshwater and saltwater animal species and older life stages of barnacles, bivalve molluscs, sea urchins, lobsters, crabs, shrimps, and abalones should be the 96-hour EC_{50} based on the percentage of organisms exhibiting loss of equilibrium, plus the percentage of organisms immobilized, plus the percentage of organisms killed. If such an EC_{50} is not available from a test, the 96-hour LC_{50} should be used in place of the desired 96-hour EC_{50}.

4. Tests with single-celled organisms are not considered acute tests, even if the duration was 96 hours or less.

5. If the tests were conducted properly, acute values reported as "greater than" values and those above the solubility of the test material should be used because rejection of such acute values would unnecessarily lower the Final Acute Value by eliminating acute values for resistant species.

F. If the acute toxicity of the material to aquatic animals apparently has been shown to be related to a water quality characteristic such as hardness or particulate matter for freshwater animals or salinity or particulate matter for saltwater animals, a Final Acute Equation should be derived based on that water quality characteristic. (Go to section V.)

G. If the available data indicate that one or more life stages are at least a factor of 2 more resistant than one or more other life stages of the same species, the data for the more resistant life stages should not be used in the calculation of the Species Mean Acute Value because a species can be considered protected from acute toxicity only if all life stages are protected.

H. The agreement of the data within and between species should be considered. Acute values that appear to be questionable in comparison with other acute and chronic data for the same species and for other species in the same genus probably should not be used in

calculation of a Species Mean Acute Value. For example, if the acute values available for a species or genus differ by more than a factor of 10, some or all of the values probably should not be used in calculations.

I. For each species for which at least one acute value is available, the Species Mean Acute Value should be calculated as the geometric mean of the results of all flow-through tests in which the concentrations of test material were measured. For a species for which no such result is available, the Species Mean Acute Value should be calculated as the geometric mean of all available acute values — i.e., results of flow-through tests in which the concentrations were not measured and results of static and renewal tests based on initial concentrations of test material. (Nominal concentrations are acceptable for most test materials if measured concentrations are not available.)

NOTE: Data reported by original investigators should not be rounded off. Results of all intermediate calculations should be rounded to four significant digits.

NOTE: The geometric mean of N numbers is the N^{th} root of the product of the N numbers. Alternatively, the geometric mean can be calculated by adding the logarithms of the N numbers, dividing the sum by N, and taking the antilog of the quotient. The geometric mean of two numbers is the square root of the product of the two numbers, and the geometric mean of one number is that number. Either natural (base 0) or common (base 10) logarithms can be used to calculate geometric means as long as they are used consistently within each set of data (i.e., the antilog used must match the logarithm used).

NOTE: Geometric means rather than arithmetic means are used here because the distributions of individual organisms' sensitivities in toxicity tests on most materials, and the distributions of species' sensitivities within a genus, are more likely to be lognormal than normal. Similarly, geometric means are used for acute-chronic ratios and bioconcentration factors because quotients are likely to be closer to lognormal than normal distributions. In addition, division of the geometric mean of a set of numerators by the geometric mean of the set of corresponding denominators will result in the geometric mean of the set of corresponding quotients.

J. The Genus Mean Acute Value should be calculated as the geometric mean of the Species Mean Acute Values available for each genus.

K. Order the Genus Mean Acute Value from high to low.

L. Assign ranks, R, to the Genus Mean Acute Value from "1" for the lowest to "N" for the highest. If two or more Genus Mean Acute Values are identical, arbitrarily assign them successive ranks.

M. Calculate the cumulative probability, P, for each Genus Mean Acute Value as R/(N+1).

N. Select the four Genus Mean Acute Values that have cumulative probabilities closest to 0.05. (If there are less than 59 Genus Mean Acute Values, these will always be the four lowest Genus Mean Acute Values).

O. Using the selected Genus Mean Acute Values and Ps, calculate:

$$S^2 = \frac{\Sigma((\ln GMAV)^2) - ((\Sigma(\ln GMAV))^2/4)}{\Sigma(P) - ((\Sigma(\sqrt{P}))^2/4)}$$

$$L = (\Sigma(\ln GMAV) - S(\Sigma(\sqrt{P})))/4$$

$$A = S(\sqrt{0.05}) + L$$

$$FAV = e^A$$

(See original document, referenced at beginning of this appendix, for development of the calculation procedure and Appendix 2 for example calculation and computer program.)

NOTE: Natural logarithms (logarithms to base e, denoted as ln) are used herein merely because they are easier to use on some hand calculators and computers than common (base 10) logarithms. Consistent use of either will produce the same result.

P. If for a commercially or recreationally important species the geometric mean of the acute values from flow-through tests in which the concentrations of test material were measured is lower than the calculated Final Acute Value, then that geometric mean should be used as the Final Acute Value instead of the calculated Final Acute Value.

Q. Go to section VI.

V. Final Acute Equation

A. When enough data are available to show that acute toxicity to two or more species is similarly related to a water quality characteristic, the relationship should be taken into account as described in section IV, steps B through G, or using analysis of covariance. The two methods are equivalent and produce identical results. The manual method described below provides an understanding of this application of covariance analysis, but computerized versions of covariance analysis are much more convenient for analyzing large data tests. If two or more factors affect toxicity, multiple regression analysis should be used.

B. For each species for which comparable acute toxicity values are available at two or more different values of the water quality characteristic, perform a least squares regression of the acute toxicity values on the corresponding values of the water quality characteristic to obtain the slope and its 95 percent confidence limits for each species.

> NOTE: Because the best documented relationship fitting these data is that between hardness and acute toxicity of metals in freshwater and a log-log relationship, geometric means and natural logarithms of both toxicity and water quality are used in the rest of this section. For relationships based on other water quality characteristics such as pH, temperature, or salinity, no transformation or a different transformation might fit the data better, and appropriate changes will be necessary.

C. Decide whether the data for each species are useful, taking into account the range and number of the tested values of the water quality characteristic and the degree of agreement within and between species. For example, a slope based on six data points might be of limited value if based only on data for a very narrow range of water quality characteristic values. A slope based on only two data points, however, might be useful if consistent with other information and if the two points cover a broad enough range of the water quality characteristic.

In addition, acute values that appear to be questionable in comparison with other acute and chronic data available for the same species and for other species in the same genus probably should not be used. For example, if after adjustment for the water quality characteristic the acute values available for a species or genus differ by more than a factor of 10, probably some or all of the values should be rejected. If useful slopes are not available for at least one fish and one invertebrate, or if the available slopes are too dissimilar, or if too few data are available to adequately define the relationship between acute toxicity and the water quality characteristic, return to section IV.G, using the results of tests conducted under conditions and in waters similar to those commonly used for toxicity tests with the species.

D. Individually for each species, calculate the geometric mean of the available acute values and then divide each of these acute values by the mean for the species. This normalizes the values so that the geometric mean of the normalized values for each species, individually, and for any combination of species is 1.0.

E. Similarly normalize the values of the water quality characteristic for each species, individually.

F. Individually for each species, perform a least squares regression of the normalized acute toxicity values on the corresponding normalized values of the water quality characteristic. The resulting slopes and 95 percent confidence limits will be identical to those obtained in

step B. However, now, if the data are actually plotted, the line of best fit for each individual species will go through the point 1,1 in the center of the graph.

G. Treat normalized data as if they were all for the same species and perform a least squares regression of all the normalized acute values on the corresponding normalized values of the water quality characteristic to obtain the pooled acute slope, V, and its 95 percent confidence limits. If all the normalized data are actually plotted, the line of best fit will go through the point 1,1 in the center of the graph.

H. For each species, calculate the geometric mean, W, of the acute toxicity values and the geometric mean, X, of the values of the water quality characteristic. (These were calculated in steps D and E.)

I. For each species, calculate the logarithm, Y, of the Species Mean Acute Value at a selected value, Z, of the water quality characteristic using the equation:

$$Y = \ln W - V(\ln X - \ln Z).$$

J. For each species, calculate the SMAV at Z using the equation:

$$SMAV = e^{Y}.$$

NOTE: Alternatively, the Species Mean Acute Values at Z can be obtained by skipping step H using the equations in steps I and J to adjust each acute value individually to Z, and then calculating the geometric mean of the adjusted values for each species individually.

This alternative procedure allows an examination of the range of the adjusted acute values for each species.

K. Obtain the Final Acute Value at Z by using the procedure described in section IV, steps J through O.

L. If the Species Mean Acute Value at Z of a commercially or recreationally important species is lower than the calculated Final Acute Value at Z, then that Species Mean Acute Value should be used as the Final Acute Value at Z instead of the calculated Final Acute Value.

M. The Final Acute Equation is written as:

$$\text{Final Acute Value} = e^{(V[\ln(\text{water quality characteristic})] + \ln A - V[\ln Z])}$$

where

V = pooled acute slope

A = Final Acute Value at Z.

Because V, A, and Z are known, the Final Acute Value can be calculated for any selected value of the water quality characteristic.

VI. Final Chronic Value

A. Depending on the data that are available concerning chronic toxicity to aquatic animals, the Final Chronic Value might be calculated in the same manner as the Final Acute Value or by dividing the Final Acute Value by the Final Acute-Chronic Ratio. In some cases, it may not be possible to calculate a Final Chronic Value.

NOTE: As the name implies, the Acute-Chronic Ratio is a way of relating acute and chronic toxicities. The Acute-Chronic Ratio is basically the inverse of the application factor, but this new name is better because it is more descriptive and should help prevent confusion between "application factors" and "safety factors." Acute-Chronic Ratios and application factors are ways of relating the acute and chronic toxicities of a material to aquatic organisms. Safety factors are used to provide an extra margin of safety beyond the known or estimated sensitivities of aquatic organisms. Another advantage of the Acute-Chronic Ratio is that it will usually be greater than 1; this should avoid the confusion as to whether a large application factor is one that is close to unity or one that has a denominator that is much greater than the numerator.

B. Chronic values should be based on results of flow- through chronic tests in which the concentrations of test material in the test solutions were properly measured at appropriate times during the test. (Exception: renewal, which is acceptable for daphnids.)

C. Results of chronic tests in which survival, growth, or reproduction in the control treatment was unacceptably low should not be used. The limits of acceptability will depend on the species.

D. Results of chronic tests conducted in unusual dilution water (dilution water in which total organic carbon or particulate matter exceeded 5 mg/L) should not be used, unless a relationship is developed between chronic toxicity and organic carbon or particulate matter, or unless data show that organic carbon, particulate matter (and so forth) do not affect toxicity.

E. Chronic values should be based on endpoints and lengths of exposure appropriate to the species. Therefore, only results of the following kinds of chronic toxicity tests should be used:

1. Life-cycle toxicity tests consisting of exposures of each of two or more groups of individuals of a species to a different concentration of the test material throughout a life cycle. To ensure that all life stages and life processes are exposed, tests with fish should begin with embryos or newly hatched young less than 48-hours old, continue through maturation and reproduction, and end not less than 24 days (90 days for salmonids) after the hatching of the next generation. Tests with daphnids should begin with young less than 24-hours old and last for not less than 21 days. Tests with mysids should begin with young less than 24-hours old and continue until seven days past the median time of first brood release in the controls.

   For fish, data should be obtained and analyzed on survival and growth of adults and young, maturation of males and females, eggs spawned per female, embryo viability (salmonids only), and hatchability. For daphnids, data should be obtained and analyzed on survival and young per female. For mysids, data should be obtained and analyzed on survival, growth, and young per female.

2. Partial life-cycle toxicity tests consisting of exposures of each of two or more groups of individuals in a fish species to a concentration of the test material through most portions of a life cycle. Partial life-cycle tests are allowed with fish species that require more than a year to reach sexual maturity so that all major life stages can be exposed to the test material in less than 15 months.

   Exposure to the test material should begin with immature juveniles at least two months prior to active gonad development, continue through maturation and reproduction, and end not less than 24 days (90 days for salmonids) after the hatching of the next generation. Data should be obtained and analyzed on survival and growth of adults and young, maturation of males and females, eggs spawned per female, embryo viability (salmonids only), and hatchability.

3. Early life stage toxicity tests consisting of 28- to 32-day (60 days post hatch for salmonids) exposures of the early life stages of a fish species from shortly after fertilization through embryonic, larval, and early juvenile development. Data should be obtained and analyzed on survival and growth.

   NOTE: Results of an early life stage test are used as predictions of results of life-cycle and partial life-cycle tests with the same species. Therefore, when results of a total or partial life-cycle test are available, results of an early life stage test with the same species should not be used. Also, results of early life stage tests in which the incidence of mortalities or abnormalities increased substantially near the end should not be used because these results are possibly not good predictions of the results of comparable total or partial life cycle or partial life cycle tests.

F. A chronic value can be obtained by calculating the geometric mean of the lower and upper chronic limits from a chronic test or by analyzing chronic data using regression analysis. A lower chronic limit is the highest tested concentration in an acceptable chronic test that did not cause an unacceptable amount of adverse effect on any of the specified biological measurements and below which no tested concentration caused an unacceptable effect. An upper chronic limit is the lowest tested concentration in an acceptable chronic test that did cause an unacceptable amount of adverse effect on one or more of the specified biological measurements and above which all tested concentrations also caused such an effect.

NOTE: Because various authors have used a variety of terms and definitions to interpret and report results of chronic tests, reported results should be reviewed carefully. The amount of effect that is considered unacceptable is often based on a statistical hypothesis test but might also be defined in terms of a specified percent reduction from the controls. A small percent reduction (e.g., 3 percent) might be considered acceptable even if it is statistically significantly different from the control, whereas a large percent reduction (e.g., 30 percent) might be considered unacceptable even if it is not statistically significant.

G. If the chronic toxicity of the material to aquatic animals apparently has been shown to be related to a water quality characteristic such as hardness or particulate matter for freshwater animals or salinity or particulate matter for saltwater animals, a Final Chronic Equation should be derived based on that water quality characteristic. Go to section VII.

H. If chronic values are available for species in eight families as described in sections III.B.1 or III.C.1, a Species Mean Chronic Value should also be calculated for each species for which at least one chronic value is available by calculating the geometric mean of all chronic values available for the species; appropriate Genus Mean Chronic Values should also be calculated. The Final Chronic Value should then be obtained using the procedure described in section III, steps J through O. Then go to section VI.M.

I. For each chronic value for which at least one corresponding appropriate acute value is available, calculate an acute-chronic ratio using for the numerator the geometric mean of the results of all acceptable flow-through acute tests in the same dilution water and in which the concentrations were measured. (Exception: static is acceptable for daphnids.)

For fish, the acute test(s) should have been conducted with juveniles and should have been part of the same study as the chronic test. If acute tests were not conducted as part of the same study, acute tests conducted in the same laboratory and dilution water but in a different study may be used. If no such acute tests are available, results of acute tests conducted in the same dilution water in a different laboratory may be used. If no such acute tests are available, an acute-chronic ratio should not be calculated.

J. For each species, calculate the species mean acute-chronic ratio as the geometric mean of all acute-chronic ratios available for that species.

K. For some materials, the acute-chronic ratio seems to be the same for all species, but for other materials, the ratio seems to increase or decrease as the Species Mean Acute Value increases. Thus the Final Acute-Chronic Ratio can be obtained in four ways, depending on the data available:

1. If the Species Mean Acute-Chronic ratio seems to increase or decrease as the Species Mean Acute Value increases, the Final Acute-Chronic Ratio should be calculated as the geometric mean of the acute-chronic ratios for species whose Species Mean Acute Values are close to the Final Acute Value.

2. If no major trend is apparent, and the acute-chronic ratios for a number of species are within a factor of 10, the Final Acute-Chronic Ratio should be calculated as the geometric mean of all the Species Mean Acute-Chronic Ratios available for both freshwater and saltwater species.

3. For acute tests conducted on metals and possibly other substances with embryos and larvae of barnacles, bivalve molluscs, sea urchins, lobsters, crabs, shrimp, and abalones (see section IV.E.2), it is probably appropriate to assume that the

acute-chronic ratio is 2. Chronic tests are very difficult to conduct with most such species, but the sensitivities of embryos and larvae would likely determine the results of life cycle tests. Thus, if the lowest available Species Mean Acute Values were determined with embryos and larvae of such species, the Final Acute-Chronic Ratio should probably be assumed to be 2, so that the Final Chronic Value is equal to the Criterion Maximum Concentration (see section XI.B)

4. If the most appropriate Species Mean Acute-Chronic Ratios are less than 2.0, and especially if they are less than 1.0, acclimation has probably occurred during the chronic test. Because continuous exposure and acclimation cannot be assured to provide adequate protection in field situations, the Final Acute-Chronic Ratio should be assumed to be 2, so that the Final Chronic Value is equal to the Criterion Maximum Concentration (see section XI.B).

   If the available Species Mean Acute-Chronic Ratios do not fit one of these cases, a Final Acute-Chronic Ratio probably cannot be obtained, and a Final Chronic Value probably cannot be calculated.

L. Calculate the Final Chronic Value by dividing the Final Acute Value by the Final Acute-Chronic Ratio. If there was a Final Acute Equation rather than a Final Acute Value, see also section VII.A.

M. If the Species Mean Chronic Value of a commercially or recreationally important species is lower than the calculated Final Chronic Value, then that Species Mean Chronic Value should be used as the Final Chronic Value instead of the calculated Final Chronic Value.

N. Go to section VIII.

VII. Final Chronic Equation

A. A Final Chronic Equation can be derived in two ways. The procedure described here will result in the chronic slope being the same as the acute slope. The procedure described in steps B through N usually will result in the chronic slope being different from the acute slope.

1. If acute-chronic ratios are available for enough species at enough values of the water quality characteristic to indicate that the acute-chronic ratio is probably the same for all species and is probably independent of the water quality characteristic, calculate the Final Acute-Chronic Ratio as the geometric mean of the available Species Mean Acute-Chronic Ratios.

2. Calculate the Final Chronic Value at the selected value Z of the water quality characteristic by dividing the Final Acute Value at Z (see section V.M) by the Final Acute-Chronic Ratio.

3. Use V = pooled acute slope (see section V.M) as L = pooled chronic slope.

4. Go to section VII.M.

B. When enough data are available to show that chronic toxicity to at least one species is related to a water quality characteristic, the relationship should be taken into account as described in steps B through G or using analysis of covariance. The two methods are equivalent and produce identical results. The manual method described in the next paragraph provides an understanding of this application of covariance analysis, but computerized versions of covariance analysis are much more convenient for analyzing large data sets. If two or more factors affect toxicity, multiple regression analysis should be used.

C. For each species for which comparable chronic toxicity values are available at two or more different values of the water quality characteristic, perform a least squares regression of

the chronic toxicity values on the corresponding values of the water quality characteristic to obtain the slope and its 95 percent confidence limits for each species.

NOTE: Because the best-documented relationship fitting these data is that between hardness and acute toxicity of metals in fresh water and a log-log relationship, geometric means and natural logarithms of both toxicity and water quality are used in the rest of this section. For relationships based on other water quality characteristics such as pH, temperature, or salinity, no transformation or a different transformation might fit the data better, and appropriate changes will be necessary throughout this section. It is probably preferable, but not necessary, to use the same transformation that was used with the acute values in section V.

D. Decide whether the data for each species are useful, taking into account the range and number of the tested values of the water quality characteristic and the degree of agreement within and between species. For example, a slope based on six data points might be of limited value if founded only on data for a very narrow range of values of the water quality characteristic. A slope based on only two data points, however, might be useful if it is consistent with other information and if the two points cover a broad enough range of the water quality characteristic. In addition, chronic values that appear to be questionable in comparison with other acute and chronic data available for the same species and for other species in the same genus probably should not be used. For example, if after adjustment for the water quality characteristic the chronic values available for a species or genus differ by more than a factor of 10, probably some or all of the values should be rejected.

If a useful chronic slope is not available for at least one species, or if the available slopes are too dissimilar, or if too few data are available to adequately define the relationship between chronic toxicity and the water quality characteristic, the chronic slope is probably the same as the acute slope, which is equivalent to assuming that the acute-chronic ratio is independent of the water quality characteristic. Alternatively, return to section VI.H, using the results of tests conducted under conditions and in waters similar to those commonly used for toxicity tests with the species.

E. Individually for each species, calculate the geometric mean of the available chronic values and then divide each chronic value for a species by its mean. This normalizes the chronic values so that the geometric mean of the normalized values for each species individually, and for any combination of species, is 1.0.

F. Similarly normalize the values of the water quality characteristic for each species, individually.

G. Individually for each species, perform a least squares regression of the normalized chronic toxicity values on the corresponding normalized values of the water quality characteristic. The resulting slopes and the 95 percent confidence limits will be identical to those obtained in section B. Now, however, if the data are actually plotted, the line of best fit for each individual species will go through the point 1,1 in the center of the graph.

H. Treat all the normalized data as if they were all for the same species and perform a least squares regression of all the normalized chronic values on the corresponding normalized values of the water quality characteristic to obtain the pooled chronic slope, L, and its 95 percent confidence limits. If all the normalized data are actually plotted, the line of best fit will go through the point 1,1 in the center of the graph.

I. For each species, calculate the geometric mean, M, of the toxicity values and the geometric mean, P, of the values of the water quality characteristic. (These were calculated in steps E and F.)

J. For each species, calculate the logarithm, Q, of the Species Mean Chronic Value at a selected value, Z, of the water quality characteristic using the equation:

$$Q = \ln M - L(\ln P - \ln Z).$$

NOTE: Although it is not necessary, it will usually be best to use the same value of the water quality characteristic here as was used in section V.I.

K. For each species, calculate a Species Mean Chronic Value at Z using the equation:

$$SMCV = e^{Q}.$$

NOTE: Alternatively, the Species Mean Chronic Values at Z can be obtained by skipping step J, using the equations in steps J and K to adjust each acute value individually to Z, and then calculating the geometric means of the adjusted values for each species individually. This alternative procedure allows an examination of the range of the adjusted chronic values for each species.

L. Obtain the Final Chronic Value at Z by using the procedure described in section IV, steps J through O.

M. If the Species Mean Chronic Value at Z of a commercially or recreationally important species is lower than the calculated Final Chronic Value at Z, then that Species Mean Chronic Value should be used as the Final Chronic Value at Z instead of the calculated Final Chronic Value.

N. The Final Chronic Equation is written as:

$$\text{Final Chronic Value} = e^{(L[\ln(\text{water quality characteristic})] + \ln S - L[\ln Z])}$$

where

L = pooled chronic slope

S = Final Chronic Value at Z.

Because L, S, and Z are known, the Final Chronic Value can be calculated for any selected value of the water quality characteristic.

VIII. Final Plant Value

A. Appropriate measures of the toxicity of the material to aquatic plants are used to compare the relative sensitivities of aquatic plants and animals. Although procedures for conducting and interpreting the results of toxicity tests with plants are not well developed, results of tests with plants usually indicate that criteria which adequately protect aquatic animals and their uses will probably also protect aquatic plants and their uses.

B. A plant value is the result of a 96-hour test conducted with an alga, or a chronic test conducted with an aquatic vascular plant.

NOTE: A test of the toxicity of a metal to a plant usually should not be used if the medium contained an excessive amount of a complexing agent, such as EDTA, that might affect the toxicity of the metal. Concentrations of EDTA above about 200 µg/L should probably be considered excessive.

C. The Final Plant Value should be obtained by selecting the lowest result from a test with an important aquatic plant species in which the concentrations of test material were measured, and the endpoint was biologically important.

IX. Final Residue Value

A. The Final Residue Value is intended to prevent concentrations in commercially or recreationally important aquatic species from affecting marketability because they exceed applicable FDA action levels and to protect wildlife (including fishes and birds) that consume aquatic organisms from demonstrated unacceptable effects. The Final Residue Value is the lowest of the residue values that are obtained by dividing maximum permissible tissue concentrations by appropriate bioconcentration or bioaccumulation factors. A maximum permissible tissue concentration is either (a) an FDA action level (Compliance Policy Guide, U.S. Food & Drug Admin. 1981) for fish oil or for the edible portion of fish or shellfish, or a maximum acceptable dietary intake based on observations on survival, growth, or reproduction in a chronic wildlife feeding study or a long-term wildlife field study. If no maximum permissible tissue concentration is available, go to section X because no Final Residue Value can be derived.

B. Bioconcentration Factors (BCFs) and bioaccumulation factors (BAFs) are quotients of the concentration of a material in one or more tissues of an aquatic organism, divided by the average concentration in the solution in which the organism had been living. A BCF is intended to account only for net uptake directly from water and thus almost must be measured in a laboratory test. Some uptake during the bioconcentration test might not be directly from water if the food sorbs some of the test material before it is eaten by the test organisms. A BAF is intended to account for net uptake from both food and water in a real-world situation. A BAF almost must be measured in a field situation in which predators accumulate the material directly from water and by consuming prey that could have accumulated the material from both food and water.

The BCF and BAF are probably similar for a material with a low BCF, but the BAF is probably higher than the BCF for materials with high BCFs. Although BCFs are not too difficult to determine, very few BAFs have been measured acceptably because adequate measurements must be made of the material's concentration in water to ascertain if it was reasonably constant for a long enough time over the range of territory inhabited by the organisms. Because so few acceptable BAFs are available, only BCFs will be discussed further. However, if an acceptable BAF is available for a material, it should be used instead of any available BCFs.

C. If a maximum permissible tissue concentration is available for a substance (e.g., parent material, parent material plus metabolites, etc.), the tissue concentration used in the calculation of the BCF should be for the same substance. Otherwise, the tissue concentration used in the calculation of the BCF should derive from the material and its metabolites that are structurally similar and are not much more soluble in water than the parent material.

1. A BCF should be used only if the test was flow-through, the BCF was calculated based on measured concentrations of the test material in tissue and in the test solution, and the exposure continued at least until either apparent steady state or 28 days was reached. Steady state is reached when the BCF does not change significantly over a period of time, such as 2 days or 16 percent of the length of the exposure, whichever is longer. The BCF used from a test should be the highest of the apparent steady-state BCF, if apparent steady state was reached; the highest BCF obtained, if apparent steady state was not reached; and the projected steady state BCF, if calculated.

2. Whenever a BCF is determined for a lipophilic material, the percent lipids should also be determined in the tissue(s) for which the BCF was calculated.

3. A BCF obtained from an exposure that adversely affected the test organisms may be used only if it is similar to a BCF obtained with unaffected organisms of the same species at lower concentrations that did not cause adverse effects.

4. Because maximum permissible tissue concentrations are almost never based on dry weights, a BCF calculated using dry tissue weights must be converted to a wet tissue weight basis. If no conversion factor is reported with the BCF, multiply the dry weight BCF by 0.1 for plankton and by 0.2 for individual species of fishes and invertebrates.

5. If more than one acceptable BCF is available for a species, the geometric mean of the available values should be used; however, the BCFs are from different lengths of exposure and the BCF increases with length of exposure, then the BCF for the longest exposure should be used.

E. If enough pertinent data exists, several residue values can be calculated by dividing maximum permissible tissue concentrations by appropriate BCFs:

1. For each available maximum acceptable dietary intake derived from a chronic feeding study or a long-term field study with wildlife (including birds and aquatic organisms), the appropriate BCF is based on the whole body of aquatic species that constitutes or represents a major portion of the diet of the tested wildlife species.

2. For an FDA action level for fish or shellfish, the appropriate BCF is the highest geometric mean species BCF for the edible portion (muscle for decapods, muscle with or without skin for fishes, adductor muscle for scallops, and total soft tissue for other bivalve molluscs) of a consumed species. The highest species BCF is used because FDA action levels are applied on a species-by-species basis.

F. For lipophilic materials, calculating additional residue values is possible. Because the steady-state BCF for a lipophilic material seems to be proportional to percent lipids from one tissue to another and from one species to another, extrapolations can be made from tested tissues, or species to untested tissues, or species on the basis of percent lipids.

1. For each BCF for which the percent lipids is known for the same tissue for which the BCF was measured, normalize the BCF to a 1 percent lipid basis by dividing it by the percent lipids. This adjustment to a 1 percent lipid basis is intended to make all the measured BCFs for a material comparable regardless of the species or tissue with which the BCF was measured.
2. Calculate the geometric mean-normalized BCF. Data for both saltwater and freshwater species should be used to determine the mean-normalized BCF unless they show that the normalized BCFs are probably not similar.
3. Calculate all possible residue values by dividing the available maximum permissible tissue concentrations by the mean-normalized BCF and by the percent lipids values appropriate to the maximum permissible tissue concentrations, i.e.,

$$\text{Residue value} = \frac{(\text{maximum permissible tissue concentration})}{(\text{mean normalized BCF})(\text{appropriate percent lipids})}$$

- For an FDA action level for fish oil, the appropriate percent lipids value is 100.
- For an FDA action level for fish, the appropriate percent lipids value is 11 for freshwater criteria and 10 for saltwater criteria because FDA action levels are applied species-by-species to commonly consumed species. The highest lipid contents in the edible portions of important consumed species are about 11 percent for both the freshwater chinook salmon and lake trout and about 10 percent for the saltwater Atlantic herring.
- For a maximum acceptable dietary intake derived from a chronic feeding study or a long-term field study with wildlife, the appropriate percent lipids is that of an aquatic species or group of aquatic species that constitute a major portion of the diet of the wildlife species.

G. The Final Residue Value is obtained by selecting the lowest of the available residue values.

NOTE: In some cases, the Final Residue Value will not be low enough. For example, a residue value calculated from a FDA action level will probably result in an average concentration in the edible portion of a fatty species at the action level. Some individual organisms and possibly some species will have residue concentrations higher than the mean value, but no mechanism has been devised to provide appropriate additional protection. Also, some chronic feeding studies and long-term field studies with wildlife identify concentrations that cause adverse effects but do not identify concentrations that do not cause adverse effects; again, no mechanism has been devised to provide appropriate additional protection. These are some of the species and uses that are not protected at all times in all places.

X. Other Data

Pertinent information that could not be used in earlier sections might be available concerning adverse effects on aquatic organisms and their uses. The most important of these are data on cumulative and delayed toxicity, flavor impairment, reduction in survival, growth, or reproduction, or any other adverse effect shown to be biologically important. Especially important are data for species for which no other data are available. Data from behavioral, biochemical, physiological, microcosm, and field studies might also be available. Data might be available from tests conducted in unusual dilution water (see IV.D and VI.D), from chronic tests

in which the concentrations were not measured (see VI.B), from tests with previously exposed organisms (see II.F), and from tests on formulated mixtures or emulsifiable concentrates (see II.D). Such data might affect a criterion if they were obtained with an important species, the test concentrations were measured, and the endpoint was biologically important.

XI. Criterion

A. A criterion consists of two concentrations: the Criterion Maximum Concentration and the Criterion Continuous Concentration.

B. The Criterion Maximum Concentration (CMC) is equal to one-half the Final Acute Value.

C. The Criterion Continuous Concentration (CCC) is equal to the lowest of the Final Chronic Value, the Final Plant Value, and the Final Residue Value, unless other data (see section X) show that a lower value should be used. If toxicity is related to a water quality characteristic, the Criterion Continuous Concentration is obtained from the Final Chronic Equation, the Final Plant Value, and the Final Residue Value by selecting the one, or the combination, that results in the lowest concentrations in the usual range of the water quality characteristic, unless other data (see section X) show that a lower value should be used.

D. Round both the Criterion Maximum Concentration and the Criterion Continuous Concentration to two significant digits.

E. The criterion is stated as follows:

The procedures described in the "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" indicate that, except possibly where a locally important species is very sensitive, *(1) aquatic organisms and their uses should not be affected unacceptably if the four-day average concentration of (2) does not exceed (3) µg/L more than once every three years on the average, and if the one-hour average concentration does not exceed (4) µg/L more than once every three years on the average.

*where (1) = insert freshwater or saltwater

(2) = insert name of material

(3) = insert the Criterion Continuous Concentration

(4) = insert the Criterion Maximum Concentration.

XII. Final Review

A. The derivation of the criterion should be carefully reviewed by rechecking each step of the guidelines. Items that should be especially checked are

1. If unpublished data are used, are they well documented?
2. Are all required data available?
3. Is the range of acute values for any species greater than a factor of 10?
4. Is the range of Species Mean Acute Values for any genus greater than a factor of 10?
5. Is there more than a factor of 10 difference between the four lowest Genus Mean Acute Values?
6. Are any of the four lowest Genus Mean Acute Values questionable?
7. Is the Final Acute Value reasonable in comparison with the Species Mean Acute Values and Genus Mean Acute Values?
8. For any commercially or recreationally important species, is the geometric mean of the acute values from flow-through tests in which the concentrations of test material were measured lower than the Final Acute Value?

9. Are any of the chronic values questionable?
10. Are chronic values available for acutely sensitive species?
11. Is the range of acute-chronic ratios greater than a factor of 10?
12. Is the Final Chronic Value reasonable in comparison with the available acute and chronic data?
13. Is the measured or predicted chronic value for any commercially or recreationally important species below the Final Chronic Value?
14. Are any of the other data important?
15. Do any data look like they might be outliers?
16. Are there any deviations from the guidelines? Are they acceptable?

B. On the basis of all available pertinent laboratory and field information, determine if the criterion is consistent with sound scientific evidence. If not, another criterion — either higher or lower — should be derived using appropriate modifications of these guidelines.

APPENDIX I

List of EPA Water Quality Criteria Documents

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

Water Quality Criteria Documents

The U.S. Environmental Protection Agency has published water quality criteria for toxic pollutant(s) categories. Copies of water quality criteria documents are available from the National Technical Information Service (NTIS), 5285 Front Royal Road, Springfield, VA 22161, (703) 487-4650. Prices of individual documents may be obtained by contacting NTIS. Order numbers are listed below. Where indicated, documents may be obtained from the Water Resource Center, 401 M St., S.W. RC-4100, Washington, DC 20460, (202) 260-7786.

Chemical	NTIS Order No.	EPA Document No.
Acenaphthene	PB 81-117269	EPA 440/5-80-015
Acrolein	PB 81-117277	EPA 440/5-80-016
Acrylonitrile	PB 81-117285	EPA 440/5-80-017
Aesthetics	PB 263943	EPA 440/9-76-023
Aldrin/Dieldrin	PB 81-117301	EPA 440/5-80-019
Alkalinity	PB 263943	EPA 440/9-76-023
Aluminum	PB 88-245998	EPA 440/5-86-008
Ammonia	PB 85-227114	EPA 440/5-85-001
Ammonia (saltwater)	PB 89-195242	EPA 440/5-88-004
Antimony	PB 81-117319	EPA 440/5-80-020
Antimony (III) — aquatic (draft)	resource center	
Arsenic — 1980	PB 81-117327	EPA 440/5-80-021
— 1984	PB 85-227445	EPA 440/5-84-033
Asbestos	PB 81-117335	EPA 440/5-80-022
Bacteria — 1976	PB 263943	EPA 440/9-76-023
— 1984	PB 86-158045	EPA 440/5-84-002
Barium	PB 263943	EPA 440/9-76-023
Benzene	PB 81-117293	EPA 440/5-80-018
Benzidine	PB 81-117343	EPA 440/5-80-023
Beryllium	PB 81-117350	EPA 440/5-80-024
Boron	PB 263943	EPA 440/9-76-023
Cadmium — 1980	PB 81-117368	EPA 440/5-80-025
— 1984	PB 85-224031	EPA 440/5-84-032
Carbon Tetrachloride	PB 81-117376	EPA 440/5-80-026
Chlordane	PB 81-117384	EPA 440/5-80-027
Chloride	PB 88-175047	EPA 440/5-88-001
Chlorinated Benzenes	PB 81-117392	EPA 440/5-80-028
Chlorinated Ethanes	PB 81-117400	EPA 440/5-80-029
Chlorinated Naphthalene	PB 81-117426	EPA 440/5-80-031
Chlorinated Phenols	PB 81-117434	EPA 440/5-80-032

Chemical	NTIS Order No.	EPA Document No.
Chlorine	PB 85-227429	EPA 440/5-84-030
Chloroalkyl Ethers	PB 81-117418	EPA 440/5-80-030
Chloroform	PB 81-117442	EPA 440/5-80-033
2-Chlorophenol	PB 81-117459	EPA 440/5-80-034
Chlorophenoxy Herbicides	PB 263943	EPA 440/9-76-023
Chlorpyrifos	PB 87-105359	EPA 440/5-86-005
Chromium — 1980	PB 81-117467	EPA 440/5-80-035
—1984	PB 85-227478	EPA 440/5-84-029
Color	PB 263943	EPA 440/9-76-023
Copper — 1980	PB 81-117475	EPA 440/5-80-036
— 1984	PB 85-227023	EPA 440/5-84-031
Cyanide	PB 85-227460	EPA 440/5-84-028
Cyanides	PB 81-117483	EPA 440/5-80-037
DDT and Metabolites	PB 81-117491	EPA 440/5-80-038
Demeton	PB 263943	EPA 440/9-76-023
Dichlorobenzenes	PB 81-117509	EPA 440/5-80-039
Dichlorobenzidine	PB 81-117517	EPA 440/5-80-040
Dichloroethylenes	PB 81-117525	EPA 440/5-80-041
2,4-Dichlorophenol	PB 81-117533	EPA 440/5-80-042
Dichloropropane/ Dichloropropene	PB 81-117541	EPA 440/5-80-043
2,4-Dimethylphenol	PB 81-117558	EPA 440/5-80-044
Dinitrotoluene	PB 81-117566	EPA 440/5-80-045
Diphenylhydrazine	PB 81-117731	EPA 440/5-80-062
Di-2-Ethylhexyl Phthalate — aquatic (draft)	resource center	
Dissolved Oxygen	PB 86-208253	EPA 440/5-86-003
Endosulfan	PB 81-117574	EPA 440/5-80-046
Endrin	PB 81-117582	EPA 440/5-80-047
Ethylbenzene	PB 81-117590	EPA 440/5-80-048
Fluoranthene	PB 81-117608	EPA 440/5-80-049
Gasses, Total Dissolved	PB 263943	EPA 440/9-76-023
Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses	PB 85-227049	
Guthion	PB 263943	EPA 440/9-76-023
Haloethers	PB 81-117616	EPA 440/5-80-050
Halomethanes	PB 81-117624	EPA 440/5-80-051
Hardness	PB 263943	EPA 440/9-76-023
Heptachlor	PB 81-117632	EPA 440/5-80-052
Hexachlorobenzene — aquatic (draft)	resource center	
Hexachlorobutadiene	PB 81-117640	EPA 440/5-80-053
Hexachlorocyclohexane	PB 81-117657	EPA 440/5-80-054

Chemical	NTIS Order No.	EPA Document No.
Hexachlorocyclopentadiene	PB 81-117665	EPA 440/5-80-055
Iron	PB 263943	EPA 440/9-76-023
Isophorone	PB 81-117673	EPA 440/5-80-056
Lead — 1980	PB 81-117681	EPA 440/5-80-057
— 1984	PB 85-227437	EPA 440/5-84-027
Malathion	PB 263943	EPA 440/9-76-023
Manganese	PB 263943	EPA 440/9-76-023
Mercury — 1980	PB 81-117699	EPA 440/5-80-058
— 1984	PB 85-227452	EPA 440/5-84-026
Methoxychlor	PB 263943	EPA 440/9-76-023
Mirex	PB 263943	EPA 440/9-76-023
Naphthalene	PB 81-117707	EPA 440/5-80-059
Nickel — 1980	PB 81-117715	EPA 440/5-80-060
— 1986	PB 87-105359	EPA 440/5-86-004
Nitrates/Nitrites	PB 263943	EPA 440/9-76-023
Nitrobenzene	PB 81-117723	EPA 440/5-80-061
Nitrophenols	PB 81-117749	EPA 440/5-80-063
Nitrosamines	PB 81-117756	EPA 440/5-80-064
Oil and Grease	PB 263943	EPA 440/9-76-023
Parathion	PB 87-105383	EPA 440/5-86-007
Pentachlorophenol — 1980	PB 81-117764	EPA 440/5-80-065
— 1986	PB 87-105391	EPA 440/5-85-009
pH	PB 263943	EPA 440/9-76-023
Phenanthrene — aquatic (draft)	resource center	
Phenol	PB 81-117772	EPA 440/5-80-066
Phosphorus	PB 263943	EPA 440/9-76-023
Phthalate Esters	PB 81-117780	EPA 440/5-80-067
Polychlorinated Biphenyls	PB 81-117798	EPA 440/5-80-068
Polynuclear Aromatic Hydrocarbons	PB 81-117806	EPA 440/5-80-069
Selenium — 1980	PB 81-117814	EPA 440/5-80-070
— 1987	PB 88-142239	EPA 440/5-87-008
Silver	PB 81-117822	EPA 440/5-80-071
Silver — aquatic (draft)	resource center	
Solids (dissolved) and Salinity	PB 263943	EPA 440/9-76-023
Solids (suspended) and Turbidity	PB 263943	EPA 440/9-76-023
Sulfides/Hydrogen Sulfide	PB 263943	EPA 440/9-76-023
Tainting Substances	PB 263943	EPA 440/9-76-023
Temperature	PB 263943	EPA 440/9-76-023
2,3,7,8-Tetrachlorodibenzo-P-Dioxin	PB 89-169825	EPA 440/5-84-007
Tetrachloroethylene	PB 81-117830	EPA 440/5-80-073
Thallium	PB 81-117848	EPA 440/5-80-074
Toluene	PB 81-117863	EPA 440/5-80-075

Chemical	NTIS Order No.	EPA Document No.
Toxaphene — 1980	PB 81-117863	EPA 440/5-80-076
— 1986	PB 87-105375	EPA 440/5-86-006
Tributyltin — aquatic (draft)	resource center	
Trichloroethylene	PB 81-117871	EPA 440/5-80-077
2,4,5-Trichlorophenol — aquatic (draft)	resource center	
Vinyl Chloride	PB 81-117889	EPA 440/5-80-078
Zinc — 1980	PB 81-117897	EPA 440/5-80-079
— 1987	PB 87-143581	EPA 440/5-87-003

APPENDIX J

Reserved

APPENDIX K

Procedures for the Initiation of Narrative Biological Criteria

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

United States
Environmental Protection
Agency

Office of Science and Technology
Office of Water
Washington, D.C. 20460

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PROCEDURES FOR INITIATING NARRATIVE BIOLOGICAL CRITERIA

PROCEDURES FOR INITIATING NARRATIVE BIOLOGICAL CRITERIA

By

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Washington, DC

October 1992

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

OFFICE OF
WATER

MEMORANDUM

To: Users of "Procedures for Initiating Narrative Biological Criteria"

Regarding: Guidance for the development of narrative biological criteria

From: Margarete Stasikowski, Director
Health and Ecological Criteria Division
Office of Science and Technology
U.S. EPA

This guidance was written in response to requests from many State water resource agencies for specific information about EPA expectations of them as they prepare narrative biological criteria for the assessment of their surface water resources.

The array of State experiences with this form of water quality evaluation extends from almost no experience in some cases to national leadership roles in others. It may therefore, be that some readers will find this information too involved, while others will feel it is too basic. To the latter we wish to express the sincere hope that this material is a fair approximation of their good examples. To the former, we emphasize that there is no expectation that a State just entering the process will develop a full blown infrastructure overnight. The intent is to outline both the initiation and the subsequent implementation and application of a State program based on commonly collected data as a starting point. User agencies are encouraged to progress through this material at their own best pace as needs and resources determine.

Specific advice, clarification and assistance may be obtained from the U.S. EPA Regional Offices by consultation with the designated resource personnel listed in the appendix to this document.

Attachment

Purpose of this Paper

The Biological Criteria Program was initiated by EPA in response to research and interest generated over the last several years by Agency, State, and academic investigators. This interest has been documented in several reports and conference proceedings that were the basis for creation of the program and for the preparation of *Biological Criteria National Program Guidance for Surface Waters* (U.S. Environ. Prot. Agency, 1990a). The overall concept and "narrative biological criteria" are described in that guide.

Because establishing narrative criteria is an important first step in the process, the material that follows here is intended to be an elaboration upon and clarification of the term narrative biological criteria as used in the guide. The emphasis here is on a practical, applied approach with particular attention to cost considerations and the need to introduce the material to readers who may not be familiar with the program.

Introduction and Background

Biological monitoring, assessment and the resultant biological criteria represent the current and increasingly sophisticated process of an evolving water quality measurement technology. This process spans almost 200 years in North America and the entire 20 years of EPA responsibility.

The initial efforts in the 1700's to monitor and respond to human impacts on watercourses were based on physical observations of sediments and debris discharged by towns, commercial operations, and ships in port (Capper, et al. 1983).

Later, chemical analyses were developed to measure less directly observable events. With industrialization, increasing technology, and land development pressures, both types of monitoring were incorporated into the body of our State and Federal public health and environmental legislation.

Valuable as these methods were, early investigations and compliance with water quality standards relied primarily on water column measurements reflecting only conditions at a given time of sampling. Investigators and managers have long recognized this limitation and have used sampling of resident organisms in the streams, rivers, lakes, or estuaries to enhance their understanding of water resource quality over a greater span of time. During the past 20 years, this biological technique has become increasingly sophisticated and reliable and is now a necessary adjunct to the established physical and chemical measures of water resources quality. In fact, the Clean Water Act states in Section 101 (a) that the objective of the law is to *restore and maintain the chemical, physical, and biological integrity of the Nation's waters.*

EPA has therefore concluded that biological assessment and consequent biological criteria are an appropriate and valuable complement to the Nation's surface water management programs. This added approach not only expands and refines this management effort, it is also consistent with the country's growing concern that the environment must be protected and managed for more than the legitimate interests of human health and welfare. The protection

of healthy ecosystems is part of EPA's responsibility and is indeed related to the public's welfare. Fish, shellfish, wildlife, and other indigenous flora and fauna of our surface waters require protection as intrinsic components of the natural system. Inherent to the Biological Criteria Program is the restoration and protection of this "biological integrity" of our waters.

A carefully completed survey and subsequent assessment of these resident organisms in relatively undisturbed areas reveal not only the character, e.g., biological integrity, of a natural, healthy waterbody, they also provide a benchmark or biological criterion against which similar systems may be compared where degradation is suspected. Biological measurements also help record waterbody changes over time with less potential temporal variation than physical or chemical approaches to water quality measurement. Thus, they can be used to help determine "existing aquatic life uses" of waterbodies requiring protection under State management programs.

This document elaborates on the initiation of narrative biological criteria as described in *Biological Criteria National Program Guidance for Surface Waters.* Future guidance documents will provide additional technical information to facilitate development and implementation of both narrative and numerical criteria for each of the surface water types.

Narrative Biological Criteria

The first phase of the program is the development of "narrative biological criteria". These are essentially statements of intent incorporated in State water laws to formally consider the fate and status of aquatic biological communities. Officially stated, biological criteria are ". . . numerical values or narrative expressions that describe the reference biological integrity of aquatic communities inhabiting waters of a given designated aquatic life use" (U.S. Environ. Prot. Agency, 1990a).

While a narrative criterion does not stipulate that numerical indices or other population parameters be used to indicate a particular level of water quality, it does rely upon the use of standard measures and data analyses to make qualitative determinations of the resident communities.

The State, Territory, or Reservation should not only carefully compose the narrative biological criteria statement but should also indicate how its application is to be accomplished. The determination of text (how the narrative biological criteria are written) and measurement procedures (how the criteria will be applied) is up to the individual States in consultation with EPA. Some degree of standardization among States sharing common regions and waters will be in their best interests. This regional coordination and cooperation could help improve efficiency, reduce costs, and expand the data base available to each State so that management determinations can be made with greater certainty.

Attributes of A Sound Narrative Criteria Statement

A narrative biological criterion should:

1. Support the goals of the Clean Water Act to provide for the protection and propagation of fish, shellfish and wildlife, and to restore and maintain the chemical, physical, and biological integrity of the Nation's waters;

2. Protect the most natural biological community possible by emphasizing the protection of its most sensitive components.

3. Refer to specific aquatic, marine, and estuarine community characteristics that must be present for the waterbody to meet a particular designated use, e.g., natural diverse systems with their respective communities or taxa indicated; and then,

4. Include measures of the community characteristics, based on sound scientific principles, that are quantifiable and written to protect and or enhance the designated use;

5. In no case should impacts degrading existing uses or the biological integrity of the waters be authorized.

An Example of A Narrative Biocriteria Statement

The State will preserve, protect, and restore the water resources of [name of State] in their most natural condition. The condition of these waterbodies shall be determined from the measures of physical, chemical, and biological characteristics of each surface waterbody type, according to its designated use. As a component of these measurements, the biological quality of any given water system shall be assessed by comparison to a reference condition(s) based upon similar hydrologic and watershed characteristics that represent the optimum natural condition for that system.

Such reference conditions or reaches of water courses shall be those observed to support the greatest variety and abundance of aquatic life in the region as is expected to be or has been historically found in natural settings essentially undisturbed or minimally disturbed by human impacts, development, or discharges. This condition shall be determined by consistent sampling and reliable measures of selected indicative communities of flora and/or fauna as established by . . . [appropriate State agency or agencies] . . . and may be used in conjunction with acceptable chemical, physical, and microbial water quality measurements and records judged to be appropriate to this purpose.

Regulations and other management efforts relative to these criteria shall be consistent with the objective of preserving, protecting, and restoring the most natural communities of fish, shellfish, and wildlife attainable in these waters; and in all cases shall protect against degradation of the highest existing or subsequently attained uses or biological conditions pursuant to State antidegradation requirements.

Data Gathering to Establish and Support Narrative Biological Criteria

A State need not specifically list in the narrative statement the sampling procedures and parameters to be employed, but it should identify and charge the appropriate administrative authority with this responsibility as indicated parenthetically in the preceding example.

The selection and sampling process, certainly at the outset, should be simple, reliable, and cost effective. In many instances existing data and State procedures will be adequate to initiate a biological criteria program, but there is no limitation on the sophistication or rigor of a State's procedures.

In reviewing existing procedures and in designing new ones, it is important that the planning group include the water resource managers, biologists, and chemists directly involved with the resource base. They should be the primary participants from the outset to help ensure that the data base and derived information adequately support the decisions to be made.

The State may choose to create procedures and regulations more complex and complete than are indicated here; however, the basic design and methodology should include the following elements:

■ **1. Resource Inventory.** A field review of State water resource conditions and a first hand documentation of the status of water quality relative to the use designation categories ("305(b)" reports) are essential to provide reliable data for the selections of reference sites, test sites, and for setting program priorities.

■ **2. Specific Objectives and Sampling Design.** States will need to design a system identifying "natural, unimpacted" reference sources appropriate to each surface waterbody type in each of the designated use categories in the State (e.g., streams, lakes and reservoirs, rivers, wetlands, estuaries and coastal waters) and the use categories (see example, Page 8) for each grouping of these waterbody types. Sources for defining reference condition may include historical data sets, screening surveys, or a consensus of experts in the region of interest, particularly in significantly disrupted areas as discussed later (see item 6, page 7).

Because natural water courses do not always follow political boundaries, the most effective approach may be a joint or group effort between two or more States. Where this coordination and cooperation is possible, it may produce a superior data base at less cost than any individual State effort. EPA is working through its regional offices to assist in the development of such joint operations through the use of ecoregions and subregions (Gallant et al. 1988). Regional EPA biologists and water quality or standards coordinators can advise and assist with these interstate cooperative efforts.

In any case, reference sites or sources for each waterbody type, subcategory of similar waters, and designated use category will be needed. These may be drawn from "upstream" locations, "far field" transects or selected nearby or "ecoregional" sites representative of rel-

atively unimpacted, highest quality natural settings (U.S. Environ. Prot. Agency, 1990a).

Care must be taken to equate comparable physical characteristics when selecting reference sites for the waterbodies to be evaluated. For example, a site on a piedmont stream cannot be the reference source against which sites on a coastal plain stream are compared; similarly, coastal tidal and nontidal wetlands should not be compared.

The organisms to be collected and communities sampled should represent an array of sensitivities to be as responsive and informative as possible. An example would be to collect fish, invertebrates representing both insects and shellfish, and perhaps macrophytes as elements of the sampling scheme.

■ **3. Collection Methods.** The same sampling techniques should always be employed at both the reference sites and test sites and should be consistent as much as possible for both spatial and temporal conditions. For example, a consistent seining or electroshocking technique should always be used in collecting fish over the same length of stream and with the same degree of effort using the same gear. In addition, the sampling area must be representative of the entire reach or waterbody segment. The temporal conditions to be considered include not only such factors as the length of time spent towing a trawl at a constant speed but also extend to the times of year when data are gathered.

Seasonality of life cycles and natural environmental pressures must be addressed to make legitimate evaluations. For example, the spring hatch of aquatic insects is usually avoided as a sampling period in favor of more stable community conditions later in the summer. Conversely, low nutrient availability in mid-summer may temporarily but cyclically reduce the abundance of estuarine or marine benthos. Dissolved oxygen cycles are another seasonal condition to consider as are migratory patterns of some fish and waterfowl. The entire array of temporal and spatial patterns must be accommodated to avoid inconsistent and misleading data gathering.

Processing and analysis of the collected specimens is usually based on the number and identity of taxa collected and the number of individuals per taxon. This preliminary information is the foundation of most of the subsequent analytical processes used to evaluate community composition. In the course of examining and sorting the plants or animals, notations should be made of any abnormal gross morphological or pathological conditions such as deformities, tumors or lesions. This information on disease and deformities in itself can be an important assessment variable.

Taxonomic sorting can also be the basis for functional groupings of the data, and preservation of the specimens allows for the option of additional analyses after the field season is concluded.

Table 1 is not all inclusive in the sense of a thorough biological investigation, but it does represent an initial approach to the selection of parameters for biological assessment to support the narrative criteria.

Table 1.—Indicator communities and reference sources for biological criteria.

WATERBODY	FLORA / FAUNA INDICATORS	REFERENCE STATIONS
Freshwater Streams	Fish, periphyton & macroinvertebrates, incl. insects & shellfish	Ecoregion, upstream and downstream stations
Lakes & Reservoirs	Same, also macrophytes	May need to start with trophic groups; far- and near-field transects, ecoregions*
Rivers	Same as lake & reservoirs	Upstream and downstream stations; where appropriate, far- and near-field transects, ecoregions*
Wetlands	All of above, plus emergent and terrestrial vegetation & perhaps wildlife & avian spp.	Ecoregion;* far- and near-field transects
Estuarine & near-coastal Waters	Fish, periphyton & macroinvertebrates, esp. shellfish, echinoderms, polychaetes	Far- and near-field transects; ecoregion* or physiographic province

* Where appropriate; ecoregions that are heterogeneous may need to be subdivided into cohesive subregions or these subregions aggregated where financial resources are limited or aquatic systems are large (tidal rivers, estuaries, near-coastal marine waters). Also, major basins and watersheds could be considered for "keystone indicators" for fish and shellfish.

■ **4. Quality Control.** Much of the analytical potential and strength of any conclusions reached will depend upon the precision and accuracy of sampling techniques and data handling procedures. Rigorous attention should therefore be given to the design and consistency of data gathering techniques and to the training and evaluation of field and laboratory staff. Data cataloging and record keeping procedures also must be carefully designed and strictly adhered to by all parties involved. EPA Regional Office personnel can provide advice and Agency guidance manuals on this subject; an example is the 1990 field and laboratory manual by the U.S. Environmental Protection Agency, (1990b). Similarly, many States already have excellent quality assurance procedures that can be used as a foundation for their biological criteria program.

■ **5. Analytical Procedures.** The usual approach to biological analyses is to identify the presence of impairment and establish the probability of being certain in that judgment.

For example, if there is a significant increase in the number of deformed or diseased organisms, and a significant decrease in the taxa and/or individuals and in sensitive or intolerant taxa — given that the physical habitats and collection techniques are equivalent — then the study site may be presumed to be degraded. This conclusion will have further support if the trend holds true over time; is also supported by applicable chemical or physical data; or if probable sources are identified. The apparent source or sources of perturbation should then be investigated and further specific diagnostic tests conducted to establish cause. Remedial action may then follow through regulatory or other appropriate management procedures.

■ **6. Reference Condition and Criteria for Significantly Disrupted Areas.** In regions of significantly disrupted land use such as areas of intensive agricultural or urban/suburban development, the only data base available to serve as a reference condition might be simply "the best of what is left." To establish criteria on this basis would mean an unacceptable lowering of water quality objectives and de facto acceptance of degraded conditions as the norm; or worse, as the goal of water quality management. The alternative would be to establish perhaps impossible goals to restore the water system to pristine, pre-development conditions.

A rational solution avoiding these two pitfalls is to establish the reference condition from the body of historical research for the region and the consensus opinion of a panel of qualified water resource experts. The panel, selected in consultation with EPA, should be required to establish an objective and reasonable expectation of the restorable (achievable) water resource quality for the region. The determination would become the basis of the biological criteria selected.

Consistent with State antidegradation requirements, the best existing conditions achieved since November 28, 1975 [see 40 CFR 131.3(c) and 131.12(a)(1)] must be the lowest acceptable status for interim consideration while planning, managing, and regulating to meet the higher criteria established above. In this way reasonable progress can be made to improve water quality without making unrealistic demands upon the community.

Application of Biological Criteria to State Surface Water Use Attainability Procedures

Another application of the data collected is in helping define the designated uses to be achieved by comparing all test sites relative to the benchmark of reference conditions established per designated use category. Biological criteria can be used to help define the level of protection for "aquatic life use" designated uses for surface waters. These criteria also help determine relative improvement or decline of water resource quality, and should be equated to appropriate reference site conditions as closely as possible. Determinations of attainable uses and biological conditions should be made in accordance with the requirements stipulated in Section 131.10 of the *EPA Water Quality Standards Regulations* (40 CFR 131). A hypothetical State-designated use category system might be as follows:

■ **Class A: Highest quality or Special Category State waters.** Includes those designated as unique aesthetic or habitat resources and fisheries, especially protected shellfish waters. No discharges of any kind and no significant landscape alterations are permitted in the drainage basins of these waters. Naturally occurring biological life shall be attained, maintained, and protected in all respects. (Indicator sensitive resident species might be designated to help define each class, e.g., trout, some darters, mayflies, oysters, or clams, etc.)

■ **Class B: High quality waters suitable for body contact.** Only highly treated nonimpacting discharges and land development with

well established riparian vegetative buffer zones are allowed. Naturally occurring biological life shall be protected and no degradation of the aquatic communities of these waters is allowed. (Indicator sensitive species might be suckers and darters, stoneflies, or soft-shelled clams, etc.)

- **Class C: Good quality water but affected by runoff from prevailing developed land uses.** Shore zones are protected, but buffer zones are not as extensive as Class B. Highly treated, well-diluted final effluent permitted. Existing aquatic life and community composition shall be protected and no further degradation of the aquatic communities is allowed. (Indicator sensitive species might be sunfish, caddisflies, or blue crabs, etc.)

- **Class D: Lowest quality water in State's designated use system.** Ambient water quality must be or become sufficient to support indigenous aquatic life and no further degradation of the aquatic community is allowed. Structure and function of aquatic community must be preserved, but species composition may differ from Class C waters.

Since all States have some form of designated use classification system, bioassessment procedures can be applied to each surface water type by class and the information used to help determine relative management success or failure. In concert with other measurements, bioassessments and biocriteria help determine designated use attainment under the Clean Water Act. This attainment or nonattainment in turn determines the need for or the conditions of such regulatory requirements as total maximum daily loads (TMDLs) and National Pollutant Discharge Elimination System (NPDES) permits. In addition, biological assessments based on these biological criteria can be used to help meet section 305(b) of the Clean Water Act, which requires periodic reports from the States on the status of their surface water resources. The procedure also can be used to support regulatory actions, detect previously unidentified problems, and help establish priorities for management projects (see "Additional Applications of Biological Criteria," Page 10).

Table 2 is a simplified illustration of this approach to evaluating comprehensive surface water quality conditions by each designated use to help determine and report "designated use attainment" status.

It is important to construct and calibrate each table according to consistent regional and habitat conditions.

Using quantitative parameters or metrics derived from the data base and the reference condition, standings in the tables can be established from which relative status can be defined. This material can eventually serve as the basis for numeric biological criteria.

A well-refined quantitative approach to the narrative process can be administratively appended to the States' preexisting narrative criteria to meet future needs for numeric criteria. This can be accomplished fairly easily by amending the narrative statement, as illustrated on page 3, to include a designated regulatory responsibility for the appropriately identified agency. The advantage of this approach is as changes in the supportive science evolve, the criteria can be appropriately adjusted.

Table 2.—Data display to facilitate evaluating waterbody condition and relative designated use attainment.

DESIGNATED USE	BIOLOGICAL ASSESSMENT PARAMETERS (by number)				
(per Sf. water type)	Taxa Inverts	Taxa Fish	Invertebrates Intolerants	Fish Intolerants	Diseased
Highest quality in designated use	high	high	high	high	low
Good quality in designated use					
Adequate to designated use					
Marginal for designated use					
Poor quality	low	low	low	low	high

DESIGNATED USE	PUBLIC HEALTH, CHEMICAL, PHYSICAL DATA						
(per Sf. water type)	T. Coli	E. Coli	D.O.	pH	PO4	NO3	Turb.
Highest quality in designated use	low	low	high		Usually low	Usually low	Usually low
Good quality in designated use				Vbl by region			
Adequate to designated use							
Marginal for designated use							
Poor quality	high	high	low		Usually high	Usually high	Usually high

Further, the compiling of physical and chemical data with the biological data facilitates comprehensive evaluations and aids in the investigation of causes of evident water quality declines. Having the numbers all in one place helps the water resource manager assess conditions. However, it is important to note that none of these parameters should supercede the others in management or regulations because they have unique as well as overlapping attributes. Failure of a designated site to meet any one of a State's physical, chemical, or biological criteria should be perceived as sufficient justification for corrective action.

One other note on the use of biological criteria is important. The data gathered should be comprehensively evaluated on a periodic basis. This gives the manager an opportunity to assess relative monitoring and management success, monitor the condition of the reference sites, and adjust procedures accordingly. As conditions improve, it will also be important to reassess and adjust the biological criteria. This may be particularly appropriate in the case of "significantly disrupted areas" discussed earlier.

Additional Applications of Biological Criteria

As shown in the previous illustrations, narrative biological criteria can have many applications to the management and enhancement of surface water quality.

- **Refinement and augmentation of existing waterbody monitoring procedures.** With between 200 and 500 new chemicals entering the market annually, it is impossible to develop chemical criteria that address them all. Further, synergism between even regulated chemicals meeting existing standards may create degraded conditions downstream that are identifiable only by using biological monitoring and criteria. Thus, the approach may help identify and correct problems not previously recognized.

- **Non-chemical impairments** (e.g., degradation of physical habitats, changes in hydrologic conditions, stocking, and harvesting) can be identified. Remediation of these impairments, when they are the primary factor, can be less expensive and more relevant than some point source abatements.

- **Waterbody management decisionmaking.** By reviewing an array of diverse parameters in a comprehensive manner, the decisionmaker is able to make better judgments. The strengths of this diversity can be used to determine with greater confidence the resources to assign to a given waterbody or groups of waterbodies in the allocation of scarce manpower or funds. The information can also be used to set priorities where required by law, such as section 303(d) of the Clean Water Act, or to help guide regulatory decisions.

  In conjunction with nutrient, chemical, and sediment parameters, biological information and criteria are an important tool for watershed investigations. The combined data helps the manager select areas of likely nonpoint as well as point sources of pertebation and makes it possible to focus remedial efforts on key subbasins.

- **Regulatory aspect.** Once established to the satisfaction of the State and EPA, the biocriteria process may be incorporated in the State's system of regulations as part of its surface water quality protection and management program. Biological assessment and criteria can become an important additional tool in this context as the Nation increasingly upgrades the quality of our water resources.

Perspective of the Future: Implementing Biological Criteria

This guide to narrative biological criteria was composed with the fiscal and technical constraints of all the States, Territories, and Reservations in mind. The array of scientific options available to biological assessment and criteria illustrated here is by no means exhaustive, and many jurisdictions will prefer a more involved approach. In no way is this guide intended to restrain States from implementing more detailed or rigorous programs. In fact, we welcome comments and suggestions for additional techniques and parameters to consider.

The basic approach discussed here, while compiled to be the least demanding on State budgets, equipment, and manpower pools, consists of a reliable, reproducible scientific method. The metrics considered should not be restricted to those illustrated in this guide. Rather, they should be developed from the expertise of State biologists and water resource managers — perhaps in concert with colleagues in neighboring States for a coordinated regional approach to waterbodies and natural biological regions that cross political boundaries. Good science should be applied to a realistic appraisal of what can actually be accomplished, and the EPA regional office specialists, listed on the following pages, can assist in such assessments and coordination. For more detailed discussions of sampling and analytical methods, the reader is also referred to the references appended to this text.

The structure for narrative biological criteria described here is an appropriate interim step for the eventual development of numeric biological criteria. The infrastructure developed now may be expanded and refined to meet future needs.

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———. 1991. Biological Criteria: State Development and Implementation Efforts. EPA-440/5-91-003. Office of Water, Health and Ecological Criteria Division, Washington, DC.

U.S. EPA Regional Sources of Technical Assistance

REGION 1: JFK Federal Building, Boston, MA 02203
Regional Biologist: Pete Nolan/Celeste Barr (617) 860-4343
Monitoring Coordinator: Diane Switzer (617) 860-4377
Water Quality Standards Coordinator: Eric Hall (617) 565-3533

REGION 2: 26 Federal Plaza, New York, NY 10278
Regional Biologist: Jim Kurtenbach (908) 321-6716
Monitoring Coordinator: Randy Braun (908) 321-6692
Water Quality Standards Coordinator: Felix Locicero (212) 264-5691

REGION 3: 841 Chestnut Street, Philadelphia, PA 19107
Regional Biologist: Ron Preston (304) 233-2315
Monitoring Coordinator: Chuck Kanetsky (215) 597-8176
Water Quality Standards Coordinator: Helene Drago (215) 597-9911

REGION 4: 345 Courtland Street, NE, Atlanta, GA 30365
Regional Biologist: Hoke Howard/Jerry Stober/William Peltier (706) 546-2296
Monitoring Coordinator: Larinda Tervelt (706) 347-2126
Water Quality Standards Coordinator: Fritz Wagener/Jim Harrison (706) 347-3396

REGION 5: 230 South Dearborn Street, Chicago, IL 60604
Regional Biologist: Charles Steiner (312) 353-9070
Monitoring Coordinator: Donna Williams (312) 886-6233
Water Quality Standards Coordinators: David Pfiefer (312) 353-9024
Tom Simon (312) 353-8341

REGION 6: 1445 Ross Avenue, Suite 1200, Dallas, TX 75202
Regional Biologist: Evan Hornig/Philip Crocker/Terry Hollister (214) 655-2289
Monitoring Coordinator: Charles Howell (214) 655-2289
Water Quality Standards Coordinator: Cheryl Overstreet (214) 655-7145

REGION 7: 726 Minnesota Avenue, Kansas City, KS 66101
Regional Biologist: Michael Tucker/Gary Welker (913) 551-5000
Monitoring Coordinator: John Helvig (913) 551-5002
Water Quality Standards Coordinator: Lawrence Shepard (913) 551-7441

REGION 8: 999 18th Street, Suite 500, Denver, CO 80202-2405
Regional Biologist: Loys Parrish (303) 236-5064
Monitoring Coordinator: Phil Johnson (303) 293-1581
Water Quality Standards Coordinator: Bill Wuerthele (303) 293-1586

REGION 9: 75 Hawthorne Street, San Francisco, CA 94105
Regional Biologist: Peter Husby (415) 744-1488
Monitoring Coordinator: Ed Liu (415) 744-2006
Water Quality Standards Coordinator: Phillip Woods (415) 744-1997

REGION 10: 1200 Sixth Avenue, Seattle, WA 98101
Regional Biologist: Joseph Cummins (206) 871-0748, ext. 1247
Monitoring Coordinator: Gretchen Hayslip (206) 553-1685
Water Quality Standards Coordinators: Sally Marquis (206) 553-2116
Marica Lagerloeff (206) 553-0176

HEADQUARTERS: 401 M Street SW, Biocriteria Program (WH 586), Washington, DC 20640
Program Coordinators: George Gibson (202) 260-7580
Susan Jackson (202) 260-1800

NOTE: *Address provided is the EPA Regional Office; personnel indicated may be located at satellite facilities.*

APPENDIX L

Reserved

APPENDIX M

Reserved

APPENDIX N

Integrated Risk Information System
Background Paper

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

IRIS

BACKGROUND PAPER

Integrated Risk Information System

Office of Health and Environmental Assessment

Office of Research and Development

FEBRUARY, 1993

VERSION 1.0

IRIS Background Paper

On February 25, 1993, a FEDERAL REGISTER notice (58 FR 11490) was published on the Integrated Risk Information System (IRIS). This background paper is a companion piece to that notice.

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For further information on IRIS, please contact:

IRIS User Support
(Operated by Computer Sciences Corporation)
26 W. Martin Luther King Drive (MS-190)
Cincinnati, OH 45268

Telephone (513) 569-7254 Facsimile (513) 569-7916

Introduction

This background paper provides the history, purposes, and goals of the Integrated Risk Information System (IRIS) and a detailed description of the current processes used by the two Agency scientific work groups responsible for developing the health hazard information in IRIS. This background will help interested persons to better understand the focus and contents of the companion FEDERAL REGISTER notice.

The February 25, 1993 FEDERAL REGISTER notice (58 FR 11490): (1) announces the availability of this paper that describes IRIS, its contents, and the current processes used by the two Agency work groups responsible for developing IRIS information; (2) discusses an Agency activity to review IRIS processes and solicits comments on this review; (3) highlights points in the current process where public input, including information submissions, is encouraged; (4) describes how to access IRIS; and (5) announces a new process to publish regularly a list of the substances scheduled for IRIS work group review and to solicit pertinent data, studies, and comments on these substances.

General Background

IRIS is an EPA data base, updated monthly, containing Agency consensus positions on the potential adverse human health effects of approximately 500 specific substances. It contains summaries of EPA qualitative and quantitative human health information that support two of the four major steps of the risk assessment process outlined in the National Research Council's (NRC) 1983 publication, "*Risk Assessment in the Federal Government: Managing the Process.*"

The risk assessment process described in the 1983 NRC publication consists of four major steps: hazard identification, dose-response evaluation, exposure assessment, and risk characterization. IRIS includes information in support of the first two of those steps, hazard identification and dose-response evaluation. Hazard identification is the qualitative determination of how likely it is that a substance will increase the incidence and/or severity of an adverse health effect. Dose-response evaluation is the quantitative relationship between the magnitude of the effect and the dose inducing such an effect. IRIS information supporting risk characterization consists of brief statements on the quality of data and very general statements on confidence in the dose-response evaluation. IRIS consensus information does not include exposure assessment information. Combined with specific situational exposure assessment information, the summary health hazard information in IRIS may be used as one source in evaluating potential public health risks of or from environmental contaminants.

Many EPA program offices and program support offices, including the Office of Research and Development, both at Headquarters and in EPA's ten Regional offices, are involved in assessment activities in support of various legislative mandates. In the 1980s, as health risk assessment became a more widespread practice across Agency programs, the need became clear for greater consensus and consistency in the areas of hazard identification and dose-response assessment. It was determined that an internal process should be established for reaching an Agency-wide judgment on the potential health effects of substances of common interest to these offices, and a system developed for communicating that Agency judgment to EPA risk assessors and risk managers. These would provide the needed consistency and coordination. In 1986, two EPA work groups with representation from program offices involved in risk assessment were convened to carry out such an internal process to reach consensus Agency positions on a chemical-by-chemical basis. In 1986, the IRIS data base was created for EPA staff as the official repository of that consensus information.

On June 2, 1988, a FEDERAL REGISTER notice (53 FR 20162-20164) of public availability of IRIS was published. That notice described IRIS, the types of risk information it contains, and how to get access to the system. It informed the public about the establishment of the IRIS Information Submission Desk. The submission desk was intended to provide opportunity for public input. The notice explained the procedures for submission of data or comments by interested parties on substances either on IRIS or scheduled for review by the work groups. As stated in the June 1988 notice, a list of the substances scheduled for work group review has been a separate file on IRIS since it became publicly available. It was hoped that users would submit pertinent information to the IRIS Information Submission Desk. In fact, few users have taken advantage of the opportunity to submit data and comments.

Therefore, data submission procedures are reiterated in the FEDERAL REGISTER notice (58 FR 11490) related to this paper and a list of the substances scheduled for review by specific work groups is included. The data submission procedures will be reprinted in the FEDERAL REGISTER every 6 months with a new or revised list of substances scheduled for work group review. For the latest status of the substances scheduled for review, interested persons should first check the IRIS data base itself or contact:

IRIS User Support (Operated by Computer Sciences Corporation)
U.S. EPA
26 W. Martin Luther King Drive (MS-190)
Cincinnati, OH 45268
Telephone: (513) 569-7254 Facsimile: (513) 569-7916

Data Base Contents

The core of IRIS is the three consensus health hazard information summary sections: the reference dose for noncancer health effects resulting from oral exposure, the reference concentration for noncancer health effects resulting from inhalation exposure, and the carcinogen assessment for both oral and inhalation exposure. All of these terms are commonly used for judging the effects of lifetime exposure to a given substance or mixture. Citations for the scientific methodologies that are the basis for the consensus health hazard sections on IRIS are included on page 10 of this paper.

In addition, an IRIS substance file may include supplemental information such as summaries of health advisories, regulatory actions, and physical/chemical properties.

Noncancer Health Effects Information

An oral reference dose (RfD) is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is believed likely to be without an appreciable risk of certain deleterious effects during a lifetime ("Reference Dose [RfD]; Description and Use in Health Risk Assessment" *Regulatory Toxicology and Pharmacology* 8:471-486, 1988). RfDs are developed by an assessment method that assumes that there is a dose threshold below which adverse effects will not occur. An RfD, which is expressed in milligrams per kilogram per day (mg/kg-day), is based on the determination of a critical effect from a review of all toxicity data and a judgment of the necessary uncertainty and modifying factors based on a review of available data. IRIS substance files contain the following information pertaining to the oral RfD: reference dose summary tables, principal and supporting studies, uncertainty and modifying factors used in calculating the RfD, a statement of confidence in the RfD, EPA documentation and review, EPA scientific contacts, and complete bibliographies for references cited.

The inhalation reference concentration (RfC) is analogous to the oral RfD (*Interim Methods for Development of Inhalation Concentrations*, EPA/600/8-90/066A). It is also based on the assumption that thresholds exist for noncancer toxic effects. The RfC considers toxic effects for both the respiratory system (portal-of-entry) and for effects peripheral to the respiratory system (extra-respiratory). The inhalation RfC is expressed in milligrams per cubic meter (mg/cu.m). The RfC method departs from that used to determine the oral RfD primarily by the integration of the anatomical and physiological dynamics of the respiratory system (i.e., portal-of-entry) with the physicochemical properties of the substance or substances entering the system. Different dosimetric adjustments are made according to whether the substance is a particle or gas and whether the observed toxicity is respiratory or extra-respiratory. These adjustments scale the concentration of the substance that causes an observed effect in laboratory animals (or in humans, when available from occupational epidemiology studies) to a human equivalent concentration for ambient exposures.

IRIS substance files contain the following inhalation RfC information: reference concentration summary tables, description of dosimetric adjustment, principal and supporting studies, uncertainty and modifying factors used to calculate the RfC, a statement of confidence in the RfC, EPA documentation and review, EPA scientific contacts, and complete bibliographies for references cited.

Cancer Health Effects Information

The carcinogen assessment of an IRIS substance file contains health hazard identification and dose-response assessments developed from procedures outlined in the EPA Guidelines for Carcinogen Risk Assessment (51 FR 33992-43003, September 24, 1986). Each cancer assessment, as a rule, is based on an Agency document that has received external peer review. The hazard identification involves a judgment in the form of a weight-of-evidence classification of the likelihood that the substance is a human carcinogen. It includes the type of data used as the basis of the classification. This judgment is made independently of considerations of the strength of the possible response. The dose-response assessment is a quantitative estimate of the potential activity or magnitude of a substance's carcinogenic effect, usually expressed as a cancer unit risk. A cancer unit risk is an upper-bound estimate on the increased likelihood that an individual will develop cancer when exposed to a substance over a lifetime at a concentration of either 1 microgram per liter (1 μg/L) in drinking water for oral exposure or 1 microgram per cubic meter (1 μg/cu.m) in air for continuous inhalation exposure. Generally, a slope factor for dietary use is also given. It is an upper-bound estimate of cancer risk for humans per milligram of agent per kilogram of body weight per day.

IRIS contains the following information in the cancer assessment section: EPA weight-of-evidence classification and its basis, a summary of human carcinogenicity studies when available, a summary of animal carcinogenicity studies, a summary of other data supporting the classification, oral and/or inhalation quantitative estimates, dose-response data used to derive these estimates and the method of calculation, statements of confidence in magnitude of unit risk, documentation and review, EPA scientific contacts, and complete bibliographies for references cited.

Scientific Contacts

It is important to note that in each of the three sections described above, EPA staff names and telephone numbers are included as scientific contacts for further information. The Agency believes that the inclusion of Agency scientific contacts able to discuss the basis for the Agency's position, has been very valuable. These individuals play a major role in providing public access to IRIS and a conduit for valued public comment.

Bibliographies

IRIS contains full bibliographic citations for each substance file, directing the user to the primary cited studies and pertinent scientific literature. One of the major intents of IRIS was to encourage users to evaluate the primary literature used to develop the IRIS information in light of the assumptions and uncertainties underlying the risk assessment process.

Supplementary Information

In addition to the RfD, RfC, and carcinogenicity sections, IRIS substance files may contain one or more of three supplementary information sections: a summary of an Office of Water's Drinking Water Health Advisory, a summary of EPA regulatory actions, and a summary of physical/chemical properties. The only purpose of these supplemental sections is to serve as accessory information to the consensus health hazard information. Since the primary intent of the IRIS data base is to communicate EPA consensus health hazard information, these other sections are only included as auxiliary material to provide a broader profile of a substance and are never added until at least one of the consensus health hazard sections described above (namely, the RfD section, RfC section, or carcinogenicity section) is prepared and approved for final inclusion on the data base. These supplemental sections should not be used as the sole or primary source of information on the current status of EPA substance-specific regulations.

Use and Development of Health Hazard Information

The type of substance-specific consensus health hazard information on IRIS may become part of the supporting materials used to develop site-specific EPA health hazard assessments. These assessments may in turn lead to EPA risk management decisions, generally resulting in the formal Agency rulemaking process. This rulemaking process often includes FEDERAL REGISTER publication of a proposed rule where the public is encouraged to comment. These comments may be directed at both the proposed rule and the scientific basis of the decision, including information obtained from IRIS and thus offer a further opportunity for comment on the risk information in the context of its use.

The area of human health risk assessment has evolved over the past several years. As the risk assessment community has grown and the field itself has matured, new approaches to the assessment and use of human health risk information have been developed. The evolving nature of risk assessment has also resulted in changes to IRIS. The development of methodologies such as those for the inhalation RfC determination illustrates the ability of the IRIS information development process to grow with the changing science. Areas of future growth may include less-than-lifetime risk information and developmental toxicity risk information and other endpoint-specific health hazard information. Also, on several occasions, the information in IRIS has

been reevaluated and modified to reflect new information and approaches. New studies on individual substances are continually being conducted by Federal, private, and academic institutions and may have significant impact on IRIS information. In those cases, the IRIS substance information is reevaluated in light of the new data; any changes resulting from that reevaluation are included on the system.

Management of the Data Base

The IRIS data base is managed and maintained by the Office of Health and Environmental Assessment (OHEA), Office of Research and Development (ORD). IRIS is an Agency system primarily funded by OHEA with additional significant support from EPA program offices.

Oversight

Oversight activities for IRIS are conducted by the IRIS Oversight Committee, a subgroup of the Agency's Risk Assessment Council. Committee membership consists of senior Agency risk assessors. The main purpose of the IRIS Oversight Committee is to serve as a forum for discussion and advice on significant scientific or science policy issues involving IRIS. The Council, which is chaired by EPA's Deputy Administrator, receives periodic status reports on IRIS and related work group activities.

Information Development Process

There are two EPA work groups, the Carcinogen Risk Assessment Verification Endeavor (CRAVE) and the Oral Reference Dose/Inhalation Reference Concentration (RfD/RfC) Work Group, that develop consensus health hazard information for IRIS. Each group consists of EPA scientists from a mix of pertinent disciplines and represents intra-Agency membership. The work groups serve as the Agency's final review for EPA risk assessment information. When the work groups reach consensus on the health effects information and the dose-response assessment for a particular substance, the descriptive summary is added to IRIS.

CRAVE: Information Development Procedures

The goals of the CRAVE are to reach Agency consensus on Agency carcinogen risk assessments; to arrive at a unified view on potential cancer risk from exposure to specific substances across Agency programs; and to identify, discuss, and resolve general issues associated with methods used to estimate carcinogenic risks for specific agents. The major outputs of the work group are summaries of risk

information that have been previously developed and documented by scientific experts in Agency program and program support offices, and results of discussions of general issues in carcinogen risk assessment.

Scientists are selected by executive appointment from respective member offices. Membership is open to all major Agency program and regional offices, ORD, and the Office of Policy, Planning, and Evaluation (OPPE). Substances are discussed at the request of Agency offices or regions according to an established timetable. The CRAVE priorities are determined by the member offices. The office requesting review prepares a summary describing both a judgment on the weight-of-evidence for potential health hazard effects and any dose-response information for the substances according to an established format. Literature files on the substances including critical studies, pertinent EPA documents, and other relevant supporting documentation are made available to work group members in advance of the meeting. Generally, the judgment and the dose-response assessment are expected to have appeared in a publicly available document of some sort.

The CRAVE usually meets bimonthly for two days. Work group members normally receive draft summaries for pre-meeting review at least one week prior to the scheduled meeting. At the meeting, data and documentation are examined, and there is discussion of the basis for the risk information and the methods by which it was derived. In addition, the nature and extent of previous internal and external peer review, including the comments received, are reviewed by the work group. The summary is revised by the office originating the review to reflect the meeting discussion and accurately express the consensus view of the work group. After the process of revision is completed, the summary is circulated again to the work group for final approval prior to its inclusion on IRIS.

Consensus means that no member office is aware either of information that would conflict with the final carcinogenicity summary, or of analyses that would suggest that a different view is more credible. Such assurance rests on the capabilities of the individuals who represent their offices; thus, every effort is made to seek scientists who are both expert in the area of human health assessment and who can represent their office.

Peer review has generally been part of the IRIS information development processes from the beginning of the system. In the preparation of summaries, emphasis has been placed on the use of peer-reviewed EPA assessments. These have included Office of Pesticide Programs assessments that have received both program office peer review and Science Advisory Panel review. Other EPA documentation includes assessments prepared by OHEA such as Health Assessment Documents, Health and Environmental Effects Documents, and Health Effects Assessments. These documents receive OHEA review and program office review and some receive Science Advisory Board (SAB) or other external review. Assessments developed by or for the Office of Ground Water and Drinking Water and incorporated

in either Drinking Water or Ambient Water Criteria Documents, or in Drinking Water Health Advisories generally receive extensive Agency review and SAB review prior to discussion by CRAVE.

On occasion, risk assessments that were contained in draft documents have been discussed by CRAVE. In these instances, results of the work group deliberations have been incorporated into the document development process at the program office or program support office level. Loading of the information on IRIS is delayed pending completion of the document.

If consensus is not reached at the meeting it is generally because an issue is raised that requires resolution. Work group deliberations continue until consensus is achieved. In the case of substance-specific issues, the substance is referred back to the member office that initiated the review for more information and clarification. In some instances, it has been necessary for more than one program office to engage in a dialogue to resolve the issue.

For general issues, CRAVE practice has been to form a subcommittee to prepare an issue paper that is subsequently discussed at a special meeting. As examples of this process, issue papers have been developed for (1) issues relating to accuracy and precision of quantitative dose-response information, (2) factors involving confidence in quantitative estimates, and (3) use of split classifications and combining estimates.

When consensus is not achieved on a particular substance at a meeting of the CRAVE, it is considered to have "under review" status. If after three months, there is no further activity to bring the substance back to the work group for additional review, the substance loses its "under review" status. The substance is then dropped from the work group review list after notifying the responsible office. Any office may resubmit the substance for further discussion at any time.

Reference Dose (RfD)/Reference Concentration (RfC): Information Development Procedures

The purpose of the RfD/RfC Work Group is to reach consensus on oral RfDs and inhalation RfCs for noncancer chronic human health effects developed by or in support of program offices and the regions. The work group also works to resolve inconsistent RfDs or RfCs among program offices and to identify, discuss, and resolve generic issues associated with methods used to estimate RfDs and RfCs.

Scientists are selected by executive appointment from respective member offices. Membership is open to all major Agency program and regional offices. There are two work group co-chairs. In addition, scientists from the Agency for Toxic Substances and Disease Registry and the Food and Drug Administration are invited to work group meetings as observers to assist the Agency in the information gathering process. Their

involvement fosters better communication and coordination among federal agencies regarding assessment approaches and data evaluation. Members reflect a variety of pertinent scientific disciplines including expertise in the fields of general and inhalation human toxicology.

Member offices schedule substances for discussion through the work group co-chairs for specific meetings, usually one or two months in advance. Regional requests for specific substance discussions are routed through the co-chairs, who then either schedule these substances in the usual manner or, if the region has not prepared a file, requests an appropriate office to undertake that task.

The RfD/RfC Work Group usually meets once a month for two days. Substances are discussed at the request of any Agency office or region. The requesting office generally prepares a file that consists of a summary sheet, a copy of the critical study and supporting documentation, and distributes these to work group members prior to the meeting.

Consensus generally means that no member office is aware either of information that would conflict with the RfD or RfC, or of analyses that would suggest a different value that is more credible. Such assurance rests on the capabilities of the individuals who represent their offices; thus, a large effort is conducted biannually to seek scientists who are both expert in this area of assessment and can represent their offices.

RfD or RfC summaries are not always based on existing EPA assessment documents but may be based on assessments prepared specifically for the work group. This is a fundamental difference between the usual processes of the RfD/RfC Work Group and those of CRAVE. As stated previously, the general rule has been that for a substance to be brought to the CRAVE Work Group for review there should be an existing peer-reviewed Agency health effects document. However, for RfDs there may or may not be an existing EPA document on which to base work group deliberations and in the case of RfCs, there have not, to date, been any existing peer-reviewed EPA documents. Thus, RfC deliberations are based on extensive assessment summaries prepared expressly for the work group. Therefore, when an Agency peer-reviewed document is not available, as with RfCs and some RfDs, extensive assessment summaries are included on IRIS once the work group has completed verification and reached consensus.

The work group co-chairs assure that the final summary accurately expresses the consensus view of the group at the meeting as specified in the meeting notes. Once unanimous consensus is reached, the substance-specific summary for either an RfD or RfC is prepared for inclusion on IRIS. In some cases, the work group agrees that adequate information is not available to derive an RfD or RfC. A message is then put on IRIS to that effect and the reasons for the "not verifiable" status. In most cases the message states that the health effects data for a specific substance were reviewed by the work group and determined to be inadequate for derivation of an RfD or RfC.

Conflicts that arise during a meeting regarding a given RfD or RfC generally are resolved outside the meeting by scientists from the appropriate offices, and then brought back to the work group for clarification and subsequent consensus. Conflicts that arise regarding the methods by which RfDs or RfCs are estimated, or the incorporation of new methods, are generally taken up at separately scheduled meetings of the work group, for which the sponsoring office prepares the appropriate material for review.

While, as discussed above, the RfD/RfC Work Group process is somewhat different from that of the CRAVE, they both use generally the same consensus procedures. Other procedural similarities are discussed in the following paragraphs.

On occasion, scientific issues on individual substances, methods, or on a general question cannot be resolved at the work group level. In the event that an issue is unresolvable in the work group processes, the issue is referred to the Risk Assessment Council. In some cases, the issue is brought to the IRIS Oversight Subcommittee for review and discussion, prior to consideration by the full Council. If an issue is raised to the Council, it may be referred by the Council to the Risk Assessment Forum for consultation.

Both the CRAVE and RfD/RfC Work Groups, through the IRIS Information Submission Desk, discussed in the companion FEDERAL REGISTER notice, have received comments and studies from interested parties outside of the Agency that were either pertinent to the work group's initial review or resulted in reconsideration of a particular substance assessment. Further, the work groups often contact the authors of a primary study if clarifications are necessary, and consult with outside experts on scientific issues that require expertise that is not present in the work group. Also, through professional societies and other private sector organizations, the work groups have fostered discussions and exchanges regarding new and innovative approaches to human health assessment methodologies.

Methods and Guidelines

Both Agency work groups responsible for the development of the health hazard information on IRIS use Agency scientific methods documents and EPA's risk assessment guidelines as the basis for their work. These guidelines and methodologies used to develop the RfD or RfC have been peer reviewed by the SAB.

Summaries of methods used for development of oral RfDs and carcinogenicity information on IRIS are contained in IRIS background documents that are available on the system. A paper copy of the oral RfD and CRAVE background documents, "Reference Dose (RfD); Description and Use in Health Risk Assessment" (*Regulatory Toxicology and Pharmacology* 8:471-486, 1988) and *The U.S. EPA Approach for Assessing the Risks Associated with Chronic Exposures to Carcinogens*, respectively, is also available from IRIS User Support by calling: (513) 569-7254.

The draft methods document, *Interim Methods for Development of Inhalation Concentrations* (EPA/600/8-90/066A), is the basis for the inhalation RfCs. A copy of the document is available from the Center for Environmental Research Information (CERI) by calling: (513) 569-7562. Please cite the EPA document number (EPA/600/8-90/066A) when requesting a copy. A revised RfC methodology document based on SAB peer-review comments will undergo a second SAB review and will be available later this year.

The CRAVE background document is based on EPA's 1986 Guidelines for Carcinogen Risk Assessment (51 FR 33992-34003). A copy of the EPA risk assessment guidelines (EPA/600/8-87/045) is also available by calling CERI.

Public Involvement

The section in the companion FEDERAL REGISTER notice (February 25, 1993, 58 FR 11490) on **Current Opportunities for Public Involvement in the IRIS Process** elaborates on opportunities for public input and dialogue.

APPENDIX O

Reserved

APPENDIX P

List of 126
CWA Section 307(a)
Priority Toxic Pollutants

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

126 Priority Pollutants

A. Chlorinated Benzenes
- Chlorobenzene
- 1,2-dichlorobenzene
- 1,3-dichlorobenzene
- 1,4-dichlorobenzene
- 1,2,4-trichlorobenzene
- Hexachlorobenzene

B. Chlorinated Ethanes
- Chloroethane
- 1,1-dichloroethane
- 1,2-dichloroethane
- 1,1,1-trichloroethane
- 1,1,2-trichloroethane
- 1,1,2,2-tetrachloroethane
- Hexachloroethane

C. Chlorinated Phenols
- 2-chlorophenol
- 2,4-dichlorophenol
- 2,4,6-trichlorophenol
- Parametachlorocresol (4-chloro-3-methyl phenol)

D. Other Chlorinated Organics
- Chloroform (trichloromethane)
- Carbon tetrachloride (tetrachloromethane)
- Bis(2-chloroethoxy)methane
- Bis(2-chloroethyl)ether
- 2-chloroethyl vinyl ether (mixed)
- 2-chloronaphthalene
- 3,3-dichlorobenzidine
- 1,1-dichloroethylene
- 1,2-trans-dichloroethylene
- 1,2-dichloropropane
- 1,2-dichloropropylene (1,3-dichloropropene)
- Tetrachloroethylene
- Trichloroethylene
- Vinyl chloride (chloroethylene)
- Hexachlorobutadiene
- Hexachlorocyclopentadiene
- 2,3,7,8-tetrachloro-dibenzo-p-dioxin (TCDD)

E. Haloethers
- 4-chlorophenyl phenyl ether
- 2-bromophenyl phenyl ether
- Bis(2-chloroisopropyl) ether

F. Halomethanes
- Methylene chloride (dichloromethane)
- Methyl chloride (chloromethane)

Methyl Bromide (bromomethane)
Bromoform (tribromomethane)
Dichlorobromomethane
Chlorodibromomethane

G. Nitrosamines
N-nitrosodimethylamine
N-nitrosodiphenylamine
N-nitrosodi-n-propylamine

H. Phenols (other than chlorinated)
2-nitrophenol
4-nitrophenol
2,4-dinitrophenol
4,6-dinitro-o-cresol (4,6-dinitro-2-methylphenol)
Pentachlorophenol
Phenol
2,4-dimethylphenol

I. Phthalate Esters
Bis(2-ethylhexyl)phthalate
Butyl benzyl phthalate
Di-N-butyl phthalate
Di-n-octyl phthalate
Diethyl phthalate
Dimethyl phthalate

J. Polnuclear Aromatic Hydrocarbons (PAHs)
Acenaphthene
1,2-benzanthracene (benzo(a) anthracene)
Benzo(a)pyrene (3,4-benzo-pyrene)
3,4-benzofluoranthene (benzo(b) fluoranthene)
11,12-benzofluoranthene (benzo(k) fluoranthene)
Chrysene
Acenaphthalene
Anthracene
1,12-benzoperylene (bonze(ghi) perylene)
Fluorene
Fluoranthene
Phenanthrene
1,2,5,6-bibenzanthracene (dibenzo(ah) anthracene)
Indeno (1,2,3-cd) pyrene (2,3-o-phenylene pyrene)
Pyrene

K. Pesticides and Metabolites
Aldrin
Dieldrin
Chlordane (technical mixture and metobolites)
Alpha-endosulfan
Beta-endosulfan
Endosulfan sulfate
Endrin
Endrin aldehyde
Heptachlor
Heptachlor epoxide (BHC-hexachlorocyclohexane)

Alpha-BHC
Beta-BHC
Gamma-BHC (Lindane)
Delta-BHC
Toxaphene

L. DDT and Metabolites
4,4-DDT
4,4-DDE (p,p-DDX)
4,4-DDD (p,p-TDE)

M. Polychlorinated Biphenyls (PCBs)
PCB-1242 (Arochlor 1242)
PCB-1254 (Arochlor 1254)
PCB-1221 (Arochlor 1221)
PCB-1232 (Arochlor 1232)
PCB-1248 (Arochlor 1248)
PCB-1260 (Arochlor 1260)
PCB-1016 (Arochlor 1016)

N. Other Organics
Acrolein
Acrylonitrile
Benzene
Benzidine
2,4-dinitrotoluene
2,6-dinitrotoluene
1,2-diphenylhydrazine
Ethylbenzene
Isophorone
Naphthalene
Nitrobenzene
Toluene

O. Inorganics
Antimony
Arsenic
Asbestos
Beryllium
Cadmium
Chromium
Copper
Cyanide, total
Lead
Mercury
Nickel
Selenium
Silver
Thallium
Zinc

APPENDIX Q

Wetlands and 401 Certification: Opportunities and Guidelines for States and Eligible Indian Tribes

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

United States
Environmental Protection
Agency

Office of Water
(A-104F)

April 1989

PA

Wetlands And 401 Certification

Opportunities And Guidelines For States And Eligible Indian Tribes

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

JUN 28 1989

OFFICE OF
WATER

NOTE TO THE READER

I am pleased to introduce this handbook, "Wetlands and 401 Certification," developed by EPA's Office of Wetlands Protection. This document examines the Section 401 State water quality certification process and how it applies to wetlands. We strongly encourage States to use this handbook as one reference when establishing a wetlands protection program or improving wetlands protection tools.

Protection of wetland resources has become an important national priority as evidenced by President Bush's 1990 Budget statement calling for "no net loss" of wetlands. In addition, the National Wetlands Policy Forum included a recommendation in their 1988 report which says that States should "make more aggressive use of their certification authorities under Section 401 of the Clean Water Act, to protect wetlands from chemical and other types of alterations". This handbook is intended to help States do just that.

EPA would like to work with States who wish to delve into 401 certification for wetlands. You will find EPA Regional contacts listed in Appendix A of the document. The Office of Wetlands Protection plans to provide additional technical support including guidance focused on wetland-specific water quality standards.

It is very important to begin now to address the loss and degradation of this nation's wetlands. That is why 401 certification is a perfect tool, already in place, for States just getting started. It can also help States fill some gaps in their own statutory authorities protecting wetlands. States can make great strides using their existing 401 certification authorities, while developing the capability and the complementary programs to provide more comprehensive protection for wetlands in the future.

Sincerely,

David G. Davis
Director
Office of Wetlands Protection

ENDNOTES

1. The state water quality certification process is authorized by Section 401 of the Clean Water Act, 33 U.S.C. §1341.

2. A Tribe is eligible for treatment as a State if it meets the following criteria: 1) it is federally recognized; 2) it carries out substantial government duties and powers over a Federal Indian Reservation; 3) it has appropriate regulatory authority over surface waters of the reservation; and 4) it is reasonably expected to be capable of administering the relevant Clean Water Act program. EPA is currently developing regulations to implement Section 518(e) for programs including Section 401 certification which will provide further explanation of the process tribes must go through to achieve state status. In addition, the term "state" also includes the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and the Trust Territory of the Pacific Islands.

3. The National Wetlands Policy Forum, chaired by Governor Kean of New Jersey, represents a very diverse group of perspectives concerned with policy issues to protect and manage the nation's wetland resources. The goal of the Forum was to develop sound, broadly supported recommendations to improve federal, state, and local wetlands policy. The Forum released its recommendations in a report, "Protecting America's Wetlands: An Action Agenda" which can be obtained from The Conservation Foundation, 1250 24th Street, NW, Washington, D.C. 20037.

4. 33 U.S.C. §4.1313 (c)(2)(A).

5. Section 301(b)(1)(c) of the Clean Water Act.

6. If the applicant is a federal agency, however, at least one federal court has ruled that the state's certification decision may be reviewed by the federal courts.

7. 33 C.F.R. §328.3 (Corps regulations); 40 C.F.R. §232.2(q) (EPA regulations).

8. For instance, except for wetlands designated as having unusual local importance, New York's freshwater wetlands law regulates only those wetlands over 12.4 acres in size.

9. Alaska Administrative Code, Title 6, Chapter 50.

10. Kentucky Environmental Protection Act, KRS 224.005(28).

11. Tennessee Water Quality Control Act, §69-3-103(29).

12. Massachusetts Clean Waters Act, Chapter 21, §26.

13. K.R.S. 224.005(28)(Kentucky enabling legislation defining waters of the state); 401 K.A.R. 5:029(1)(bb)(Kentucky water quality standards defining surface waters); Ohio Water Pollution Control Act, §6111.01(H)(enabling legislation defining waters of the state); Ohio Administrative Code, §3745-1-02(DDD) (water quality standards defining surface waters of the state).

14. Massachusetts Clean Waters Act, Chapter 21, §26 (enabling legislation defining waters of the state); 314 Code of Mass. Regs. 4.01(5)(water quality standards defining surface waters).

15. Ohio Administrative Code, 3745-32-01(N).

16. 40 C.F.R. §131.

17. A use attainability analysis (40 C.F.R. §131.10(g)) must show at least one of six factors in order to justify not meeting the minimum "fishable/swimmable" designated uses or to remove such a designated use. The analysis must show that attaining a use is not feasible because of: naturally occurring pollutant concentrations; natural flow conditions or water levels that cannot be made up by effluent discharges without violating state water conservation requirements; human caused pollution that cannot be remedied or that would cause more environmental damage if corrected; hydrologic modifications, if it is not feasible to restore the water to its original conditions or operate the modification to attain the use; natural non-water quality physical conditions precluding attainment of aquatic life protection uses; or controls more stringent than those required by §301(b) and §306 would result in substantial and widespread economic and social impact.

18. Questions and Answers on Antidegradation (EPA, 1985). this document is designated as Appendix A of Chapter 2 of EPA's Water Quality Standards Handbook.

19. The regulations implementing Section 404(b)(1) of the Clean Water Act are known as the "(b)(1) Guidelines" and are located at 40 C.F.R. §230.

20. 40 C.F.R. §230.1(d)

21. 40 C.F.R. §230.10(c).

22. Code of Maryland Regulations Title 10, §10.50.01.02(B)(2)(a).

23. Minnesota Rules, §7050.0170. The rule states in full:

> The waters of the state may, in a state of nature, have some characteristics or properties approaching or exceeding the limits specified in the water quality standards. The standards shall be construed as limiting the addition of pollutants of human activity to those of natural origin, where such be present, so that in total the specified limiting concentrations will not be exceeded in the waters by reason of such controllable additions. Where the background level of the natural origin is reasonably definable and normality is higher than the specified standards the natural level may be used as the standard for controlling the addition of pollutants of human activity which are comparable in nature and significance with those of natural origin. The natural background level may be used instead of the specified water quality standard as a maximum limit of the addition of pollutants, in those instances where the natural level is lower than the specified standard and reasonable justification exists for preserving the quality to that found in a state of nature.

24. No. 83-1352-I (Chancery Court, 7th Division, Davidson County, 1984)(unpublished opinion).

25. These criteria are at 401 K.A.R. 5:031, §2(4) and §4(1)(c), respectively.

26. Ohio Admin. Code, §3745-32-05.

27. Ohio Admin. Code, §3745-1-05(C).

28. Copies of Ohio's review guidelines are available from Ohio EPA, 401 Coordinator, Division of Water Quality Monitoring and Assessment, P.O. Box 1049, Columbus, Ohio 43266-0149.

29. 40 CFR §131.12.

30. 48 Fed. Reg. 51,400, 51,403 (1983)(preamble).

31. Kentucky Water Quality Standards, Title 401 K.A.R. 5:031, §7.

32. Minnesota Rules, §7050.0180, Subpart 7.

33. 314 Code of Massachusetts Regulation, §4.04(4).

34. Minnesota Rules, §7050.0180, Subpart 9.

35. H.R. Rep. No. 91-127, 91st Cong., 1st Sess. 6 (1969).

36. 115 Cong. Rec. H9030 (April 15, 1969)(House debate); 115 Cong. Rec. S28958-59 (Oct. 7, 1969)(Senate debate).

37. C.F.R. §323.2(d). However, in Reid v. Marsh, a case predating these regulations, the U.S. District Court for the Northern Corps District of Ohio ruled that "even minimal discharges of dredged material are not exempt from Section 404 review". In this district, the Corps treats all dredging projects under Section 404.

38. West Virginia Code, §47-5A-1 (emphasis added).

39. Clean Water Act, §401(a)(2).

40. 40 C.F.R. §230.10(a).

41. 40 C.F.R. §230.10(d).

42. Arnold Irrigation District v. Department of Environmental Quality, 717 Pac.Rptr.2d 1274 (Or.App. 1986).

43. Marmac Corporation v. Department of Natural Resources of the State of West Virginia, C.A. No. CA-81-1792 (Cir. Ct., Kanawha County 1982).

44. 33 U.S.C. §1313(c)(2)(A).

45. West Va. Admin. Code, §47-5A-9.3 (a).

46. Unpublished paper by Dr. Paul Hill of West Virginia's Department of Natural Resources. Prepared for EPA-sponsored December 1987 workshop on "The Role of Section 401 Certification in Wetlands Protection".

47. 33 C.F.R. §325.2(b)(ii).

48. 18 C.F.R. §4.38(e)(2).

49. 40 C.F.R. §124.53(c)(3).

50. Wisconsin Administrative Code, NR 299.04.

51. West Va. Admin. Code, §47-5A-4.3.

52. Id.

53. 40 C.F.R. §121.2. EPA's regulations implementing Section 401 were issued under the 1970 Water Pollution Control Act, (not the later Clean Water Act) and thus, may have some anomalies as a result.

54. This is a reference to Section 10 of the Rivers and Harbors Act.

55. Ohio Admin. Code, §3745-32-05.

56. See, e.g., P. Adamus, Wetland Evaluation Technique (WET), Volume II: Methodology Y-87(U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS, 1987); L. Cowardin, Classification of Wetlands and Deepwater Habitats of the United States (U.S. Fish and Wildlife Service 1979). See also Lonard and Clairain, Identification of Wetland Functions and Values, in Proceedings: National Wetlands Assessment Symposium (Chester, VT: Association of State Wetland Managers, 1986)(list of twenty five methodologies).

57. See, e.g., R. Tiner, Wetlands of the United States: Current Status and Recent Trends (U.S. Govt. Printing Office 1984)(National Wetlands Inventory). The National Wetlands Inventory has mapped approximately 45 percent of the lower forty eight states and 12 percent of Alaska. A number of regional and state reports may be obtained from the National Wetlands Inventory of the U.S. Fish and Wildlife Service in Newton Corner, MA. Region 5 maps can also be ordered from the U.S. Geological Survey's National Cartographic Information Center in Reston, VA.

58. The new joint Federal Manual for Identifying and Delineating Jurisdictional Wetlands, can be obtained from the U.S. Government Printing Office 1989).

59. See, e.g., Chesapeake Bay Critical Areas Commission, Guidance Paper No. 3, Guidelines for Protecting Non-Tidal Wetlands in the Critical Area (Maryland Department of Natural Resources, April 1987).

60. For information on the Wetlands Values Data Base contact: Data Base Administrator, U.S. Fish and Wildlife Service, National Energy Center, 2627 Redwing Road, Creekside One, Fort Collins, Colorado, 80526. Phone: (303) 226-9411.

61. For example, Florida's Section 380 process designates "Areas of Critical State Concern" which often include wetlands. Florida Statutes §380.05.

62. 40 C.F.R. §230.80 (1987).

63. 16 U.S.C. §1452(3) (1980). See also, U.S.Army Corps of Engineers, Regulatory Guidance Letter No. 10 (1986).

64. See D. Burke, Technical and Programmatic Support for 401 Certification in Maryland, (Maryland Department of Natural Resources, Water Resources Administration, December 1987)(unpublished); A. Lam, Geographic Information Systems for River Corridor and Wetland Management in River Corridor Handbook (N.Y.Department of Environmental Conservation)(J. Kusler and E. Meyers eds., 1988).

The system described by Burke is called MIPS (Map and Image Processing System) and is capable of translating a myriad of information to the scale specified by the user.

65. See, e.g., [multiple authors], "Ecological Considerations in Wetlands Treatment of Municipal Wastewaters," (Van Nostrand Reinhold Co., New York, 1985); E. Stockdale, "The Use of Wetlands for Stormwater Management and Nonpoint Pollution Control: A Review of the Literature," (Dept. of Ecology, State of Washington 1986); "Viability of Freshwater Wetlands for Urban Surface Water Management and Nonpoint Pollution: An Annotated Bibliography," prepared by The Resource Planning Section of King County, Washington Department of Planning and Community Development (July, 1986).

66. The Warren S. Henderson Wetlands Protection Act of 1984, Fla. Stat. §403.91 - 403.938, required the Florida Department of Environmental Regulation to establish specific criteria for wetlands that receive and treat domestic wastewater treated to secondary standards. The rule is at Fla. Admin. Code, §17-6.

67. Maximization of sheet flow.

68. Hydrologic loading and retention rates.

69. Id.; See also L. Schwartz, Criteria for Wastewater Discharge to Florida Wetlands, (Florida Department of Environmental Regulation)(Dec. 1987)(unpublished report).

70. Copies of the draft, "Use of Advance Identification Authorities under Section 404 of the Clean Water Act: Guidance for Regional Offices", can be obtained from the Regulatory Actitivities Division of the Office of Wetlands Protection (A-104F), EPA, 401 M Street, SW, Washington, D.C. 20460.

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I. INTRODUCTION

This handbook has been developed by EPA's Office of Wetlands Protection (OWP) to highlight the potential of the State water quality certification process for protecting wetlands, and to provide information and guidance to the States.[1] Throughout this document, the term "State" includes those Indian Tribes which qualify for treatment as States under the federal Clean Water Act (CWA) Section 518(e).[2] We encourage Tribes who are interested in expanding their protection of wetlands and other waters under this new provision of the CWA to examine water quality certification as a readily available tool to begin their programs.

One of OWP's key mandates is to broaden EPA's wetlands protection efforts in areas which complement our authority under the Clean Water Act Section 404 regulatory program. Thus, we are exploring and working with other laws, regulations, and nonregulatory approaches to enhance their implementation to protect wetlands. In addition, the National Wetlands Policy Forum has recommended in its report issued in November 1988, that States "make more aggressive use of their certification authorities under Section 401 of the CWA, to protect their wetlands from chemical and other types of alterations."[3]

In light of these directives, we have examined the role of the Section 401 State water quality certification process and are working with States to improve its application to wetlands. This process offers the opportunity to fulfill many goals for wetland protection because:

* **It is a cooperative federal/State program and it increases the role of States in decisions regarding the protection of natural resources;**

* **It gives States extremely broad authority to review proposed activities in and/or affecting State waters (including wetlands) and, in effect, to deny or place conditions on federal permits or licenses that authorize such activities;**

* **It is an existing program which can be vastly improved to protect wetlands without major legislative initiatives;**

* **Its proper implementation for wetlands should integrate many State programs related to wetlands, water quality, and aquatic resource preservation and enhancement, to ensure consistency of activities with these State requirements. Examples of such programs include coastal zone management, floodplain management, and nonpoint source programs.**

The issues discussed in this handbook were identified through discussions with State 401 certification program personnel and through a workshop held in December 1987 with many of the States who actively apply 401 certification to wetlands. The handbook includes examples of how some States have successfully approached the issues discussed. Because the water quality certification process is continually evolving, we do not attempt to address all the issues here. This handbook is a first step towards clarifying how 401 certification applies to wetlands, and helping States use this tool more effectively.

EPA would like to work with the States to ensure that their authority under Section 401 is exercised in a manner that achieves the goals of the Clean Water Act and reflects the State role at the forefront in administering water quality programs. Clearly, the integrity of waters of the U.S. cannot be protected by an exclusive focus on wastewater effluents in open waters. While the federal Section 404 program addresses many discharges into wetlands, and other federal agencies have environmental review programs which benefit wetlands, these do not substitute for a State's responsibilities under Section 401. A State's authority under Section 401 includes consideration of a broad range of chemical, physical, and biological impacts. The State's responsibility includes acting upon the recognition that wetlands are critical components of healthy, functioning aquatic systems.

To help States implement the guidance provided in this handbook and to foster communication on 401 issues, you will find a list of State 401 certification contacts and federal EPA contacts in Appendix A. In order to keep this and other wetland contact lists current, EPA has asked the Council of State Governments to establish a computerized database of State wetland programs and contacts (See Appendix A for details.) EPA is also refining a list of Tribal contacts to foster communication with interested Tribes.

SUMMARY OF ACTIONS NEEDED

The following is a summary of the activities needed to make 401 certification a more effective tool to protect wetlands. States can undertake many of these activities right away, while also taking other actions which lay the groundwork for improving future 401 certification decisions. Tribes, who primarily are just beginning to develop wetlands programs, should consider these actions (along with developing water quality standards) as first steps to becoming more involved in wetlands regulatory efforts. The actions below are discussed throughout the handbook.

- **All states should begin by including wetlands in their definitions of state waters.**
- **States should develop or modify their existing 401 certification and water quality standard regulations and guidelines to accomodate special wetland considerations.**
- **States should make more effective use of their existing narrative water quality standards (including the antidegradation policy) to protect the integrity of wetlands.**
- **States should initiate or improve upon existing inventories of their wetland resources.**
- **States should designate uses for these wetlands based on wetland functions associated with each wetland type. Such estimated uses could be verified when needed for individual applications with an assessment tool such as the Wetlands Evaluation Technique, or Habitat Evaluation Procedure, or region-specific evaluation methods.**
- **States should tap into the potential of the outstanding resource waters designation of the antidegradation policy for their wetlands.**
- **States should incorporate 401 certification for wetlands into their water quality management planning process. This process can integrate wetland resource information with different water management programs affecting wetlands (including coastal zone management, nonpoint source and wastewater programs).**

II. WHAT IS WATER QUALITY CERTIFICATION AND HOW DOES IT WORK?

States may grant or deny "certification" for a federally permitted or licensed activity that may result in a discharge to the waters of the United States, if it is the State where the discharge will originate. The decision to grant or deny certification is based on a State's determination from data submitted by an applicant (and any other information available to the State) whether the proposed activity will comply with the requirements of certain sections of the Clean Water Act enumerated in Section 401(a)(1). These requirements address effluent limitations for conventional and nonconventional pollutants, water quality standards, new source performance standards, and toxic pollutants (Sections 301, 302, 303, 306 and 307). Also included are requirements of State law or regulation more stringent than those sections or their federal implementing regulations.

States adopt surface water quality standards pursuant to Section 303 of the Clean Water Act and have broad authority to base those standards on the waters' use and value for "public water supplies, propagation of fish and wildlife, recreational purposes, and . . . other purposes."[4] All permits must include effluent limitations at least as stringent as needed to maintain established beneficial uses and to attain the quality of water designated by States for their waters.[5] Thus, the States' water quality standards are a critical concern of the 401 certification process.

If a State grants water quality certification to an applicant for a federal license or permit, it is in effect saying that the proposed activity will comply with State water quality standards (and the other CWA and State law provisions enumerated above). The State may thus deny certification because the applicant has not demonstrated that the project will comply with those requirements. Or it may place whatever limitations or conditions on the certification it determines are necessary to assure compliance with those provisions, and with any other "appropriate" requirements of State law.

If a State denies certification, the federal permitting or licensing agency is prohibited from issuing a permit or license. While the procedure varies from State to State, a State's decision to grant or deny certification is ordinarily subject to an administrative appeal, with review in the State courts designated for appeals of agency decisions. Court review is typically limited to the question of whether the State agency's decision is supported by the record and is not arbitrary or capricious. The courts generally presume regularity in agency procedures and defer to agency expertise in their review.[6]

States may also waive water quality certification, either affirmatively or involuntarily. Under Section 401(a)(1), if the State fails to act on a certification request

"within a reasonable time (which shall not exceed one year)" after the receipt of an application, it forfeits its authority to grant conditionally or to deny certification.

The most important regulatory tools for the implementation of 401 certification are the States' water quality standards regulations and their 401 certification implementing regulations and guidelines. While all of the States have some form of water quality standards, not all States have standards which can be easily applied to wetlands. Most Tribes do not yet have water quality standards, and developing them would be a first step prior to having the authority to conduct water quality certification. Also, many States have not adopted regulations implementing their authority to grant, deny and condition water quality certification. The remainder of this handbook discusses specific approaches, and elements of water quality standards and 401 certification regulations that OWP views as effective to implement the States' water quality certification authority, both generally, and specifically with regard to wetlands.

III. 401 CERTIFICATION CAN BE A POWERFUL TOOL TO PROTECT WETLANDS

In States without a wetlands regulatory program, the water quality certification process may be the only way in which a State can exert any direct control over projects in or affecting wetlands. It is thus critical for these States to develop a program that fully includes wetlands in their water quality certification process.

But even in States which have their own wetlands regulatory programs, the water quality certification process can be an extremely valuable tool to protect wetlands. First, most State wetland regulatory laws are more limited in the wetlands that are subject to regulation than is the Clean Water Act. The Clean Water Act covers all interstate wetlands; wetlands adjacent to other regulated waters; and all other wetlands, the use, degradation or destruction of which could affect interstate or foreign commerce.[7] This definition is extremely broad and one would be hard pressed to find a wetland for which it could be shown that its use or destruction clearly would not affect interstate commerce. Federal jurisdiction extends beyond that of States which regulate only coastal and/or shoreline wetlands, for instance. And in States that regulate inland wetlands, often size limitations prevent States from regulating wetlands that are subject to federal jurisdiction.[8]

Even if State jurisdiction is as encompassing or more so than federal jurisdiction, however, water quality certification may still be a valuable and essential wetlands protection device. In the State of Massachusetts, for instance, a 401 certification is not simply "rubber stamped" on the permitting decisions made pursuant to the Massachusetts Wetlands Protection Act. The State has denied certification to proposed projects requiring a federal permit even though the State wetlands permitting authority

(in Massachusetts, permits are granted by local "conservation commissions") has granted authorization for a project.

There may be a number of reasons that a proposed activity may receive authorization under a State wetland regulatory program, but fail to pass muster under a 401 certification review. The most commonly cited reason, however, is that water quality personnel have a specialized understanding of the requirements and implementation of the State's water quality standards and the ways in which certain activities may interfere with their attainment.

It is important, however, to keep in mind the limitations of 401 certification when considering a comprehensive approach to protecting your wetland resources. The primary limitation is that if 401 certification is the only tool a State has to protect wetlands, it cannot place limits on activities which do not require a federal license or permit. Some activities such as drainage or groundwater pumping, can have severe impacts on the viability of wetlands, but may not require a permit or license. Ideally, 401 certification should be combined with other programs in the State offering wetlands protection opportunities (such as coastal management and floodplain management). For example, Alaska has integrated its 401 certification and coastal management consistency review processes so that the provisions of each program augment the other to provide more comprehensive protection. This approach not only strengthens protection, it reduces duplication of State efforts and coordinates permit review for applicants.[9]

IV. THE ROLE OF WATER QUALITY STANDARDS IN THE CERTIFICATION PROCESS

A. Wetlands Should be Specifically Designated as Surface Waters of the States

In order to bring wetlands fully into the State water quality certification process, a first step is to include the term "wetlands" in the State water quality standards' definition of surface waters. EPA will be working with all States through the triennial review process of State standards to ensure that their definitions are at least as comprehensive as the federal definitions for waters (see Appendix B for federal definitions of "Waters of the U.S." and the term "wetlands").

It may seem minor, but from every standpoint, it is important to have wetlands specifically designated as surface waters in State water quality standards. First, it precludes any arguments that somehow wetlands are not covered by water quality standards. Second, it predisposes decision makers (from 401 certification program managers, to the head of the agency or a water quality board, all the way to the judges

on the courts that may review these decisions) to consider the importance of wetlands as part of the aquatic ecosystem. Third, it makes it clear that wetlands are to be treated as waters in and of themselves for purposes of compliance with water quality standards and not just as they relate to other surface waters.

The third point is critical and bears further explanation. When States include wetlands in the definition of surface waters covered by their water quality standards, they clarify that activities in or affecting wetlands are subject to the same analysis in the certification decision as are projects affecting lakes, rivers, or streams. This is not to say that a wetland project's effects on adjacent or downstream waters are not also part of the water quality certification analysis. Rather, it is to say that wetlands, either adjacent to or isolated from other waters, are waterbodies in and of themselves and an applicant for water quality certification must show that a proposed project will not violate water quality standards in those wetlands, as well as in other waters.

The States currently have a variety of definitions of "waters of the State" in the legislation that enables water quality standards (e.g., multi-media environmental protection acts, water quality acts, and the like). Only three States currently have the term "wetlands" explicitly listed as one of the types of waters in this enabling legislation (Nebraska, Rhode Island, West Virginia). These States need only to repeat that definition in their water quality standards and their 401 certification implementing regulations.

While most States do not have the term "wetlands" in their enabling legislation, many use the term "marshes" in a list of different types of waters to illustrate "waters of the State" in their enabling legislation. Kentucky, for example, defines waters of the State as:

> *. . . any and all rivers, streams, creeks, lakes, ponds, impounding reservoirs, springs, wells, marshes, and all other bodies of surface or underground water, natural or artificial, situated wholly or partly within or bordering upon the Commonwealth or within its jurisdiction.*[10]

When used in this way, the term "marshes" is typically understood to be generic in nature rather than being descriptive of a type of wetland, and can therefore be considered as the equivalent of the term "wetlands". In these States, however, in order to ensure that the term "marshes" is interpreted as the equivalent of wetlands, the best approach is to include the term "wetlands" in the definition of surface waters used in the State's water quality standards and in the 401 certification implementing regulations.

There is another group of States that has neither the term "wetlands" or "marshes" in the enabling legislation's definition of waters of the State. These definitions typically contain language that describes in some generic manner, however,

all waters that exist in the State. They may not specifically designate any particular type of water body, as, for instance, Tennessee's Water Quality Control Act:

> *. . . any and all water, public or private, on or beneath the surface of the ground, which [is] contained within, flow[s] through, or border[s] upon Tennessee or any portion thereof . . . .*[11]

Or they may specify some types of surface waters and then generically include all others with a clause such as "and all other water bodies" or "without limitation", as does Massachusetts:

> *All waters within the jurisdiction of the Commonwealth, including, without limitation, rivers, streams, lakes, ponds, springs, impoundments, estuaries, and coastal waters and groundwaters.*[12]

In these States, as in the States with "marshes" in the enabling legislation's definition of waters, regulators should clarify that wetlands are part of the surface waters of the State subject to the States' water quality standards by including that term, and any others they deem appropriate, in a definition of surface waters in their water quality standards and in their 401 certification implementing regulations.

Both Kentucky and Ohio, for instance, which have the term "marshes," but not the term "wetlands" in their enabling legislation, have included the term "wetlands" in their surface water quality standards' definition of waters.[13] Massachusetts, which does not have the term "wetlands" or "marshes" in its enabling legislation, has put the term "wetlands" into its water quality standards also.[14] Additionally, Ohio's 401 certification implementing regulations include the term "wetlands" in the definition of waters covered by those regulations and specifically address activities affecting the integrity of wetlands.[15]

B. General Requirements of EPA's Water Quality Standards Regulations.[16]

When the States review their water quality standards for applicability to projects affecting wetlands, it is important to have in mind the basic concepts and requirements of water quality standards generally. Congress has given the States broad authority to adopt water quality standards, directing only that the States designate water uses that protect the public health and welfare and that take into account use of State waters for drinking water, the propagation of fish and wildlife, recreation, and agricultural, industrial and other purposes.

EPA's water quality standards regulations require States to adopt water quality standards which have three basic components: use designations, criteria to protect those uses, and an antidegradation policy.

EPA directs that, where attainable, designated uses must include, at a minimum, uses necessary to protect the goals of the CWA for the protection and propagation of fish, shellfish, and wildlife and provide for recreation in and on the waters. This baseline is commonly referred to as the "fishable/swimmable" designation. If the State does not designate these minimum uses, or wishes to remove such a designated use, it must justify it through a use attainability analysis based on at least one of six factors.[17] In no event, however, may a beneficial existing use (any use which is actually attained in the water body on or after November 28, 1975) be removed from a water body or segment.

Criteria, either pollutant-specific numerical criteria or narrative criteria, must protect the designated and existing uses. Many of the existing numeric criteria are not specifically adapted to the characteristics of wetlands (see last section of handbook for steps in this direction). However, almost all States have some form of the narrative standards (commonly known as the "free froms") which say that all waters shall be free from substances that: settle to form objectionable deposits; float as debris, scum, oil or other matter to form nuisances; produce objectionable color, odor, taste, or turbidity; injure, or are toxic,or produce adverse physiological responses in humans, animals, or plants; or produce undesirable or nuisance aquatic life. States have also used other narrative criteria to protect wetland quality. The use of criteria to protect wetlands is discussed in the following section.

In addition, EPA also requires that all States adopt an antidegradation policy. Several States have used their antidegradation policy effectively to protect the quality of their wetland resources. At a minimum, a State's antidegradation policy must be consistent with the following provisions:

(1) **Existing uses and the level of water quality necessary to protect existing uses in all segments of a water body must be maintained;**

(2) **if the quality of the water is higher than that necessary to support propagation of fish, shellfish, and wildlife, and recreation in and on the water, that quality shall be maintained and protected, unless the State finds that lowering the water quality is justified by overriding economic or social needs determined after full public involvement. In no event, however, may water quality fall below that necessary to protect the existing beneficial uses;**

(3) **if the waters have been designated as outstanding resource waters (ORWs) no degradation (except temporary) of water quality is allowed.**

In the case of wetland fills, however, EPA allows a slightly different interpretation of the antidegradation policy.[18] Because on the federal level, the Congress has anticipated the issuance of at least some permits by virtue of Section 404, it is EPA's policy that, except in the case of ORWs, the "existing use" requirements of the antidegradation policy are met if the wetland fill does not cause or contribute to "significant degradation" of the aquatic environment as defined by Section 230.10(c) of the Section 404(b)(1) Guidelines.[19]

These Guidelines lay a substantial foundation for protecting wetlands and other special aquatic sites from degradation or destruction. The purpose section of the Guidelines states that:

". . . from a national perspective, the degradation or destruction of special aquatic sites, such as filling operations in wetlands, is considered to be among the most severe environmental impacts covered by these Guidelines. The guiding principal should be that degradation or destruction of special sites may represent an irreversible loss of valuable aquatic resources."[20]

The Guidelines also 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."[21]

The Guidelines may be used by the 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 more stringent requirements than federal law requires for their water quality standards in general.

C. Applying Water Quality Standards Regulations to Wetlands - What States are Doing Now

Some States have taken the lead in using 401 certification as a wetlands protection tool to protect them for their water quality and other irreplaceable functions, such as storage places for flood waters, erosion control, foodchain support and habitat

for a wide variety of plants and animals. These States have taken several different approaches to wetlands protection in their water quality certification process.

1. Using Narrative Criteria

States have applied a variety of narrative criteria to projects in or affecting wetlands in the 401 certification determination. For example, Maryland's water quality standards contain a narrative directive, which the agency relied upon to deny certification for a non-tidal wetland fill. The standard provides that "[a]ll waters of this State shall be protected for the basic uses of water contact recreation, fish, other aquatic life, wildlife, and water supply."[22] In its denial, Maryland stated:

> *Storm waters are relieved of much of their sediment loads via overbanking into the adjacent wetland and a resultant decrease in nutrient and sediment loading to downstream receiving waters is occurring. To permit the fill of this area would eliminate these benefits and in the future, would leave the waterway susceptible to adverse increased volumes of storm waters and their associated pollutants. It is our determination that [a specified waterway] . . . requires protection of these wetland areas to assure that the waters of this State are protected for the basic uses of fish, other aquatic life, wildlife and water supply.*

Because wetlands vary tremendously in background levels of certain parameters measured by the traditional numerical/chemical criteria applied to surface waters, some States have relied on "natural water quality" criteria to protect wetlands in the 401 certification process. Minnesota, for instance, has taken this approach in denying certification for a flood control project because of the State's "primary concern . . . that the project would likely change Little Diann Lake from an acid bog to a fresh-circumneutral water chemistry type of wetland." The agency was concerned that "introduction of lake water into the closed acid system of Little Diann Lake would completely destroy the character of this natural resource." It relied on a provision of its water quality standards allowing the State to limit the addition of pollutants according to background levels instead of to the levels specified by criteria for that class of waters generally. The denial letter pointed out that this rule "States that the natural background level may be used instead of the specified water quality standards, where reasonable justification exists for preserving the quality found in the State of nature." According to the denial letter, because of the clear potential for impacts to the bog, the State was invoking that particular provision.[23]

Tennessee has relied on broad prohibitory language in its water quality standards to deny water quality certification for wetland fill projects and has been upheld in court. Hollis v. Tennessee Water Quality Control Board[24] was brought by a 401 certification

applicant who proposed to place fill along the southeastern shoreline of a natural swamp lake. The court upheld the denial of 401 certification, explaining:

> *Reelfoot Lake is classified for fish and aquatic life, recreation, and livestock watering and wildlife uses. The [Water Quality] Board has established various standards for the waters in each classification. Among other things, these standards pertain to dissolved oxygen, pH, temperature, toxic substances, and other pollutants. The Permit Hearing Panel found the petitioner's activity will violate the "other pollutants" standard in each classification. Collectively, these ["other pollutants"] standards provide that other pollutants shall not be added to the water that will be detrimental to fish or aquatic life, to recreation, and to livestock watering and wildlife.*

The court found that while there was no evidence that the project in and of itself would "kill" Reelfoot Lake, there was evidence that the shoreline was important to recreation because tourists visit Reelfoot to view its natural beauty and the lacustrine wetlands function as a spawning ground for fish and produce food for both fish and wildlife. It found that although the evidence in the record did not quantify the damage to fish and aquatic life, recreation, and wildlife that would result from the proposed fill, the opinion of the State's expert that the activity would be detrimental to these uses was sufficient to uphold the denial of certification.

Kentucky has also relied on narrative criteria. It denied an application to place spoil from underground mine construction in a wetland area because wetlands are protected from pollution as "Waters of the Commonwealth" and because placing spoil or any fill material (pollutants under KRS 224.005(28)) in a wetland specifically violated at least two water quality criteria. One of Kentucky's criteria, applicable to all surface waters, provides that the waters "*shall not be aesthetically or otherwise degraded by substances that . . . [i]njure, [are] toxic to or produce adverse physiological or behavioral responses in humans, animals, fish and other aquatic life.*"

The other criterion, applicable to warm water aquatic habitat, provides that "*[f]low shall not be altered to a degree which will adversely affect the aquatic community.*"[25] This second criterion which addresses hydrological changes is a particularly important but often overlooked component to include in water quality standards to help maintain wetland quality. Changes in flow can severely alter the plant and animal species composition of a wetland, and destroy the entire wetland system if the change is great enough.

Ohio has adopted 401 certification regulations applicable to wetlands (and other waters) that, together with internal review guidelines, result in an approach to the 401 certification decision similar to that of the 404(b)(1) Guidelines. Its 401 certification regulations first direct that no certification may be issued unless the applicant has

demonstrated that activities permitted by Section 404 or by Section 10 of the Rivers and Harbors Act (RHA) will not:

> *(1) prevent or interfere with the attainment or maintenance of applicable water quality standards;*
>
> *(2) result in a violation of Sections 301, 302, 303, 306 or 307 of the CWA; additionally, the agency may deny a request notwithstanding the applicant's demonstration of the above if it concludes that the activity "will result in adverse long or short term impacts on water quality."*[26]

Ohio has placed all of its wetlands as a class in the category of "State resource waters." For these waters, Ohio has proposed amendments to its standards to say that "[p]resent ambient water quality and uses shall be maintained and protected without exception." [27] The proposed standards also require that point source discharges to State resource waters be regulated according to Ohio's biological criteria for aquatic life.

However, Ohio has not yet developed biological indices specifically for wetlands. Thus, for projects affecting wetlands, it bases its certification decisions on internal review guidelines that are similar to the federal Section 404(b)(1) Guidelines. Ohio's guidelines are structured by type of activity. For instance, for fills, their requirements are as follows:

> *(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 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.*

Ohio's internal review guidelines also call for (1) an historical overview and ecological evaluation of the site (including biota inventory and existing bioaccumulation studies); (2) a sediment physical characterization (to predict contaminant levels) and (3) a sediment analysis.[28]

Using these guidelines, Ohio frequently conditions or denies certification for projects that eliminate wetland uses. For instance, Ohio has issued a proposed denial of an application to fill a three acre wetland area adjacent to Lake Erie for a

recreational and picnic area for a lakefront marina based on its classification of wetlands as "State resource waters:"

> *Wetlands serve a vital ecological function including food chain production, provision of spawning, nursery and resting habitats for various aquatic species, natural filtration of surface water runoff, ground water recharge, and erosion and flood abatement. The O.A.C. Section 3745-1-05(C) includes wetlands [in the] State Resource Waters category and allows no further water quality degradation which would interfere with or become injurious to the existing uses. The addition of fill material to the wetland would cause severe adverse effects to the wetland. This fill would eliminate valuable wetland habitat, thereby degrading the existing use.*

The justification for this denial, according to Ohio program managers, was not only that the project would interfere with existing uses, but in addition, the project was not water dependent as called for in Ohio's internal guidelines. Ohio 401 certification program personnel note that these review guidelines present the general approach to certification, but with regard to projects that are determined to be of public necessity, this approach may give way to other public interest concerns. For example, a highway is not water dependent per se; if, however, safety and financial considerations point to a certain route that necessitates filling wetlands, the agency may allow it. In that event, however, mitigation by wetland creation and/or restoration would be sought by the agency as a condition of certification.

2. Highest Tier of Protection: Wetlands as Outstanding Resource Waters

One extremely promising approach taken by some of the States has been to designate wetlands as outstanding resource waters (ORW), in which water quality must be maintained and protected according to EPA's regulations on antidegradation (i.e., no degradation for any purposes is allowed, except for short term changes which have no long term consequences).[29] This approach provides wetlands with significant protection if the States' antidegradation policies are at least as protective as that of EPA. EPA designed this classification not only for the highest quality waters, but also for water bodies which are "important, unique, or sensitive ecologically, but whose water quality as measured by the traditional parameters (dissolved oxygen, pH, etc.) may not be particularly high or whose character cannot be adequately described by these parameters."[30] This description is particularly apt for many wetland systems.

The designation of wetlands as outstanding resource waters has occurred in different ways in different States. Minnesota, for instance, has designated some of its rare, calcareous fens as ORWs and intends to deny fills in these fens.

Ohio has issued for comment, proposed revised water quality standards that include a newly created "outstanding State resource waters" category. Ohio intends to prohibit all point source discharges to these waters. Of fourteen specific water bodies proposed to be included in this category by the Ohio EPA at this time, ten are wetlands: four fens; three bogs; and three marshes.

Because the designation of wetlands as ORWs is such an appropriate classification for many wetland systems, it would behoove the States to adopt regulations which maximize the ability of State agencies and citizens to have wetlands and other waters placed in this category. The State of Kentucky has set out procedures for the designation of these waters in its water quality standards. Certain categories of waters automatically included as ORWs are: waters designated under the Kentucky Wild Rivers Act or the Federal Wild and Scenic Rivers Act; waters within a formally dedicated nature preserve or published in the registry of natural areas and concurred upon by the cabinet; and waters that support federally recognized endangered or threatened species. In addition, Kentucky's water quality standards include a provision allowing anyone to propose waters for the ORW classification.[31]

Minnesota has a section in its water quality standards that could be called an "emergency" provision for the designation of outstanding resource waters. Normally it is necessary under Minnesota's water quality standards for the agency to provide an opportunity for a hearing before identifying and establishing outstanding resource waters and before prohibiting or restricting any discharges to those waters. The "emergency" provision allows the agency to prohibit new or expanded discharges for unlisted waters *"to the extent . . . necessary to preserve the existing high quality, or to preserve the wilderness, scientific, recreational, or other special characteristics that make the water an outstanding resource value water."*[32] This provision allows the agency to protect the waterbody while completing the listing process which could take several years.

Moreover, some States have improved on the formulation of the ORW classification by spelling out the protection provided by that designation more specifically than do EPA's regulations. For instance, Massachusetts' water quality standards state that for "National Resource Waters:"

> *Waters so designated may not be degraded and are not subject to a variance procedure. New discharges of pollutants to such waters are prohibited. Existing discharges shall be eliminated unless the discharger is able to demonstrate that: (a) Alternative means of disposal are not reasonably available or feasible; and (b) The discharge will not affect the quality of the water as a national resource.*[33]

This provision explicitly outlines how the State intends to maintain and protect the water quality of ORWs. Another provision which Minnesota uses to control discharges to waters that flow into ORWs for their effect on ORWs is that:

> *The agency shall require new or expanded discharges that flow into outstanding resource value waters [to] be controlled so as to assure no deterioration in the quality of the downstream outstanding resource value water.*[34]

V. USING 401 CERTIFICATION

A. The Permits/Licenses Covered and the Scope of Review

The language of Section 401(a)(1) is written very broadly with respect to the activities it covers. "[A]ny activity, including, but not limited to, the construction or operation of facilities, which may result in any discharge" requires water quality certification.

When the Congress first enacted the water quality certification provision in 1970, it spoke of the "wide variety of licenses and permits . . . issued by various Federal agencies," which "involve activities or operations potentially affecting water quality."[35] The purpose of the water quality certification requirement, the Congress said, was to ensure that no license or permit would be issued "for an activity that through inadequate planning or otherwise could in fact become a source of pollution."[36]

1. Federal Permits/Licenses Subject to Certification

The first consideration is which federal permits or licenses are subject to 401 certification. OWP has identified five federal permits and/or licenses which authorize activities which may result in a discharge to the waters. **These are: permits for point source discharges under Section 402 and discharges of dredged and fill material under Section 404 of the Clean Water Act; permits for activities in navigable waters which may affect navigation under Sections 9 and 10 of the Rivers and Harbors Act (RHA); and licenses required for hydroelectric projects issued under the Federal Power Act.**

There are likely other federal permits and licenses, such as permits for activities on public lands, and Nuclear Regulatory Commission licenses, which may result in a discharge and thus require 401 certification. Each State should work with EPA and the federal agencies active in its State to determine whether 401 certification is in fact applicable.

Indeed, it is not always clear when 401 certification should apply. For instance, there remains some confusion under Sections 9 and 10 of RHA concerning which projects may involve or result in a discharge, and thus require State certification. In many cases there is an overlap between Section 404 CWA and Sections 9 and 10 RHA. Where these permits overlap, 401 certification always applies. Under the Section 404 regulations, the question of whether dredging involves a discharge and is therefore subject to Section 404, depends on whether there is more than "de minimis, incidental soil movement occurring during normal dredging operations".[37]

Where only a Section 9 or 10 permit is required, 401 certification would apply if the activity may lead to a discharge. For example, in the case of pilings, which the Corps sometimes considers subject to Section 10 only, a 401 certification would be required for the Section 10 permit if structures on top of the pilings may result in a discharge.

States should notify the regional office of federal permitting or licensing agencies of their authority to review these permits and licenses (e.g., the Corps of Engineers for Section 404 in nonauthorized States, and Sections 9 and 10 of the RHA; EPA for Section 402 permits in nonauthorized States; and the Federal Energy Regulatory Commission (FERC) for hydropower licenses). In their 401 certification implementing regulations, States should also give notice to applicants for these particular federal permits and licenses, and for all other permits and licenses that may result in a discharge to waters of the State, of their obligation to obtain 401 certification from the State.

West Virginia's 401 certification implementing regulations, for instance, state that:

> *1.1. Scope. . . . Section 401 of the Clean Water Act requires that any applicant for a federal license or permit to conduct an activity which will or may discharge into waters of the United States (as defined in the Clean Water Act) must present the federal authority with a certification from the appropriate State agency. Federal permits and licenses issued by the federal government requiring certification include permits issued by the United States Army Corps of Engineers under Section 404 of the Clean Water Act, 33 U.S.C. 1344 and licenses issued by the Federal Energy Regulatory Commission under the Federal Power Act, 16 U.S.C. 1791 et seq.*[38]

Because West Virginia has been authorized to administer the NPDES permitting program under Section 402 of the Clean Water Act, applicants for NPDES permits do not have to apply for water quality certification separately. In addition, West Virginia has not specifically designated Rivers and Harbors Act permits in the above regulation. However, because the regulation States that such permits or licenses include Section

404 and FERC licenses, those and all other permits not specifically designated but which may result in a discharge to the waters would be covered by the regulation's language. The better approach would be to enumerate all such licenses and permits that are known to the State and include a phrase for all others generically.

2. Scope of Review Under Section 401

An additional issue is the scope of the States' review under Section 401. Congress intended for the States to use the water quality certification process to ensure that no federal license or permits would be issued that would violate State standards or become a source of pollution in the future. Also, because the States' certification of a construction permit or license also operates as certification for an operating permit (except for in certain instances specified in Section 401(a)(3)), it is imperative for a State review to consider all potential water quality impacts of the project, both direct and indirect, over the life of the project.

A second component of the scope of the review is when an activity requiring 401 certification in one State (i.e. the State in which the discharge originates) will have an impact on the water quality of another State.[39] The statute provides that after receiving notice of application from a federal permitting or licensing agency, EPA will notify any States whose water quality may be affected. Such States have the right to submit their objections and request a hearing. EPA may also submit its evaluation and recommendations. If the use of conditions cannot insure compliance with the affected State's water quality requirements, the federal permitting or licensing agency shall not issue such permit or license.

The following example of 401 certification denial by the Pennsylvania Department of Environmental Resources (DER) for a proposed FERC hydroelectric project illustrates the breadth of the scope of review under Section 401 (see Appendix C for full description of project and impacts addressed). The City of Harrisburg, Pennsylvania proposed to construct a hydroelectric power project on the Susquehanna River. The Pennsylvania DER considered a full range of potential impacts on the aquatic system in its review. The impacts included those on State waters located at the dam site, as well as those downstream and upstream from the site. The impacts considered were not just from the discharge initiating the certification review, but water quality impacts from the entire project. Thus, potential impacts such as flooding, changes in dissolved oxygen, loss of wetlands, and changes in groundwater, both from construction and future operation of the project, were all considered in the State's decision.

The concerns expressed by the Pennsylvania Department of Environmental Resources are not necessarily all those that a State should consider in a dam

certification review; each project will have its own specific impacts and potential water quality problems. The point of the illustration is to show that **all of the potential effects of a proposed activity on water quality -- direct and indirect, short and long term, upstream and downstream, construction and operation -- should be part of a State's certification review.**

B. Conditioning 401 Certifications for Wetland Protection

In 401(d), the Congress has given the States the authority to place any conditions on a water quality certification that are necessary to assure that the applicant will comply with effluent limitations, water quality standards, standards of performance or pretreatment standards; with any State law provisions or regulations more stringent than those sections; and with "any other appropriate requirement of State law."

The legislative history of the subsection indicates that the Congress meant for the States to impose whatever conditions on the certification are necessary to ensure that an applicant complies with all State requirements that are related to water quality concerns.

1. What are Appropriate Conditions?

There are any number of possible conditions that could be placed on a certification that have as their purpose preventing water quality deterioration.

By way of example, the State of Maryland issued a certification with conditions for placement of fill to construct a 35-foot earthen dam located 200 feet downstream of an existing dam. Maryland used some general conditions applicable to many of the proposed projects it considers, along with specific conditions tailored to the proposed project. Examples of the conditions placed on this particular certification include:

> *The applicant shall obtain and certify compliance with a grading and sediment control plan which has been approved by the [county] Soil Conservation District. The approved plan shall be available at the project site during all phases of construction.*
>
> *Stormwater runoff from impervious surfaces shall be controlled to prevent the washing of debris into the waterway. The natural vegetation shall be maintained and restored when disturbed or eroded. Stormwater drainage facilities shall be designed, implemented, operated, and maintained in accordance with the requirements of the applicable approving authority.*

The applicant is required to provide a mixing tower release structure to achieve in-stream compliance with Class III trout temperature (20[degrees] C) and dissolved oxygen (5.0 mg/liter) standards prior to the Piney Run/Church Creek confluence. The design of this structure shall be approved by the Maryland Department of the Environment (MDE).

The applicant is required to provide a watershed management plan to minimize pollutant loadings into the reservoir. This plan shall be reviewed and approved by MDE prior to operation of the new dam facility. In conjunction with this plan's development any sources of pollutant loading identified during field surveys shall be eliminated or minimized to the extent possible given available technology.

The applicant is required to provide to MDE an operating and maintenance plan for the dam assuring minimum downstream flows in accordance with the requirements of the DNR and assuring removal of accumulated sediments with subsequent approved disposal of the materials removed.

The applicant is to provide mitigation for the wetlands lost as a result of the construction of this project and its subsequent operation. Wetland recreation should be located in the newly created headwaters areas to: a) assure adequate filtration of runoff prior to its entry into the reservoir and b) replace the aquatic resource being lost on an acre for acre basis.

See Appendix D for the full list of conditions placed on this certification. While few of these conditions are based directly on traditional water quality standards, all are valid and relate to the maintenance of water quality or the designated use of the waters in some way. Some of the conditions are clearly requirements of State or local law related to water quality other than those promulgated pursuant to the CWA sections enumerated in Section 401(a)(1). Other conditions were designed to minimize the project's adverse effects on water quality over the life of the project.

In addition, Appendix D contains a list of conditions which West Virginia and Alaska placed on the certification of some Section 404 nationwide permits. Many of the West Virginia conditions are typical of ones it uses on individual proposals as well. For any particular project, West Virginia will include more specific conditions designed to address the potential adverse effects of the project in addition to those enumerated in Appendix D. The conditions from Alaska are used on a nationwide permit (#26) regarding isolated waters and waters above headwaters. These conditions are discussed in Section V. C(1).

2. The Role of Mitigation in Conditioning Certification

Many States are trying to determine the role that mitigation should play in 401 certification decisions. We cannot answer this question definitively for each State, but offer as a guide EPA's general framework for mitigation under the Section 404(b)(1) Guidelines used to evaluate applications for Section 404 permits. In assuring compliance of a project with the Guidelines, **EPA's approach is to first, consider avoidance of adverse impacts, next, determine ways to minimize the impacts, and finally, require appropriate and practicable compensation for unavoidable impacts.**

The Guidelines provide for avoiding adverse impacts by selecting the least environmentally damaging practicable alternative. In addition, wetlands are "special aquatic sites." For such sites, if the proposed activity is not "water dependent," practicable alternatives with less adverse environmental impacts are presumed to be available unless the applicant clearly demonstrates otherwise.[40]

The Guidelines also require an applicant to take "appropriate and practicable" steps to minimize the impacts of the least environmentally damaging alternative selected.[41] Examples in the Guidelines for minimizing impacts through project modifications and best management practices are provided in Appendix E.

After these two steps are complete, appropriate compensation is required for the remaining unavoidable adverse impacts. Compensation would consist of restoration of previously altered wetlands or creation of wetlands from upland sites. In most cases, compensation on or adjacent to the project site is preferred over off-site locations. The restoration or creation should be functionally equivalent to the values which are lost. Finally, compensating with the same type of wetland lost is preferred to using another wetland type.

The States may choose to adopt mitigation policies which require additional replacement to help account for the uncertainty in the science of wetland creation and restoration. What is important from EPA's perspective is that mitigation not be used as a trade-off for avoidable losses of wetlands, and that mitigation compensate, to the fullest extent possible, for the functional values provided to the local ecosystem by the wetlands unavoidably lost by the project.

3. The Role of Other State Laws

Another question that has been asked is what State law or other requirements are appropriately used to condition a 401 certification. The legislative history of Section 401(d) indicates that Congress meant for the States to condition certifications on compliance with any State and local law requirements related to water quality

preservation. The courts that have touched on the issue have also indicated that conditions that relate in any way to water quality maintenance are appropriate. Each State will have to make these determinations for itself, of course; there are any number of State and local programs that have components related to water quality preservation and enhancement.

One issue that has arisen in two court cases is whether a State may use State law requirements, other than those that are more stringent than the provisions of Sections 301, 302, 303, 306 and 307 of the CWA(401(a)(1)), to deny water quality certification. An Oregon State court has ruled that a State may, and indeed must, include conditions on certifications reflecting State law requirements "to the extent that they have any relationship to water quality." "Only to the extent that [a State law requirement] has absolutely no relationship to water quality," the court said, "would it not be an 'other appropriate requirement of State law.'"[42] State agencies must act in accord with State law, of course, and thus the decision to grant certification carries with it the obligation to condition certification to ensure compliance with such State requirements.

This State court decision struck down a State agency's denial of certification because it was based on the applicant's failure to certify compliance with a county's comprehensive plan and land use ordinances. The court held that such "other appropriate requirement[s] of State law" could not be the basis for denying certification. However, the court held that the agency should determine which of the provisions of the land use ordinances had any relation to the maintenance and preservation of water quality. Any such provisions, the court said, could and should be the basis for conditions placed on a certification.

Another State court, however, this one in West Virginia, has upheld the State's denial of certification on the basis of State law requirements unrelated to the implementation of the CWA provisions enumerated in Section 401(a)(1).[43] The court simply issued an order upholding the State's denial, however, and did not write an opinion on the subject. The questions raised by these two opinions are thorny. If States may not deny certification based on State law requirements other than those implementing the CWA, yet want to address related requirements of State law, they must walk a thin line between their State requirements and the limitations of their certification authority under federal law.

One way to avoid these difficulties and to ensure that 401 certification may properly be used to deny certification where the State has determined that the activity cannot be conditioned in such a way as to ensure compliance with State water quality related requirements, is to adopt water quality standards that include all State provisions related to water quality preservation. Congress has given the States great latitude to adopt water quality standards that take into consideration the waters' use for

such things as "the propagation of fish and wildlife, recreational purposes, and . . . other purposes."[44] Because of the broad authority granted by the Congress to the States to adopt water quality standards pursuant to Section 303 of the CWA, and because compliance with Section 303 is clearly one of the bases on which a State can deny certification, the States can avoid the difficulty of the deny/condition dilemma by adopting water standards that include all the water quality related considerations it wishes to include in the 401 certification review.

For example, the State of Washington has included State water right permit flow requirements in its conditions for certification of a dam project. This is one means of helping to ensure that hydrological changes do not adversely affect the quality of a waterbody. However, a more direct approach is to include a narrative criterion in the State's water quality standards that requires maintenance of base flow necessary to protect the wetland's (or other waterbody's) living resources. The State of Kentucky has such a criterion in its water quality standards (see previous section IV. D(1) on "Using Narrative Criteria"). Placing the provision directly in the State standards might better serve the State if a certification is challenged because the requirement would be an explicit consideration of 401 certification.

C. Special Considerations for Review of Section 404 Permits: Nationwide and After-the-Fact Permits

1. Nationwide Permits.

Pursuant to Section 404(e) of the CWA, the Corps may issue general permits, after providing notice and an opportunity for a hearing, on a State, regional or nationwide basis for any category of activities involving discharges of dredged or fill material, where such activities are similar in nature and will cause only minimal adverse environmental effects both individually and cumulatively. These permits may remain in effect for 5 years, after which they must be reissued with notice and an opportunity for a hearing. If the activities authorized by general permits may result in a discharge, the permits are subject to the State water quality certification requirement when they are first proposed and when proposed for reissuance. States may either grant certification with appropriate conditions or deny certification of these permits.

Under the Corps' regulations, if a State has denied certification of any particular general permit, any person proposing to do work pursuant to such a permit must first obtain State water quality certification. If a State has conditioned the grant of certification upon some requirement of State review prior to the activity's commencing, such condition[s] must be satisfied before work can begin.

Some States have reported that for general permits for which they have denied water quality certification or on which they have imposed some condition of review, they are having difficulties ensuring that parties performing activities pursuant to these permits are applying to the State for water quality certification or otherwise fulfilling the conditions placed on the certification prior to the commencement of work under these permits.

At least one State is grappling with the problem through its 401 certification implementing regulations. The State of West Virginia denied certification for some nationwide permits issued by the Corps and conditioned the granting of certification for others. One of the conditions that West Virginia has imposed on those certifications that it granted (which thus apply to all nationwide permits in the State) is compliance with its 401 certification implementing regulations. The regulations in turn require that any person authorized to conduct an activity under a nationwide permit must, prior to conducting any activity authorized by a Corps general permit, publish a Class I legal advertisement in a qualified newspaper in the county where the activity is proposed to take place. The notice must describe the activity, advise the public of the scope of the conditionally granted certification, the public's right to comment on the proposed activity and its right to request a hearing. The applicant must forward a certificate of publication of this notice to the State agency prior to conducting any such activity.[45]

The regulation further provides that any person whose property, interest in property or "other constitutionally protected interest under [the West Virginia Constitution] [is] directly affected by the Department's certification" may request a hearing within 15 days of the publication of the notice given by the applicant. The agency will then decide whether to "uphold, modify or withdraw certification for the individual activity."

West Virginia program officers have described the reasons for this procedure:

> *Because of a long-standing concern . . . that untracked dredge and fill activities could prove disastrous on both individual and cumulative bases, the regulations require an authorized permittee [under federal law] to forward proof of publication and a copy of the newspaper advertisement. The information on the notice is logged into a computer system and a site specific inspection sheet is generated. Inspectors then may visit the site to determine compliance with permit conditions and to evaluate cumulative impacts.*[46]

Without such notice and a tracking system of activities performed under these permits, such as that adopted by West Virginia, it will be difficult for a State to evaluate whether or not to grant or deny water quality certification for these permits when they come up for reissuance by the Corps or to condition them in such a way as to avoid adverse impacts peculiar to each of these general permits. It is advisable for

the States, regardless of whether they have granted or denied certification, to adopt as part of their 401 certification implementing regulations, provisions addressing these concerns for general permits.

Another way in which some States are attempting to minimize the potential environmental impact of nationwide permits is by stringently conditioning their certification. Alaska, for instance, placed conditions on nationwide permit 26 regarding isolated waters and waters above the headwaters. One of the conditions Alaska used excludes isolated or headwater wetlands of known or suspected high value. When there is uncertainty about a particular wetland, the Corps is required to send pre-discharge notification to designated State officials for a determination. (See Appendix D for a full description of conditions on nationwide permit 26).

2. Section 404 After-the-Fact Permits

The Corps of Engineers' regulations implementing Section 404 provide for the acceptance of after-the-fact permit applications for unauthorized discharges except under certain circumstances. Several States have expressed concern with after-the-fact permits, including the belief that once the discharges have taken place, the water quality certification process is moot. Because of that belief, many States report that they waive certification for after-the-fact permits. Such an approach frustrates law enforcement efforts generally and the water quality certification process in particular because it encourages illegal activity.

The evaluation of after-the-fact permit applications should be no different than for normal applications. Because the burden should be on the applicant to show compliance with water quality standards and other CWA requirements, rather than waiving certification, States could deny certification if the applicant cannot show from baseline data prior to its activity that the activity did not violate water quality standards. If data exist to determine compliance with water quality standards, the States' analysis should be no different merely because the work has already been partially performed or completed. Arkansas denied after-the-fact water quality certification of a wetland fill as follows:

> *[a certain slough] is currently classified as a warmwater fishery . . . . Draining and clearing of [its associated] wetlands will significantly alter the existing use by drastically reducing or eliminating the fishery habitat and spawning areas. This physical alteration of the lake will prevent it from being "water which is suitable for the propagation of indigenous warmwater species of fish" which is the definition of a warmwater fishery. Thus, the . . . project [violates] Section 3 (A) of the Arkansas Water Quality Standards, "Existing instream water uses and the level of water quality necessary to protect the*

existing uses shall be maintained and protected." The Department recommends the area be restored to as near original contours as possible.

With after-the-fact permits, just as with any other permit application, if the State denies certification, the Corps is prohibited from granting a permit. If the applicant refuses to restore the area and does not have a permit, the applicant is subject to a potential enforcement action for restoration and substantial penalties for the unpermitted discharge of pollutants by the EPA, the Corps, a citizen under the citizen suit provision of the CWA, or by the State, if the activity violates a prohibition of State law.

If the State determines that it will get a better environmental result by conditioning certification, it may choose to take that approach. The condition might require mitigation for the filled area (where restoration may cause more environmental harm than benefit, for instance) with restoration or creation of a potentially more valuable wetland area.

In any event, a State should not waive certification of an after-the-fact permit application simply because it is after-the-fact.

VI. DEVELOPING 401 CERTIFICATION IMPLEMENTING REGULATIONS: ADDITIONAL CONSIDERATIONS

A comprehensive set of 401 certification implementing regulations would have both procedural and substantive provisions which maximize the State agency's control over the process and which make its decisions defensible in court. The very fact of having 401 certification regulations goes a long way in providing the State agency that implements 401 certification with credibility in the courts. Currently, no State has "ideal" 401 certification implementing regulations, and many do not have them at all. When 401 certification regulations are carefully considered, they can be very effective not only in conserving the quality of the State's waters, but in providing the regulated sectors with some predictability of State actions, and in minimizing the State's financial and human resource requirements as well.

Everything in this handbook relates in some way to the development of sound water quality standards and 401 certification implementing regulations that will enhance wetland protection. This section addresses some very basic procedural considerations of 401 certification implementing regulations which have not been treated elsewhere. These include provisions concerning the contents of an application for certification; the agency's timeframe for review; and the requirements placed on the applicant in the certification process.

A. Review Timeframe and "Complete" Applications

Under Section 401(a)(1) a State will be deemed to have waived certification if it fails to act within "a reasonable period of time (which shall not exceed one year) after receipt of such request." Program managers should keep in mind that the federal permitting or license agency may have regulations of its own which provide a time limit for the State's certification decision. For instance, Corps regulations say that a waiver "will be deemed to occur if the certifying agency fails or refuses to act on a request for certification within sixty days after receipt . . . unless the district engineer determines a shorter or longer period is reasonable . . . ."[47] FERC rules state that a certifying agency "is deemed to have waived the certification requirements if . . . [it] has not denied or granted certification by one year after the date the certifying agency received the request".[48] EPA regulations for Section 402 in non-authorized States set a limit of 60 days unless the Regional Administrator finds that unusual circumstances require a longer time.[49]

States should coordinate closely with the appropriate federal agency on timing issues. For example, Alaska negotiated joint EPA/State procedures for coastal NPDES permit review. The agreement takes into account and coordinates EPA, Coastal Zone Management, and 401 certification time frames.

It is also advisable for the States to adopt rules which reasonably protect against an unintended waiver due, for example, to insufficient information to make a certification decision or because project plans have changed enough to warrant a reevaluation of the impacts on water quality. Thus, after taking the federal agencies' regulations into account, the State's 401 certification regulations should link the timing for review to what is considered receipt of a complete application.

Wisconsin, for instance, requires the applicant to submit a complete application for certification before the official agency review time begins. The State's regulations define the major components of a complete application, including the existing physical environment at the site, the size of the area affected, all environmental impact assessment information provided to the licensing or permitting agency, and the like. The rules State that the agency will review the application for completeness within 30 days of its receipt and notify the applicant of any additional materials reasonably necessary for review. Although the application will be deemed "complete" for purposes of review time if the agency does not request additional materials within 40 days of receipt of the application, the agency reserves the right to request additional information during the review process.[50]

In the case of FERC projects, West Virginia has taken additional precautions with regard to time for review:

> *If the project application is altered or modified during the FERC licensing process prior to FERC's final decision, the applicant shall inform the Department of such changes. The Department may review such alterations or modifications and, if the changes are deemed significant by the Director, the Department may require a new application for certification. The Department will have ninety (90) days to review such changes or until the end of the year review period . . . , whichever is longer, to determine whether to require a new application or to alter its original certification decision. If the department requires a new application because of a significant application modification, then the Department will have six (6) months to issue its certification decision from the date of submission of the application.*[51]

B. Requirements for the Applicant

It is very important, in particular for conserving the agency's resources and ensuring that there is sufficient information to determine that water quality standards and other provisions of the CWA will not be violated by the activity, to clarify that it is the applicant who is responsible for providing or proving particular facts or requirements.

For instance, Section 401(a)(1) requires that a State "establish procedures for public notice in the case of all applications for certification." West Virginia requires applicants for FERC licenses to be responsible for this notice. In the case of Section 404 permits, West Virginia has a joint notice process with the Corps to issue public notices for 404 applications which also notify the public of the State certification process. Thus, there is no need for West Virginia to require the applicant to do so for these permits.[52]

A second consideration is that States should require the applicant to demonstrate the project's compliance with applicable federal and State law and regulation. EPA's 401 certification regulations name the sources of information a State should use as that contained in the application and other information "furnished by the applicant" sufficient to allow the agency to make a statement that water quality standards will not be violated.[53] Of course in addition, the regulations also refer to other information the agency may choose to examine which is not furnished by the applicant.

Ohio, for instance, has written a requirement for the applicant to demonstrate compliance into its 401 certification implementing regulations:

> *(A) The director shall not issue a Section 401 water quality certification unless he determines that the applicant has demonstrated that the discharge of dredged or fill material to waters of the state or the creation of any obstruction or alteration in waters of the state will:*[54] *(1) Not prevent or interfere with the attainment or maintenance of applicable water quality standards; (2) Not result in a violation of any applicable provision of the following sections of the Federal Water Pollution Control Act [301, 302, 303, 306 and 307].*
>
> *(B) Notwithstanding an applicant's demonstration of the criteria in paragraph (A) . . . the director may deny an application for a Section 401 water quality certification if the director concludes that the discharge of dredged or fill material or obstructions or alterations in waters of the state will result in adverse long or short term impact on water quality.*[55]

C. Permit Fees

A very significant concern for all States who plan to initiate or expand their 401 certification program is the availability of funding. Application fee requirements are a potential funding source to supplement State program budgets. The State of California's Regional Water Quality Control Boards require filing fees for 401 certification applications unless a Board determines that certification is not required. The fee structure is spelled out in the California Water Code. The money collected from the fees goes into the State agency's general fund. The Regional Boards may recover some portion of the fees through the budget request process. The State of Ohio also has a fee structure for 401 certification applicants. In Ohio, however, fees go into the State's general fund, rather than back into the State agency. Neither State collects fees sufficient to support the 401 certification program fully. Despite these potential barriers, application fees could provide a much needed funding source which States should explore.

D. Basis for Certification Decisions

The regulations should also set out the grounds on which the decision to grant or deny certification will be based, the scope of the State's review, and the bases for conditioning a certification. If a State has denied water quality certification for a general permit or has conditioned such a permit on some requirement of State review, the State's 401 certification implementing regulations might also outline the obligations

of a person proposing to accomplish work under such a permit. The following is a hypothetical example of regulatory language a State might use to define the grounds for the State's decision to grant, condition, or deny certification:

> In order to obtain certification of any proposed activity that may result in a discharge to waters of the United States, an applicant must demonstrate that the entire activity over its lifetime will not violate or interfere with the attainment of any limitations or standards contained in Section 301, 302, 303, 306, and 307, the federal regulations promulgated pursuant thereto, and any provisions of state law or regulation adopted pursuant to, or which are more stringent than, those provisions of the Clean Water Act.
>
> . . .
>
> The agency may condition certification on any requirements consistent with ensuring the applicant's compliance with the provisions listed above, or with any other requirements of state law related to the maintenance, preservation, or enhancement of water quality.

This sample regulatory language provides the grounds for the certification decision, sets the scope of review (lifetime effects of the entire activity) and clearly States that the applicant must demonstrate compliance. For purposes of conditioning the certification in the event it is granted, the same standards can be applied, with the addition of any other requirements of State law that are related to water quality.

Regulations are not project specific. They must be generally applicable to all projects subject to 401 certification review, while at the same time providing reasonable notice to an applicant regarding the general standards employed by the agency in the certification process. (A State may choose to adopt license/permit-specific regulations for 401 certification, but such regulations will still have to be applicable to all activities that may occur pursuant to that license or permit).

There are other considerations that should be addressed in 401 certification implementing regulations, some of which have been mentioned in other parts of this handbook. These include provisions which require applicants for federal licenses and permits which may result in a discharge to apply for water quality certification; provisions which define waters of the State to include wetlands and which define other pertinent terms; and provisions addressing general permits.

VII. EXISTING AND EMERGING SOURCES OF DATA TO AID 401 CERTIFICATION AND STANDARDS DECISION MAKERS

According to a number of State program managers, more data on wetland functions, or "uses," would greatly assist the certification process. Wetland ecosystems not only perform a wide variety of functions but do so in varying degrees. Public agencies and private applicants currently employ a number of assessment methods such as the Wetlands Evaluation Technique and the Habitat Evaluation Procedure to determine what functions or uses exist in a particular wetland system.[56] In many States, however, water quality certification reviewers lack the resources to perform even a simple assessment of a wetland's boundaries, values and functions. Information about the location and types of wetland systems, and of the functions they may perform (such as flood storage, habitat, pollution attenuation, nutrient uptake, and sediment fixing) would aid standard writers in developing appropriate uses and criteria for wetlands, and allow 401 certification officials to conduct a more thorough review.

Several States already have extensive knowledge of their wetland resources, and data gathering efforts are also being undertaken by EPA, the U.S. Fish and Wildlife Service and other agencies.[57] Although these efforts to inventory and classify wetlands have not been closely tied to the 401 certification process in the past, these existing data can be valuable sources of information for 401 certification reviewers. It is important to remember, however, that wetland boundaries for regulatory purposes may differ from those identified by National Wetland Inventory maps for general inventory purposes. The EPA, Corps of Engineers, Fish and Wildlife Service, and Soil Conservation Service have adopted a joint manual for identifying and delineating wetlands in the United States. The manual will be available in June, 1989.[58]

There are several programs that offer technical support for 401 certification decisions. For example, approximately forty States have worked with the Nature Conservancy to establish "natural heritage programs," which identify the most critical species, habitats, plant communities, and other natural features within a State's territorial boundaries. Most States now have a State natural heritage office to coordinate this identification program. Inventory efforts such as the natural heritage program could give 401 certification managers some of the information they need to limit or prohibit adverse water quality impacts in important wetland areas. Specifically, the inventory process can identify existing wetland uses in order to maintain them. The information may also be used in identifying wetlands for Outstanding Resource Waters designation.[59]

The Fish and Wildlife Service maintains a Wetlands Values Data Base which may be very useful in identifying wetland functions and in designating wetland uses for water quality standards. The data base is on computer and contains an annotated bibliography of scientific literature on wetland functions and values.[60] Several States

have established critical area programs to identify and protect unique and highly sensitive land and water resources. These programs can provide data to the State water quality certification office and thereby strengthen the scientific basis for 401 certification decision making.[61]

Another potential source of information which might identify wetlands appropriate for designation as Outstanding Resource Waters are the wetland plans which each State is required to develop to comply with the 1986 Emergency Wetlands Resources Act. Beginning in fiscal year 1988, Statewide Comprehensive Outdoor Recreation Plans (SCORP) must now contain a Wetlands Priority Conservation Plan approved by the Department of Interior. Although these plans are primarily focused on wetlands for acquisition, they are a potential source of data on wetland locations and functions. The wetlands identified may also be suitable for special protection under the Outstanding Resource Waters provisions of the antidegradation policy.

The Advance Identification program (ADID), conducted by EPA and the permitting authority, may also furnish a considerable amount of useful information. EPA's 404(b)(1) Guidelines contain a procedure for identifying in advance areas that are generally suitable or unsuitable for the deposit of dredged or fill material.[62] In recent years, EPA has made greater use of this authority. ADID is often used in wetland areas that are experiencing significant development or other conversion pressures. Many ADID efforts generate substantial data on the location and functions of wetlands within the study area such as wetland maps, and habitat, water quality, or hydrological studies.

Special Area Management Plans (SAMPs) are another planning process which may yield useful information. SAMPs refer to a process authorized by the 1980 amendments to the Coastal Zone Management Improvement Act, which provides grants to States to develop comprehensive plans for natural resource protection and "reasonable coastal-dependent economic growth."[63] The SAMP process implicitly recognizes the State water quality certification process, directing all relevant local, State, and federal authorities to coordinate permit programs in carrying out the completed SAMP. The Corps of Engineers has supported and initiated several of these processes. In addition, other SAMPs have been completed by several States.

Much of these data can be collected, combined, and used in decision making with the aid of geographic-based computer systems that can store, analyze, and present data related to wetlands in graphic and written forms.[64] A reviewing official can quickly access and overlay a range of different existing information bases such as flora and fauna inventories, soil surveys, remote sensing data, watershed and wetland maps, existing uses and criteria, and project proposal information.

Finally, data is presently emerging on the use of wetlands as treatment areas for wastewater, stormwater, and non-point discharges.[65] Florida, for instance, has adopted a rule on wastewater releases into wetlands.[66] Florida prohibits wastewater discharges into the following kinds of wetlands: those designated as outstanding waters of the State; wetlands within potable water supplies; shellfish propagation or harvesting waters; wetlands in areas of critical State concern; wetlands where herbaceous ground cover constitutes more than thirty percent of the uppermost stratum (unless seventy-five percent is cattail); and others. Wastewater discharges are permitted in certain wetlands dominated by woody vegetation, certain hydrologically altered wetlands, and artificially created wetlands; however, the State applies special effluent limitations to take account of a wetland's ability to assimilate nitrogen and phosphorus. It also applies qualitative[67] and quantitative[68] design criteria.

The rule establishes four "wetland biological quality" standards. First, the flora and fauna of the wetland cannot be changed so as to impair the wetland's ability to function in the propagation and maintenance of fish and wildlife populations or substantially reduce its effectiveness in wastewater treatment. Second, the Shannon-Weaver diversity index of benthic macroinvertebrates cannot be reduced below fifty percent of background levels. Third, fish populations must be monitored and maintained, and an annual survey of each species must be conducted. Fourth, the "importance value" of any dominant plant species in the canopy and subcanopy at any monitoring station cannot be reduced by more than fifty percent, and the average "importance value" of any dominant plant species cannot be reduced by more than twenty-five percent.[69]

These types of efforts, constantly being adjusted to take account of new information in a field where knowledge is rapidly expanding, are fertile sources of information for wetland standard writers and 401 certification decision makers.

VIII. SUMMARY OF ACTIONS NEEDED

This handbook has only scratched the surface of issues surrounding effective use of 401 certification to protect wetlands. The preceding discussion and examples from active States have highlighted possible approaches for all States to incorporate into their 401 certification programs. The handbook shows that there are many things that a State can act on right away to improve the effectiveness of 401 certification to protect the integrity of its wetlands. At the same time, there are improvements to water quality standards for wetlands which will have to take place within a longer timeframe.

A. Steps States Can Take Right Away

- **All states should begin by explicitly incorporating wetlands into their definitions of state waters in both state water quality standards regulations, and in state 401 certifications regulations.**

- **States should develop or modify their regulations and guidelines for 401 certification and water quality standards to clarify their programs, codify their decision process, and to incorporate special wetlands considerations into the more traditional water quality approaches.**

- **States should make more effective use of their existing narrative water quality standards (including the antidegradation policy) to protect wetlands.**

- **States should initiate or improve upon existing inventories of their wetland resources.**

- **States should designate uses for their wetlands based on estimates of wetland functions typically associated with given wetland types. Such potential uses could be verified for individual applications with an assessment tool such as the Wetlands Evaluation Technique or Habitat Evaluation Procedure.**

- **States should tap into the potential of the outstanding resource waters tier of the antidegradation policy for wetlands. It may not be an appropriate designation for all of a state's wetlands, but it can provide excellent protection to particularly valuable or ecologically sensitive wetlands from both physical and chemical degradation.**

- **States should incorporate wetlands and 401 certification into their other water quality management processes. Integrating this tool with other mechanisms such as coastal zone management programs, point and nonpoint source programs, and water quality management plans will help fill the gaps of each individual tool and allow better protection of wetlands systems from the whole host of physical, chemical, and biological impacts.**

Time and the courts may be needed to resolve some of the more complicated and contentious issues surrounding 401 certification such as which federal permits and licenses require 401 certification. EPA intends to support States in resolving such issues.

OWP, in cooperation with the Office of Water Regulations and Standards (OWRS), will build on this 401 certification handbook by developing guidance in FY 89-90 on water quality standards for wetlands. The guidance will provide the framework for States to incorporate wetlands into their water quality standards. The guidance will: require States to include wetlands as "waters of the State;" provide methods to designate wetland uses that recognize differences in wetland types and functions; address some chemical-specific and narrative biological criteria for wetlands; and discuss implementation of State antidegradation policies.

B: Laying the Groundwork for Future Decisions

Many States are successfully applying their existing narrative and, to a lesser extent, numeric water quality criteria to their wetland resources. Nevertheless, more work is needed to test the overall adequacy and applicability of these standards for wetlands, and to develop additional criteria where needed.

For example, existing criteria related to pH do not account for the extreme natural acidity of many peat bogs nor the extreme alkalinity of certain fens. Also, many existing criteria focus too extensively on the chemical quality of the water column without adequately protecting the other physical and biological components which are an integral part of wetland aquatic systems. Some numeric criteria for chemicals may not be protective enough of species (particularly bird species) which feed, breed, and/or spend a portion of their life cycle in wetlands. Hydrological changes can have severe impacts on wetland quality, but these changes are rarely addressed in traditional water quality standards.

Research of interest to State programs is being sponsored by the Wetlands Research Program of EPA's Office of Research and Development (ORD). Research covers three areas: Cumulative Effects, Water Quality, and Mitigation. Although these efforts will be developed over several years, interim products will be distributed to the States. States may find these products of use when developing criteria and standards, when identifying and designating wetlands as outstanding resource waters, and when making 401 certification decisions.

Cumulative Effects:

EPA's research on cumulative effects of wetlands takes a regional perspective. Through a series of regional pilot studies involving landscape analyses, ORD is correlating water quality conditions at the outlets of major watersheds with the percentage of wetlands in these watersheds. The types of wetlands, their position, and

non-wetland factors are also being analyzed. The results will allow water quality managers in these regions to specify the optimal percentage and combination of various types of wetlands needed to maintain water quality of lakes and rivers. Such watershed criteria could be used to guide efforts to create or restore wetlands for the purpose of intercepting and improving the quality of nonpoint runoff.

The pilot studies will also determine which wetland features can be used to predict wetland functions. Once differences among wetlands can be identified based on their functions, it will be possible to classify particular wetlands with regard to specific designated uses.

The cumulative effects program is using the results of the pilot studies as technical support for developing a "Synoptic Assessment Method". This method has already been used to rank watersheds within certain regions, according to the likely cumulative benefits of their wetlands. Also, sources of information useful for designating uses of individual wetlands were described by ORD in EPA's draft guidance for Advance Identification Appendix D.[70] Information on regionally rare or declining wetland wildlife, which could be used as one basis for establishing "special aquatic areas" in selected wetlands, is also available from the ORD Wetlands Research Team at the Corvallis EPA Lab.

Water Quality:

Another ORD study, being implemented through the Duluth Lab, is examining impacts to the water quality and biota of 30 wetlands, before and after regional development. This study will be useful, as part of 401 certification, for developing performance standards for activities which may affect wetland water quality.

Several research projects being proposed by the Wetland Research Program could produce information very useful to water quality managers. These are described in ORD's publication, "Wetlands and Water Quality: A Research and Monitoring Implementation Plan for the Years 1989-1994". Many of these proposals are planned, but will hinge upon funding decisions in future budget years. Those which drew the most support from a 1988 EPA workshop of scientists and State program administrators were as follows:

- **Water Quality Criteria to Protect Wetland Function.** Existing quality criteria for surface waters would be reviewed for applicability to wetlands. Methods for biological and chemical monitoring of wetlands would be refined, and a field manual produced.

- **Ecological Status and Trends of the Wetland Resource.** A nationwide network would be established to monitor the wetland resource. Field surveys would define the expected range of numerical values within each region for particular chemicals and especially, for biological community metrics, across a gradient of sites ranging from nearly-pristine to severely disturbed.

- **Waste Assimilative Limits of Wetlands.** Observable features which determine the long-term ability of wetlands to retain contaminants and nutrients would be tested. "Safe" loading limits for various substances would be proposed for specific wetland types or regions. Similar kinds of information would also become available from a research effort focused specifically on artificial wetlands and coordinated by EPA-Cincinnati, in cooperation with the Corvallis and Duluth Labs. That study would recommend engineering design factors essential in wetlands constructed by municipalities for tertiary wastewater treatment.

Mitigation:

Information useful to 401 certification will also originate from ORD'S mitigation research. This research aims to determine if created and restored wetlands replace functions lost by wetland destruction permitted under Section 404. The research is organized to (1) synthesize current knowledge on wetland creation and restoration, (2) compile 404 permit information on created and restored wetlands, and (3) compare created and naturally occurring wetlands. Research results will be incorporated into a "Mitigation Handbook" useful for designing and evaluating mitigation projects. A literature synthesis being developed as a Provisional Guidance Document will be available in 1989. A provisional version of the handbook will be produced in 1990. This will assist States in identifying areas at greatest risk due to 404 permit activities and thus help target 401 certification and water quality standards activities.

APPENDIX A

Provided below are State 401 certifictation contacts and EPA wetlands contacts who can provide assistance in applying 401 to wetlands.

EPA has asked the Council of State Governments (CSG) to maintain a database of State wetland contacts and programs. In order to help keep the database up to date, please contact CSG when you have changes in your program or staff contacts, or if you come across inaccuracies in other State programs. You can access this database using virtually any computer with a modem. In order to obtain your free username and password contact:

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APPENDIX B
FEDERAL DEFINITIONS

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

(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;
(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.)

The federal definition of "wetlands" (40 CFR § 232.2(r)). 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.

APPENDIX C

SCOPE OF PROJECT REVIEW: PENNSYLVANIA DAM PROPOSAL EXAMPLE

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 eight miles upstream on the Susquehanna River and approximately three 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 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.

APPENDIX D

EXAMPLES OF CERTIFICATION CONDITIONS

****MARYLAND****

Maryland certified with conditions the fill/alteration of 6.66 acres of non-tidal wetlands as part of the construction of an 18 hole golf course and a residential subdivision. Approximately three-fourths of the entire site of 200 acres had been cleared for cattle grazing and agricultural activities in the past. As a result, a stream on the east side of the property with no buffer had been severely degraded. An unbuffered tractor crossing had also degraded the stream. A palustrine forested wetland area on the southeast side of the property received stormwater runoff from a highway bordering the property and served as a flood storage and ground water recharge area. Filling this area for construction of a fairway would eliminate some 4.5 acres of wetlands. Additionally, other smaller wetland areas on the property, principally around an old farm pond that was to be fashioned into four separate ponds for water traps, were proposed to be altered or lost as a result of the development.

The Corps did not exercise its discretionary authority to require an individual permit and thus the project was permitted under a nationwide permit (26). The State decided to grant certification, conditioned on a number of things that it believed would improve the water quality of the stream in the long run.

The filled wetland areas had to be replaced on an acre-for-acre basis on the property and in particular, the 4.5 acre forested palustrine wetland had to be replaced onsite with a wetland area serving the same functions regarding stormwater runoff from the highway.

Some of the other conditions placed on the certification were as follows:

1. The applicant must obtain and certify compliance with a grading and sediment control plan approved by the [name of county] Soil Conservation District;

2. Stormwater runoff from impervious surfaces shall be controlled to prevent the washing of debris into the waterway. Stormwater drainage facilities shall be designed, implemented, operated and maintained in accordance with the requirements of the [applicable county authority];

3. The applicant shall ensure that fish species are stocked in the ponds upon completion of the construction phase in accordance with the requirements of the [fisheries division of the natural resources department of the State];

4. The applicant shall ensure that all mitigation areas are inspected annually by a wetlands scientist to ensure that all wetlands are functioning properly;

5. A vegetated buffer shall be established around the existing stream and proposed ponds;

6. Biological control methods for weed, insects and other undesirable species are to be employed whenever possible on the greens, tees, and fairways located within or in close proximity to the wetland or waterways;

7. Fertilizers are to be used on greens, tees, and fairways only. From the second year of operation, all applications of fertilizers at the golf course shall be in the lower range dosage rates [specified]. The use of slow release compounds such as sulfur-coated urea is required. There shall be no application of fertilizers within two weeks of verticutting, coring or spiking operations.

** WEST VIRGINIA **

THE FOLLOWING GENERAL CONDITIONS APPLY TO ALL NATIONWIDE PERMITS IN WEST VIRGINIA:

1. Permittee will investigate for water supply intakes or other activities immediately downstream which may be affected by suspended solids and turbidity increases caused by work in the watercourse. He will give notice to operators of any such water supply intakes before beginning work in the watercourse in sufficient time to allow preparation for any change in water quality.

2. When no feasible alternative is available, excavation, dredging or filling in the watercourse will be done to the minimum extent practicable.

3. Spoil materials from the watercourse or onshore operations, including sludge deposits, will not be dumped into the water course or deposited in wetlands.

4. Permittee will employ measures to prevent or control spills from fuels, lubricants, or any other materials used in construction from entering the watercourse.

5. Upon completion of earthwork operations, all fills in the watercourse or onshore and other areas disturbed during construction, will be seeded, riprapped, or given some other type of protection from subsequent soil erosion. If riprap is utilized, it is to be of such weight and size that bank stress or slump conditions will not be created due to its placement. Fill is to be clean and of such composition that it will not adversely effect the biological, chemical or physical properties of the receiving waters.

6. Runoff from any storage areas or spills will not be allowed to enter storm sewers without acceptable removal of solids, oils and toxic compounds. All spills will promptly be reported to the appropriate Department of Natural Resources office.

7. Best Management Practices for sediment and erosion control as described in the 208 Construction Water Quality Management Plan are to be implemented.

8. Green concrete will not be permitted to enter the watercourse unless contained by tightly sealed forms or cells. Concrete handling equipment will not discharge waste washwater into the watercourse or wetlands without adequate wastewater treatment.

9. No instream work is permissible during the fish spawning season April through June.

10. Removal of mature riparian vegetation not directly associated with project construction is prohibited.

11. Instream equipment operation is to be minimized and should be accomplished during low flow periods.

12. Nationwide permits are not applicable for activities on Wild and Scenic Rivers or study streams, streams on the Natural Streams Preservation List or the New River Gorge National River. These streams include New River (confluence with Gauley to mouth of Greenbrier); Greenbrier River (mouth to Knapps Creek), Birch River (mouth to Cora Brown Barge in Nicholas County), Anthony Creek, Cranberry Run, Bluestone River, Gauley River, and Meadow River.

13. Each permittee shall follow the notice requirements contained in Section 9 of the Department of Natural Resources Regulations for State Certification of Activities Requiring Federal Licenses and Permits, Chapter 20-1, Series XIX (1984).

14. Each permittee shall, if he does not understand or is not aware of applicable Nationwide Permit conditions, contact the Corps of Engineers prior to conducting any activity authorized by a nationwide permit in order to be advised of applicable conditions.

** ALASKA **

EXAMPLES OF CERTIFICATION CONDITIONS REQUIRED FOR NATIONWIDE PERMIT 26 FROM ALASKA

(26) Discharges of dredged or fill material into the waters listed in subparagraph (i) and (ii) of this paragraph which do not cause the loss or substantial adverse modification of 10 acres or more of waters of the United States, including wetlands. For discharges which cause the loss or substantial adverse modification of 1 to 10 acres of such waters, including wetlands, notification of the District Engineer is required in accordance with 330.7 of this part (see Section 2 of this Public Notice).

(i) Non-tidal rivers, streams, and their lakes and impoundments, including adjacent wetlands, that are located above the headwaters.

(ii) Other non-tidal waters of the United States, including adjacent wetlands, that are not part of the surface tributary system to interstate waters or navigable waters of the United States (i.e., isolated waters).

REGIONAL CONDITION H: Work in a designated anadromous fish stream is subject to authorization from the Alaska Department of Fish and Game. (No change from REGIONAL CONDITION H previously published in SPN 84-7.)

REGIONAL CONDITION J:

a. If, during review of the pre-discharge notification, the Corps of Engineers or the designated State of Alaska reviewing officials determine that the proposed activity would occur in any of the following areas, the applicant will be advised that an individual 404 permit will be required. Where uncertainty exists, the Corps will send pre-discharge notification to the designated State officials for a determination.

1. National Wildlife Refuges
2. National Parks and Preserves
3. National Conservation Areas
4. National Wild and Scenic Rivers
5. National Experimental Areas
6. State Critical Habitat AReas
7. State Sanctuaries
8. State Ranges and Refuges
9. State Eagle Preserves
10. State Ecological Reserves and Experimental Areas
11. State Recreation Areas

12. Wetlands contiguous with designated anadromous fish streams
13. Headwaters and isolated wetlands in designated public water supply watersheds of Craig, Hoonah, Hydaburg, Anchorage, Cordova, Seldovia and Kodiak
14. Sitka Area: Wetlands in the Swan Lake Area Meriting Special Attention (AMSA) in the district Coastal Management Plan
15. Anchorage area: Designated Preservation and Conservation Wetlands in the Wetlands Management Plan
16. Bethel area: Designated Significant Wetlands in the district Coastal Management Plan not covered under General Permit 83-4
17. Hydaburg area: The six AMSA's of the district Coastal Management Plan
18. Bering Strait area: All designated conservation AMSA's of the district Coastal Management Plan
19. Juneau area: Designated Sensitive Wetlands of the district Coastal Management Plan
20. NANA: Designated Special Use Areas and Restricted/ Sensitive areas in the district Coastal Management Plan
21. Tanana Basin Area Plan: type A-1 wetlands in the Alaska Rivers Cooperative State/Federal Study
22. Susitna Area Plan: type A-1 wetlands in the Alaska Rivers Cooperative State/Federal Study
23. High value headwaters and isolated wetlands identified once the ongoing Wetlands Management Plans or Guides listed in b-5 (below) are completed
24. Alaska Natural Gas Pipeline Corridor designated type A and B wetlands
25. Headwaters and isolated waters which include identified bald eagle, peregrine falcon, and trumpeter swan nesting areas
26. ADF&G identified waterfowl use areas of statewide significance
27. Designated caribou calving areas.

Any individual permit issued in locations covered by district coastal management plans, State or Federal regional wetlands plans or local wetlands plans (numbers 14 through 23 above) will be consistent with the plan provisions for the specific wetland type and may require adding stipulations.

Oil and gas activities in the North Slope Borough which involve the discharge of dredged or fill material into waters including wetlands are not covered by the previous nationwide permit under 33 CFR 330.4(a) and (b) and are not covered under the nationwide permit 26. These activities require individual 404 permits or other general permits. These activities were previously excluded by the Corps of Engineers Special Public Notice 84-3 dated March 9, 1984.

b. Pre-discharge notification received by the Corps of Engineers for the discharge of dredged or fill material in the following areas will be provided to designated State agencies which include (1) the appropriate ADEC Regional Environmental Supervisor, (2) the appropriate ADF&G Regional Habitat Supervisor, (3) the appropriate DGC regional contact point, and (4) the appropriate DNR regional contact (should DNR indicate interest in receiving notices).

1. Headwater tributaries of designated anadromous fish streams and their adjacent contiguous wetlands
2. Open water areas of isolated wetlands greater than 10 acres and lakes greater than 10 acres above the headwaters
3. North Slope Borough wet and moist tundra areas not already covered by APP process
4. Wet and moist tundra areas outside the North Slope Borough
5. High value headwaters and isolated wetlands identified in the following ongoing State or Federal wetland management guides or plans: Mat-Su, Kenai Borough, Valdez, North Star Borough Yukon Delta and Copper River Basin
6. Headwater or isolated wetlands within local CZM district boundaries or the identified coastal zone boundary, whichever is geographically smaller (not withstanding the requirements under "a." 14.20 (above))
7. Anchorage Area: designated Special Study areas in the Wetlands Management Plan
8. Tanana Basin Area Plan: areas designated A-2, B-1, B-2 in the Alaska River Cooperative State/Federal Study
9. Susitna Area Plan: areas designated A-2, A-3, A-4 in the Alaska River Cooperative State/Federal Study

The designated officials of the State of Alaska, and the Corps will evaluate the notifications received for the areas listed "b." above under the provisions set forth in 33 CFR 330.7 (see Section 2 of this Public Notice) which includes an evaluation of the

environmental effects using the guidelines set forth in Section 404(b)(1) of the Clean Water Act. Notices shall be screened against the nationwide conditions under 330.5(b) (See Section 4 of the Public Notice) using available resource information. Conditions 330.5(b)(1), (2), (3), (4), (6), and (7) and (9) will be focused on during the State review.

The State's review of these areas under "b." above will encompass the following:

1. After receiving pre-discharge notification from the Corps, the State of Alaska shall comment verbally, and/or if time permits, in writing to the Corps District Engineer through a single State agency concerning the need for an individual permit review.

2. Existing fish and wildlife atlases and field knowledge shall be used to evaluate notices. If significant resource values are not identified for the area in question or if insufficient resource information exists, State agencies will not request an individual permit unless:

(a) An on-site field evaluation will be conducted, weather permitting, during the extended review provided under the individual permit, or;

(b) Federal resource agencies plan a similar field evaluation that could provide identical information to State resource agencies.

Should either the State review or the Corps review determine that the nationwide permit is not applicable, an individual 404 permit will be required.

New categories may be added at a later date should either the Corps or the State of Alaska recognize a need. These changes will be made available for public review through a public notice and comment period at the appropriate time.

This REGIONAL CONDITION shall be effective for the period of time that nationwide permit 26 is in effect unless the REGIONAL CONDITION is sooner revoked by the Department of the Army with prior coordination with the State of Alaska.

APPENDIX E

Subpart H—Actions To Minimize Adverse Effects

Note.—There are many actions which can be undertaken in response to § 203.10(d) to minimize the adverse effects of discharges of dredged or fill material. Some of these, grouped by type of activity, are listed in this subpart.

§ 230.70 Actions concerning the location of the discharge.

The effects of the discharge can be minimized by the choice of the disposal site. Some of the ways to accomplish this are by:

(a) Locating and confining the discharge to minimize smothering of organisms:

(b) Designing the discharge to avoid a disruption of periodic water inundation patterns:

(c) Selecting a disposal site that has been used previously for dredged material discharge:

(d) Selecting a disposal site at which the substrate is composed of material similar to that being discharged, such as discharging sand on sand or mud on mud:

(e) Selecting the disposal site, the discharge point, and the method of discharge to minimize the extent of any plume;

(f) Designing the discharge of dredged or fill material to minimize or prevent the creation of standing bodies of water in areas of normally fluctuating water levels, and minimize or prevent the drainage of areas subject to such fluctuations.

§ 230.71 Actions concerning the material to be discharged.

The effects of a discharge can be minimized by treatment of, or limitations on the material itself, such as:

(a) Disposal of dredged material in such a manner that physiochemical conditions are maintained and the potency and availability of pollutants are reduced.

(b) Limiting the solid, liquid, and gaseous components of material to be discharged at a particular site;

(c) Adding treatment substances to the discharge material;

(d) Utilizing chemical flocculants to enhance the deposition of suspended particulates in diked disposal areas.

§ 230.72 Actions controlling the material after discharge.

The effects of the dredged or fill material after discharge may be controlled by:

(a) Selecting discharge methods and disposal sites where the potential for erosion, slumping or leaching of materials into the surrounding aquatic ecosystem will be reduced. These sites or methods include, but are not limited to:

(1) Using containment levees, sediment basins, and cover crops to reduce erosion;

(2) Using lined containment areas to reduce leaching where leaching of chemical constituents from the discharged material is expected to be a problem;

(b) Capping in-place contaminated material with clean material or selectively discharging the most contaminated material first to be capped with the remaining material;

(c) Maintaining and containing discharged material properly to prevent point and nonpoint sources of pollution;

(d) Timing the discharge to minimize impact, for instance during periods of unusual high water flows, wind, wave, and tidal actions.

§ 230.73 Actions affecting the method of dispersion.

The effects of a discharge can be minimized by the manner in which it is dispersed, such as:

(a) Where environmentally desirable, distributing the dredged material widely in a thin layer at the disposal site to maintain natural substrate contours and elevation;

(b) Orienting a dredged or fill material mound to minimize undesirable obstruction to the water current or circulation pattern, and utilizing natural bottom contours to minimize the size of the mound;

(c) Using silt screens or other appropriate methods to confine suspended particulate/turbidity to a small area where settling or removal can occur;

(d) Making use of currents and circulation patterns to mix, disperse and dilute the discharge;

(e) Minimizing water column turbidity by using a submerged diffuser system. A similar effect can be accomplished by submerging pipeline discharges or otherwise releasing materials near the bottom;

(f) Selecting sites or managing discharges to confine and minimize the release of suspended particulates to give decreased turbidity levels and to maintain light penetration for organisms;

(g) Setting limitations on the amount of material to be discharged per unit of time or volume of receiving water.

§ 230.74 Actions related to technology.

Discharge technology should be adapted to the needs of each site. In determining whether the discharge operation sufficiently minimizes adverse environmental impacts, the applicant should consider:

(a) Using appropriate equipment or machinery, including protective devices, and the use of such equipment or machinery in activities related to the discharge of dredged or fill material;

(b) Employing appropriate maintenance and operation on equipment or machinery, including adequate training, staffing, and working procedures;

(c) Using machinery and techniques that are especially designed to reduce damage to wetlands. This may include machines equipped with devices that scatter rather than mound excavated materials, machines with specially designed wheels or tracks, and the use of mats under heavy machines to reduce wetland surface compaction and rutting;

(d) Designing access roads and channel spanning structures using culverts, open channels, and diversions that will pass both low and high water flows, accommodate fluctuating water levels, and maintain circulation and faunal movement;

(e) Employing appropriate machinery and methods of transport of the material for discharge.

§ 230.75 Actions affecting plant and animal populations.

Minimization of adverse effects on populations of plants and animals can be achieved by:

(a) Avoiding changes in water current and circulation patterns which would interfere with the movement of animals;

(b) Selecting sites or managing discharges to prevent or avoid creating habitat conducive to the development of undesirable predators or species which have a competitive edge ecologically over indigenous plants or animals;

(c) Avoiding sites having unique habitat or other value, including habitat of threatened or endangered species;

(d) Using planning and construction practices to institute habitat development and restoration to produce a new or modified environmental state of higher ecological value by displacement of some or all of the existing environmental characteristics. Habitat development and restoration techniques can be used to minimize adverse impacts and to compensate for destroyed habitat. Use techniques that have been demonstrated to be effective in circumstances similar to those under consideration wherever possible. Where proposed development and restoration techniques have not yet advanced to the pilot demonstration stage, initiate their use on a small scale to allow corrective action if unanticipated adverse impacts occur.

(e) Timing discharge to avoid spawning or migration seasons and other biologically critical time periods;

(f) Avoiding the destruction of remnant natural sites within areas already affected by development.

§ 230.76 Actions affecting human use.

Minimization of adverse effects on human use potential may be achieved by:

(a) Selecting discharge sites and following discharge procedures to prevent or minimize any potential damage to the aesthetically pleasing features of the aquatic site (e.g. viewscapes), particularly with respect to water quality;

(b) Selecting disposal sites which are not valuable as natural aquatic areas;

(c) Timing the discharge to avoid the seasons or periods when human recreational activity associated with the aquatic site is most important;

(d) Following discharge procedures which avoid or minimize the disturbance of aesthetic features of an aquatic site or ecosystem.

(e) Selecting sites that will not be detrimental or increase incompatible human activity, or require the need for frequent dredge or fill maintenance activity in remote fish and wildlife areas;

(f) Locating the disposal site outside of the vicinity of a public water supply intake.

§ 230.77 Other actions.

(a) In the case of fills, controlling runoff and other discharges from activities to be conducted on the fill;

(b) In the case of dams, designing water releases to accommodate the needs of fish and wildlife.

(c) In dredging projects funded by Federal agencies other than the Corps of Engineers, maintain desired water quality of the return discharge through agreement with the Federal funding authority on scientifically defensible pollutant concentration levels in addition to any applicable water quality standards.

(d) When a significant ecological change in the aquatic environment is proposed by the discharge of dredged or fill material, the permitting authority should consider the ecosystem that will be lost as well as the environmental benefits of the new system.

APPENDIX R

Policy on the Use of Biological Assessments and Criteria in the Water Quality Program

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

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

JUN. 19 1991

OFFICE OF WATER

MEMORANDUM

SUBJECT: Transmittal of Final Policy on Biological Assessments and Criteria

FROM: Tudor T. Davies, Director
Office of Science and Technology (WH-551)

TO: Water Management Division Directors
Regions I-X

Attached is EPA's "Policy on the Use of Biological Assessments and Criteria in the Water Quality Program" (Attachment A). This policy is a significant step toward addressing all pollution problems within a watershed. It is a natural outgrowth of our greater understanding of the range of problems affecting watersheds from toxic chemicals to physical habitat alteration, and reflects the need to consider the whole picture in developing watershed pollution control strategies.

This policy is the product of a broad-based workgroup chaired by Jim Plafkin and Chris Faulkner of the Office of Wetlands, Oceans and Watersheds. The workgroup was composed of representatives from seven EPA Headquarters offices, four EPA Research Laboratories, all 10 EPA Regions, U.S. Fish and Wildlife Service, U.S. Forest Service, and the States of New York and North Carolina (see Attachment B). This policy also reflects review comments to the draft policy statement issued in March of 1990. Comments were received from three EPA Headquarters offices, three EPA Research Laboratories, five EPA Regions and two States. The following sections of this memorandum provide a brief history of the policy development and additional information on relevant guidance.

Background

The Ecopolicy Workgroup was formed in response to several converging initiatives in EPA's national water program. In September 1987, a major management study entitled "Surface Water Monitoring: A Framework for Change" strongly emphasized the need to "accelerate development and application of promising biological monitoring techniques" in State and EPA monitoring programs. Soon thereafter, in December 1987, a National Workshop on Instream Biological Monitoring and Criteria reiterated this

recommendation but also pointed out the importance of integrating the biological criteria and assessment methods with traditional chemical/physical methods (see Final Proceedings, EPA-905/9-89/003). Finally, at the June 1988 National Symposium on Water Quality Assessment, a workgroup of State and Federal representatives unanimously recommended the development of a national bioassessment policy that encouraged the expanded use of the new biological tools and directed their implementation across the water quality program.

Guided by these recommendations, the workgroup held three workshop-style meetings between July and December 1988. Two major questions emerged from the lengthy discussions as issues of general concern:

ISSUE 1 - How hard should EPA push for formal adoption of biological criteria (biocriteria) in State water quality standards?

ISSUE 2 - Despite the many beneficial uses of biomonitoring information, how do we guard against potentially inappropriate uses of such data in the permitting process?

Issue 1 turns on the means and relative priority of having biological criteria formally incorporated in State water quality standards. Because biological criteria must be related to local conditions, the development of quantitative national biological criteria is not ecologically appropriate. Therefore, the primary concern is how biological criteria should be promoted and integrated into State water quality standards.

Issue 2 addresses the question of how to reconcile potential apparent conflicts in the results obtained from different assessment methods (i.e., chemical-specific analyses, toxicity testing, and biosurveys) in a permitting situation. Should the relevance of each be judged strictly on a case-by-case basis? Should each method be applied independently?

These issues were discussed at the policy workgroup's last meeting in November 1988, and consensus recommendations were then presented to the Acting Assistant Administrator of Water on December 16, 1988. For Issue 1, it was determined that adapting biological criteria to State standards has significant advantages, and adoption of biological criteria should be strongly encouraged. Therefore, the current Agency Operating Guidance establishes the State adaptation of basic narrative biological criteria as a program priority.

With respect to Issue 2, the policy reflects a position of "independent application." Independent application means that any one of the three types of assessment information (i.e., chemistry, toxicity testing results, and ecological assessment) provides conclusive evidence of nonattainment of water quality

standards regardless of the results from other types of assessment information. Each type of assessment is sensitive to different types of water quality impact. Although rare, apparent conflicts in the results from different approaches can occur. These apparent conflicts occur when one assessment approach detects a problem to which the other approaches are not sensitive. This policy establishes that a demonstration of water quality standards nonattainment using one assessment method does not require confirmation with a second method and that the failure of a second method to confirm impact does not negate the results of the initial assessment.

Review of Draft Policy

The draft was circulated to the Regions and States on March 23, 1990. The comments were mostly supportive and most of the suggested changes have been incorporated. Objections were raised by one State that using ecological measures would increase the magnitude of the pollution control workload. We expect that this will be one result of this policy but that our mandate under the Clean Water Act to ensure physical, chemical, and biological integrity requires that we adopt this policy. Another State objected to the independent application policy. EPA has carefully considered the merits of various approaches to integrating data in light of the available data, and we have concluded that independent application is the most appropriate policy at this time. Where there are concerns that the results from one approach are inaccurate, there may be opportunities to develop more refined information that would provide a more accurate conclusion (e.g., better monitoring or more sophisticated wasteload allocation modelling).

Additional discussion on this policy occurred at the Water Quality Standards for the 21st Century Symposium in December, 1990.

What Actions Should States Take

This policy does not require specific actions on the part of the States or the regulated community. As indicated under the Fiscal Year 1991 Agency Operating Guidance, States are required to adopt narrative biocriteria at a minimum during the 1991 to 1993 triennial review. More specific program guidance on developing biological criteria is scheduled to be issued within the next few months. Technical guidance documents on developing narrative and numerical biological criteria for different types of aquatic systems are also under development.

Relevant Guidance

There are several existing EPA documents which pertain to biological assessments and several others that are currently under development. Selected references that are likely to be important in implementing this policy are listed in Attachment C.

Please share this policy statement with your States and work with them to institute its provisions. If you have any questions, please call me at (FTS) 382-5400 or have your staff contact Geoffrey Grubbs of the Office of Wetlands, Oceans and Watersheds at (FTS) 382-7040 or Bill Diamond of the Office of Science and Technology at (FTS) 475-7301.

Attachments

cc: OW Office Directors
Environmental Services Division Directors, Regions I-X

Attachment A

Policy on the Use of Biological Assessments and Criteria in the Water Quality Program

May 1991

Contents

Statement of Policy

Definitions

Background

- Context of Policy
- Rationale for Conducting Biological Assessments

Conduct of Biological Surveys

Integration of Methods and Regulatory Application

- Site-specific Considerations
- Independent Application

Biological Criteria

Statutory Basis

- Section 303(c)
- Section 304(a)

State/EPA Roles in Policy Implementation

- State Implementation
- EPA Guidance and Technical Support

Statement of Policy

To help restore and maintain the biological integrity of the Nation's waters, it is the policy of the Environmental Protection Agency (EPA) that biological surveys shall be fully integrated with toxicity and chemical-specific assessment methods in State water quality programs. EPA recognizes that biological surveys should be used together with whole-effluent and ambient toxicity testing, and chemical-specific analyses to assess attainment/nonattainment of designated aquatic life uses in State water quality standards. EPA also recognizes that each of these three methods can provide a valid assessment of designated aquatic life use impairment. Thus, if any one of the three assessment methods demonstrate that water quality standards are not attained, it is EPA's policy that appropriate action should be taken to achieve attainment, including use of regulatory authority.

It is also EPA's policy that States should designate aquatic life uses that appropriately address biological integrity and adopt biological criteria necessary to protect those uses. Information concerning attainment/nonattainment of standards should be used to establish priorities, evaluate the effectiveness of controls, and make regulatory decisions.

Close cooperation among the States and EPA will be needed to carry out this policy. EPA will provide national guidance and technical assistance to the States; however, specific assessment methods and biological criteria should be adopted on a State-by-State basis. EPA, in its oversight role, will work with the States to ensure that assessment procedures and biological criteria reflect important ecological and geographical differences among the Nation's waters yet retain national consistency with the Clean Water Act.

Definitions

Ambient Toxicity: Is measured by a toxicity test on a sample collected from a waterbody.

Aquatic Community: An association of interacting populations of aquatic organisms in a given waterbody or habitat.

Aquatic Life Use: Is the water quality objective assigned to a waterbody to ensure the protection and propagation of a balanced, indigenous aquatic community.

Biological Assessment: An evaluation of the biological condition of a waterbody using biological surveys and other direct measurements of resident biota in surface waters.

Biological Criteria (or Biocriteria): Numerical values or narrative expressions that describe the reference biological integrity of aquatic communities inhabiting waters of a given designated aquatic life use.

Biological Integrity: Functionally defined as the condition of the aquatic community inhabiting unimpaired waterbodies of a specified habitat as measured by community structure and function.

Biological Monitoring: Use of a biological entity as a detector and its response as a measure to determine environmental conditions. Toxicity tests and biosurveys are common biomonitoring methods.

Biological Survey (or Biosurvey): Consists of collecting, processing, and analyzing a representative portion of the resident aquatic community to determine the community structure and function.

Community Component: Any portion of a biological community. The community component may pertain to the taxonomic group (fish, invertebrates, algae), the taxonomic category (phylum, order, family, genus, species), the feeding strategy (herbivore, omnivore, carnivore), or organizational level (individual, population, community association) of a biological entity within the aquatic community.

Habitat Assessment: An evaluation of the physical characteristics and condition of a waterbody (example parameters include the variety and quality of substrate, hydrological regime, key environmental parameters and surrounding land use.)

Toxicity Test: Is a procedure to determine the toxicity of a chemical or an effluent using living organisms. A toxicity test measures the degree of response of exposed test organisms to a specific chemical or effluent.

Whole-effluent Toxicity: Is the total toxic effect of an effluent measured directly with a toxicity test.

Background

Policy context

Monitoring data are applied toward water quality program needs such as identifying water quality problems, assessing their severity, and setting planning and management priorities for remediation. Monitoring data should also be used to help make regulatory decisions, develop appropriate controls, and evaluate the effectiveness of controls once they are implemented. This policy focuses on the use of a particular type of monitoring information that is derived from ambient biosurveys, and its proper integration with chemical-specific analyses, toxicity testing methods, and biological criteria in State water quality programs.

The distinction between biological surveys, assessments and criteria is an important one. Biological surveys, as stated in the section above, consist of the collection and analysis of the resident aquatic community data and the subsequent determination of the aquatic community's structure and function. A biological assessment is an evaluation of the biological condition of a waterbody using data gathered from biological surveys or other direct measures of the biota. Finally, biological criteria are the numerical values or narrative expressions used to describe the expected structure and function of the aquatic community.

Rationale for Conducting Biological Assessments

To more fully protect aquatic habitats and provide more comprehensive assessments of aquatic life use attainment/nonattainment, EPA expects States to fully integrate chemical-specific techniques, toxicity testing, biological surveys and biological criteria into their water quality programs. To date, EPA's activities have focused on the interim goal of the Clean Water Act (the Act), stated in Section 101(a)(2): To achieve; "...wherever attainable, an interim goal of water quality which provides for protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water...." However, the ultimate objective of the Act, stated in Section 101(a), goes further. Section 101(a) states: "The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Taken together, chemical, physical, and biological integrity define the overall ecological integrity of an aquatic ecosystem. Because biological integrity is a strong indicator of overall ecological integrity, it can serve as both a meaningful goal and a useful measure of environmental status that relates directly to the comprehensive objective of the Act.

Deviations from, and threats to, biological integrity can be estimated indirectly or directly. Traditional measures, such as chemical-specific analyses and toxicity tests, are indirect estimators of biological conditions. They assess the suitability of the waters to support a healthy community, but they do not directly assess the community itself. Biosurveys are used to directly evaluate the overall structural and/or functional characteristics of the aquatic community. Water quality programs should use both direct and indirect methods to assess biological conditions and to determine attainment/nonattainment of designated aquatic life uses.

Adopting an integrated approach to assessing aquatic life use attainment/nonattainment represents the next logical step in the evolution of the water quality program. Historically, water quality programs have focused on evaluating the impacts of specific chemicals discharged from discreet point sources. In 1984, the program scope was significantly broadened to include a combination of chemical-specific and whole-effluent toxicity testing methods to evaluate and predict the biological impacts of potentially toxic mixtures in wastewater and surface waters. Integration of these two indirect measures of biological impact into a unified assessment approach has been discussed in detail in national policy (49 FR 9016) and guidance (EPA-440/4-85-032). This approach has proven to be an effective means of assessing and controlling toxic pollutants and whole-effluent toxicity originating from point sources. Additionally, direct measures of biological impacts, such as biosurvey and bioassessment techniques, can be useful for regulating point sources. However, where pollutants and pollutant sources are difficult to characterize or aggregate impacts are difficult to assess (e.g., where discharges are multiple, complex, and variable; where point and nonpoint sources are both potentially important; where physical habitat is potentially limiting), direct measures of ambient biological conditions are also needed.

Biosurveys and biological criteria add this needed dimension to assessment programs because they focus on the resident community. The effects of multiple stresses and pollution sources on the numerous biological components of resident communities are integrated over a relatively long period of time. The community thus provides a useful indicator of both aggregate ecological impact and overall temporal trends in the condition of an aquatic ecosystem. Furthermore, biosurveys can detect aquatic life impacts that other available assessment methods may miss. Biosurveys detect impacts caused by: (1) pollutants that are difficult to identify chemically or characterize toxicologically (e.g., rare or unusual toxics [although biosurveys cannot themselves identify specific toxicants causing toxic impact], "clean" sediment, or nutrients); (2) complex or unanticipated exposures (e.g., combined point and non-point source loadings, storm events, spills); and perhaps most importantly, (3) habitat degradation (e.g., channelization, sedimentation, historical contamination), which disrupt the interactive balance among community components.

Biosurveys and biological criteria provide important information for a wide variety of water quality program needs. This data could be used to:

- Refine use classifications among different types of aquatic ecosystems (e.g., rivers, streams, wetlands, lakes, estuaries, coastal and marine waters) and within a given type of use category such as warmwater fisheries;
- Define and protect existing aquatic life uses and classify Outstanding National Resource Waters under State antidegradation policies as required by the Water Quality Standards Regulation (40 CFR 131.12);
- Identify where site-specific criteria modifications may be needed to effectively protect a waterbody;
- Improve use-attainability studies;
- Fulfill requirements under Clean Water Act Sections 303(c), 303(d), 304(l), 305(b), 314, and 319;
- Assess impacts of certain nonpoint sources and, together with chemical-specific and toxicity methods, evaluate the effectiveness of nonpoint source controls;
- Develop management plans and conduct monitoring in estuaries of national significance under Section 320;
- Monitor the overall ecological effects of regulatory actions under Sections 401, 402, and 301(h);
- Identify acceptable sites for disposal of dredge and fill material under Section 404 and determine the effects of that disposal;
- Conduct assessments mandated by other statutes (e.g., CERCLA/RCRA) that pertain to the integrity of surface waters; and
- Evaluate the effectiveness and document the instream biological benefits of pollution controls.

Conduct of Biological Surveys

As is the case with all types of water quality monitoring programs, biosurveys should have clear data quality objectives, use standardized, validated

laboratory and field methods, and include appropriate quality assurance and quality control practices. Biosurveys should be tailored to the particular type of waterbody being assessed (e.g., wetland, lake, stream, river, estuary, coastal or marine water) and should focus on community components and attributes that are both representative of the larger community and are practical to measure. Biosurveys should be routinely coupled with basic physicochemical measurements and an objective assessment of habitat quality. Due to the importance of the monitoring design and the intricate relationship between the biosurvey and the habitat assessment, well-trained and experienced biologists are essential to conducting an effective biosurvey program.

Integration of Assessment Methods and Regulatory Application

Site-specific Considerations

Although biosurveys provide direct information for assessing biological integrity, they may not always provide the most accurate or practical measure of water quality standards attainment/nonattainment. For example, biosurveys and measures of biological integrity do not directly assess nonaquatic life uses, such as agricultural, industrial, or drinking water uses, and may not predict potential impacts from pollutants that accumulate in sediments or tissues. These pollutants may pose a significant long-term threat to aquatic organisms or to humans and wildlife that consume these organisms, but may only minimally alter the structure and function of the ambient community. Furthermore, biosurveys can only indicate the presence of an impact; they cannot directly identify the stress agents causing that impact. Because chemical-specific and toxicity methods are designed to detect specific stressors, they are particularly useful for diagnosing the causes of impact and for developing source controls. Where a specific chemical or toxicity is likely to impact standards attainment/nonattainment, assessment methods that measure these stresses directly are often needed.

Independent Application

Because biosurvey, chemical-specific, and toxicity testing methods have unique as well as overlapping attributes, sensitivities, and program applications, no single approach for detecting impact should be considered uniformly superior to any other approach. EPA recognizes that each method can provide valid and independently sufficient evidence of aquatic life use impairment, irrespective of any evidence, or lack of it, derived from the other two approaches. The failure of one method to confirm an impact identified by another method would not negate the results of the initial assessment. This policy, therefore, states that appropriate action should be taken when any one of the three types of assessment determines that the standard is not attained. States are encouraged to implement and integrate all three approaches into their water quality programs and apply them in combination or independently as site-specific conditions and

assessment objectives dictate.

In cases where an assessment result is suspected to be inaccurate, the assessment may be repeated using more intensive and/or accurate methods. Examples of more intensive assessment methods are dynamic modelling instead of steady state modelling, site specific criteria, dissolved metals analysis, and a more complete biosurvey protocol.

Biological Criteria

To better protect the integrity of aquatic communities, it is EPA's policy that States should develop and implement biological criteria in their water quality standards.

Biological criteria are numerical measures or narrative descriptions of biological integrity. Designated aquatic life use classifications can also function as narrative biological criteria. When formally adopted into State standards, biological criteria and aquatic life use designations serve as direct, legal endpoints for determining aquatic life use attainment/nonattainment. Per Section 131.11(b)(2) of the Water Quality Standards Regulation (40 CFR Part 131), biological criteria can supplement existing chemical-specific criteria and provide an alternative to chemical-specific criteria where such criteria cannot be established.

Biological criteria can be quantitatively developed by identifying unimpaired or least-impacted reference waters that operationally represent best attainable conditions. EPA recommends States use the ecoregion concept when establishing a list of reference waters. Once candidate references are identified, integrated assessments are conducted to substantiate the unimpaired nature of the reference and to characterize the resident community. Biosurveys cannot fully characterize the entire aquatic community and all its attributes. Therefore, State standards should contain biological criteria that consider various components (e.g., algae, invertebrates, fish) and attributes (measures of structure and/or function) of the larger aquatic community. In order to provide maximum protection of surface water quality, States should continue to develop water quality standards integrating all three assessment methods.

Statutory Basis

Section 303(c)

The primary statutory basis for this policy derives from Section 303 of the Clean Water Act. Section 303 requires that States adopt standards for their waters and review and revise these standards as appropriate, or at least once every three years. The Water Quality Standards Regulation (40 CFR 131)

requires that such standards consist of the designated uses of the waters involved, criteria based upon such uses, and an antidegradation policy.

Each State develops its own use classification system based on the generic uses cited in the Act (e.g., protection and propagation of fish, shellfish, and wildlife). States may also subcategorize types of uses within the Act's general use categories. For example, aquatic life uses may be subcategorized on the basis of attainable habitat (e.g., cold- versus warm-water habitat), innate differences in community structure and function (e.g., high versus low species richness or productivity), or fundamental differences in important community components (e.g., warm-water fish communities naturally dominated by bass versus catfish). Special uses may also be designated to protect particularly unique, sensitive or valuable aquatic species, communities, or habitats.

Each State is required to "specify appropriate water uses to be achieved and protected" (40 CFR 131.10). If an aquatic life use is formally adopted for a waterbody, that designation becomes a formal component of the water quality standards. Furthermore, nonattainment of the use, as determined with either biomonitoring or chemical-specific assessment methods, legally constitutes nonattainment of the standard. Therefore, the more refined the use designation, the more precise the biological criteria (i.e., the more detailed the description of desired biological attributes), and the more complete the chemical-specific criteria for aquatic life, the more objective the assessment of standards attainment/nonattainment.

Section 304(a)

Section 304(a) requires EPA to develop and publish criteria and other scientific information regarding a number of water-quality-related matters, including:

- Effects of pollutants on aquatic community components ("Plankton, fish, shellfish, wildlife, plant life...") and community attributes ("diversity, productivity, and stability...");
- Factors necessary "to restore and maintain the chemical, physical, biological integrity of all navigable waters...", and "for protection and propagation of shellfish, fish, and wildlife for classes and categories of receiving waters...";
- Appropriate "methods for establishing and measuring water quality criteria for toxic pollutants on other bases than pollutant-by-pollutant criteria, including biological monitoring and assessment methods."

This section of the Act has been historically cited as the basis for

publishing national guidance on chemical-specific criteria for aquatic life, but is equally applicable to the development and use of biological monitoring and assessment methods and biological criteria.

State/EPA Roles in Policy Implementation

State Implementation

Because there are important qualitative differences among aquatic ecosystems (streams, rivers, lakes, wetlands, estuaries, coastal and marine waters), and there is significant geographical variation even among systems of a given type, no single set of assessment methods or numeric biological criteria is fully applicable nationwide. Therefore, States must take the primary responsibility for adopting their own standard biosurvey methods, integrating them with other techniques at the program level, and applying them in appropriate combinations on a case-by-case basis. Similarly, States should develop their own biological-criteria and implement them appropriately in their water quality standards.

EPA Guidance and Technical Support

EPA will provide the States with national guidance on performing technically sound biosurveys, and developing and integrating biological criteria into a comprehensive water quality program. EPA will also supply guidance to the States on how to apply ecoregional concepts to reference site selection. In addition, EPA Regional Administrators will ensure that each Region has the capability to conduct fully integrated assessments and to provide technical assistance to the States.

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Attachment B

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Attachment C

Relevant Guidance

Existing documents

- Chemical-specific evaluations

  Guidance for Deriving National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses (45 FR 79342, November 28, 1990, as amended at 50 FR 30784, July 29, 1985)

  Quality Criteria for Water 1986 (EPA 440/5-86-001, May 1, 1987)

- Toxicity testing

  Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Second Edition (EPA/600-4-89-001), March 1989)

  Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms (EPA/600-4-87/028, May 1988)

  Methods for Measuring Acute Toxicity of Effluents to Freshwater and Marine Organisms (EPA/600-4-85-013, March 1985)

- Biosurveys and integrated assessments

  Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses: Volumes I-III (Office of Water Regulations and Standards, November 1983-1984)

  Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90/001, March 1991)

  Rapid Bioassessment Protocols for Streams and Rivers: Benthic Macro-invertebrates and Fish (EPA/444-4-89-001, May 1989)

  Hughes, Robert M. and David P. Larsen. 1988. Ecoregions: An Approach to Surface Water Protection. Journal of the Water Pollution Control Federation 60, No. 4: 486-93.

  Omerik, J.M. 1987. Ecoregions of the Coterminous United States. Annals of the Association of American Geographers 77, No. 1: 118-25.

Regionalization as a Tool for Managing Environmental Resources (EPA/600-3-89-060, July 1989)

EPA Biological Criteria - National Program Guidance for Surface Waters (EPA/440-5-90-004, April 1990)

Documents being developed

Technical Guidance on the Development of Biological Criteria

State Development of Biological Criteria (case studies of State implementation)

Monitoring Program Guidance

Sediment Classification Methods Compendium

Macroinvertebrate Field and Laboratory Manual for Evaluating the Biological Integrity of Surface Waters

Fish Field and Laboratory Manual for Determining the Biological Integrity of Surface Waters

APPENDIX S

Reserved

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

APPENDIX T

Use Attainability Analysis
Case Studies

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

CASE STUDIES

Introduction

The Water Body Survey and Assessment Guidance for Conducting Use Attainability Analyses provides guidance on the factors that may be examined to determine if an aquatic life protection use is attainable in a given stream or river system. The guidance proposed that States perform physical, chemical and biological evaluations in order to determine the existing and potential uses of a water body. The analyses suggested within this guidance represent the type of analyses EPA believes are sufficient for States to justify changes in uses designated in a water quality standard and to show in Advanced Treatment Project Justifications that the uses are attainable. States are also encouraged to use alternative analyses as long as they are scientifically and technically supportable. Furthermore, the guidance also encourages the use of existing data to perform the physical, chemical and biological evaluations and whenever possible States should consider grouping water bodies having similar physical and chemical characteristics to treat several water bodies or segments as a single unit.

Using the framework provided by this guidance, studies were conducted to (1) test the applicability of the guidance, (2) familiarize State and Regional personnel with the procedures and (3) identify situations where additional guidance is needed. The results of these case studies, which are summarized in this Handbook, pointed out the following:

(1) The Water Body Surveys and Assessment guidance can be applied and provides a good framework for conducting use attainability analyses;
(2) The guidance provides sufficient flexibility to the States in conducting such analyses; and,
(3) The case studies show that EPA and States can cooperatively agree to the data and analyses needed to evaluate the existing and potential uses.

Upon completion of the case studies, several States requested that EPA provide additional technical guidance on the techniques mentioned in the guidance document. In order to fulfill these requests, EPA has developed a technical support manual on conducting attainability analyses and is continuing research to develop new cost effective tools for conducting such analyses. EPA is striving to develop a partnership with States to improve the scientific and technical bases of the water quality standards decision-making process and will continue to provide technical assistance.

The summaries of the case studies provided in this Handbook illustrate the different methods States used in determining the existing and potential uses. As can be seen, the specific analyses used were dictated by (1) the characteristics of the site, (2) the

States capabilities and technical expertise using certain methods and (3) the availability of data. EPA is providing these summaries to show how use attainability analyses can be conducted. States will find these case studies informative on the technical aspects of use attainability analyses and will provide them with alternate views on how such analyses may be conducted.

WATER BODY SURVEY AND ASSESSMENT
Assabet River, Massachusetts

I. INTRODUCTION

A. Site Description

The drainage basin of the Assabet River comprises 175 square miles located in twenty towns in East-Central Massachusetts. The Assabet River begins as the outflow from a small wildlife preservation impoundment in the Town of Westborough and flows northeast through the urban centers of Northborough, Hudson, Maynard and Concord to its confluence with the Sudbury River, forming the Concord River. Between these urbanized centers, the river is bordered by stretches of rural and undeveloped land. Similarly, the vast majority of the drainage basin is characterized by rural development. Figure 1 presents a schematic diagram of the drainage basin.

The Assabet River provides the opportunity to study a repeating sequence of water quality degradation and recovery. One industrial and six domestic wastewater treatment plants (WWTP) discharge their effluents into this 31-mile long river. All of the treatment plants presently provide secondary or advanced secondary treatment, although many of them are not performing to their design specifications. Most of the treatment plants are scheduled to be upgraded in the near future.

Interspersed among the WWTP discharges are six low dams, all but one of which were built at least a half century ago. All are "run-of-the-river" structures varying in height from three to eleven feet. The last dam built on the river was a flood control structure completed in 1980.

The headwaters of the Assabet River are formed by the discharge from a wildlife preservation impoundment, and are relatively "clean" except for low dissolved oxygen (DO) and high biochemical oxygen demand (BOD) during winter and summer. Water is discharged from the preserve through the foot of the dam that forms the impoundment, and therefore, tends to be low in DO. DO and BOD problems in the impoundment are attributed to winter ice cover and peak algal growth in summer. After the discharge of effluents from the Westborough and Shrewsbury municipal wastewater treatment plants, the river enters its first degradation/recovery cycle. The cycle is repeated as the river receives effluent from the four remaining domestic treatment plants. Water quality problems in the river are magnified when the effluents are discharged into the head of an impoundment. However, the flow of water over the dams also serves as a primary means of reaeration in the river, and thus, the dams also become a major factor in the recovery segment of the cycle. Water quality surveys performed in 1979 showed violations of the fecal coliform, phosphorus, and dissolved oxygen criteria throughout the river.

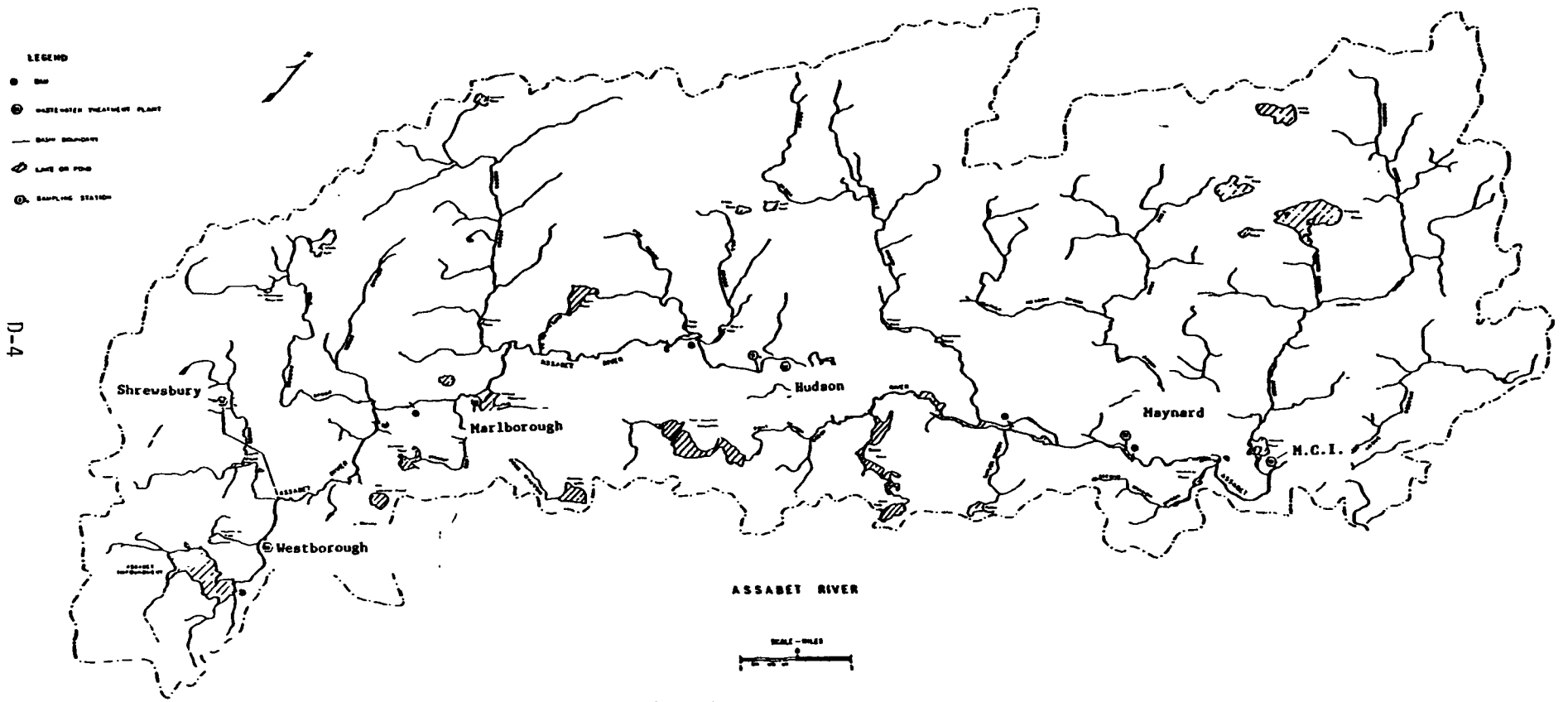


Figure 1 ASSABET RIVER DRAINAGE SYSTEM

At present, the entire length of the Assabet River is classified B, which is designated for the protection and propagation of fish, other aquatic life and wildlife, and for primary and secondary recreation. Two different uses have been designated for the Assabet River--from river mile 31.8 to 12.4 the designated use is "aquatic life" and from river mile 12.4 to the confluence with the Sudbury River the designated use is a "warm water fishery". The difference in these designated uses is that maintenance of a warm water fishery has a maximum temperature criterion of 83 degrees F, and a minimum DO of 5 mg/l. There are no temperature or DO criteria associated with the aquatic life use. These designations seem contrary to the existing data, which document violations of both criteria in the lower reaches of the river where warm water fishery is the designated use.

B. Problem Definition

The Assabet River was managed as a put and take trout fishery prior to the early 1970s when the practice was stopped on advisement of the MDWPC because of poor water quality conditions in the river. While the majority of the water quality problems are attributable to the wastewater treatment plant discharges, the naturally low velocities in the river, compounded by its impoundment in several places, led to the examination of both factors as contributors to the impairment of aquatic life uses. This combination of irreversible physical factors and wastewater treatment plant-induced water quality problems led to the selection of the Assabet River for this water body survey.

C. Approach to Use Attainability Analysis

Assessment of the Assabet River is based on the previously mentioned site visits and discussions among representatives of the Massachusetts Division of Water Pollution Control (MDWPC); the U.S. Environmental Protection Agency (EPA); and the Massachusetts Fish and Wildlife Division. This assessment is also based in part upon findings reported in the field and laboratory analyses on the Assabet River in early June, 1979, and again in early August, 1979. These surveys are part of the on-going MDWPC monitoring program, which included similar water quality assessments of the Assabet in 1969 and 1974. The water quality monitoring includes extensive information on the chemical characteristics of the Assabet River.

Analyses Conducted

A review of physical, chemical and biological information was conducted to determine which aquatic life use designations would be appropriate.

A. Physical Factors

The low flow condition of the river during the summer months may have an impact on the ability of certain fish species to survive. Various percentages of average annual flow (AAF) have been used to describe stream regimens for critical fisheries flow. As reported in

Cortell (1977), studies conducted by Tennant indicate that 10%, 30%, and 60% of AAF describe the range of fisheries flows from absolute minimum (10% AAF) to optimum (60% of AAF). The average annual flow of the Assabet River, as calculated from 39 years of record at the USGS gauge at river mile 7.7, is 183 cfs. Flow measurements taken at the USGS gauge on four consecutive days in early August, 1979, were 43, 34, 27, and 33 cfs. These flows average about 19 percent of the AAF indicating that some impairment of the protection of fish species may occur due to low flow in the river. The 7-day 10-year low flow for this reach of the river is approximately 18 to 20 cfs.

The outstanding physical features of the Assabet River are the dams, which have a significant influence on the aquatic life of the river. Most fish are incapable of migrating upstream of the dams, thus limiting their ability to find suitable (sufficient) habitats when critical water quality conditions occur. The low flow conditions downstream of the dams during dry periods also result in high water temperatures, further limiting fish survival in the river.

B. Biological Factors

As with data on the physical parameters for the Assabet River, biological data are sparse. The last fish survey of the Assabet River was conducted by the Massachusetts Fish and Wildlife Division in 1952. Yellow perch, bluegills, pickerel, sunfish, and bass were all observed. The Assabet River was sampled by the MDWPC for macroinvertebrates at five locations in June, 1979, as part of an intensive water quality survey.

The data were reviewed and analyses performed to determine whether conditions preclude macroinvertebrate habitats. The results were inconclusive.

C. Chemical Factors

Of all the chemical constituents measured in the June and August, 1979, water quality surveys, dissolved oxygen, ammonia nitrogen, and temperature have the greatest potential to limit the survival of aquatic life. Ammonia toxicity was investigated using the criteria outlined in Water Quality Criteria 1972. The results of this analysis indicate that the concentration of un-ionized ammonia would need to be increased approximately three times before acute mortality in the species of fish listed would occur. Therefore, ammonia is not a problem.

Temperatures in the lower reaches of the Assabet frequently exceed the maximum temperature criteria (83 degrees F) for maintenance of a warm water fishery. However, temperature readings were taken in early and late afternoon and are believed to be surface water measurements. They are short-term localized observations and should not preclude the maintenance of a warm water fishery in those reaches. Dissolved oxygen concentrations above Maynard are unsuitable for supporting cold or warm water fisheries, but are sufficient to support a fishery below this point.

The impoundments may exhibit water quality problems in the form of high surface temperatures and low bottom DO. Surface temperatures have been found to be similar to those in the remainder of the river. The only depth sample was at 13 feet in the wildlife impoundment, where the temperature was 63 degrees F, while 83 degrees F at the surface. While such bottom temperatures are likely to be sufficient to support a cold water fishery, it is likely that the DO at the bottom of the impoundments will be near zero due to benthic demands and lack of surface aeration, which would preclude the survival of any fish.

Findings

The data, observations, and analyses as presented herein lead to the conclusion that there are four possible uses for the Assabet: aquatic life, warm water fishery, cold water fishery, and seasonal cold water fishery. The seasonal fishery would be managed by stocking the river during the spring.

These uses were analyzed under three water quality conditions: existing, existing without the wastewater discharges, and inclusion of the wastewater effluent discharges with treatment at the levels stipulated in the 1981 Suasco Basin Water Quality Management Plan. The no discharge condition is included as a baseline that represents the quality under "natural" conditions.

A. Existing Uses

A limited number of warm water fish species predominate in the Assabet River under existing conditions. The species should not be different from those observed during the 1952 survey. The combination of numerous low-level dams and wastewater treatment plants with low flow conditions in the summer results in dissolved oxygen concentrations and temperatures which place severe stress on the metabolism of the fish.

The observed temperatures are most conducive to support the growth of coarse fish, including pike, perch, walleye, smallmouth and largemouth bass, sauger, bluegill and crappie.

The minimum observed DO concentrations are unacceptable for the protection of any fish. Water Quality Criteria establishes the values 6.8, 5.6, and 4.2 mg/l of DO for high, moderate, and low levels of protection of fish for rivers with the temperature characteristics of the Assabet. The Draft National Criteria for Dissolved Oxygen in Freshwater establishes criteria as 3.0 mg/l for survival, 4.0 mg/l for moderate production impairment, 5.0 mg/l for slight impairment, and 6.0 for no production impairment. The upper reaches will not even support a warm water fishery at the survival level, except in the uppermost reach. On the other hand, the lower reaches can support a warm water fishery under existing conditions.

B. Potential Uses

The potential aquatic life uses of the Assabet River would be restricted by temperature and low flow, and by physical barriers that would exist even if water quality (measured in terms of DO and bacteria) is significantly improved. Despite an overall improvement in treated effluent quality, the river would be suitable for aquatic life, as it is currently, and would continue to be too warm to support a cold water fishery in the summertime. The possibility of maintaining the cold water species in tributaries during the summer was investigated, but there are no data on which to draw conclusions. Water quality observations in the only tributary indicate temperatures similar to those in the mainstem. Therefore, the maintenance of a cold water fishery in the Assabet is considered unfeasible.

The attainable uses in the river without discharges or at planned levels of treatment are warm water fishery and seasonal cold water fishery. These uses are both attainable throughout the basin, but may be impaired in Reach 1, as the water naturally entering Reach 1 from the wildlife preservation impoundment is low in DO. The seasonal cold water fishery is attainable because the discharge limits are established to maintain a DO of 5 mg/l under 7Q10 conditions. If the DO is 5 mg/l under summer low flow conditions, it will certainly be 6 mg/l or greater during the colder, higher flow spring stocking period, and a seasonal cold water fishery would be attainable.

According to the Fish and Wildlife Division, the impoundments of the Assabet River have the potential to be a valuable warm water fishery. The reaches of the river that have a non-vegetated gravel bottom also have a high potential to support a significant fishery because these habitats allow the benthic invertebrates that comprise the food supply for the fish to flourish. It was further suggested that if the dissolved oxygen concentration could be maintained above 5 mg/l, the river could again be stocked as a put and take trout fishery in the spring.

Summary and Conclusions

The low flow conditions of the Assabet River have been exacerbated by the low dams which span its course. In the summer months, the flow in the river is slowed as the river passes through its impoundments and flow below the dams is often reduced to a relative trickle. When flow is reduced, temperatures in the shallow river (easily walkable in many places) can exceed the maximum temperature criterion for protection and propagation of a warm water fishery. Additionally, the dams limit the mobility of fish. At present, most of the river reaches also undergo extensive degradation due to the discharge of wastewater treatment plant effluent which is manifest in low dissolved oxygen concentrations. All of these factors impair the aquatic life potential of the Assabet River.

Three use levels corresponding with three alternative actions related to the wastewater discharges are possible in the Assabet. The no action alternative would result in very low dissolved oxygen concentrations in many reaches which are appropriate only for the use designation of aquatic life and warm water fishery. In this scenario, fish would only survive in the lowest river reaches, and aquatic life would be limited to sludge worms and similar invertebrates in the upper reaches. The remaining two alternatives are related to upgrading treatment plants in the basin. If the discharges are improved sufficiently to raise the instream DO to 5 mg/l throughout, as stipulated in the 1981 Water Quality Management Plan, it will be suitable as a warm water or seasonal cold water fishery. Should the discharge be eliminted altogether, the same uses would be attainable.

The treatment plant discharges inhibit the protection and propagation of aquatic life. Most of the treatment plants are scheduled to be upgraded in the near future, which would relieve the existing dissolved oxygen problems. Even if the river is returned to relatively pristine conditions, the type of fish that would be able to propagate there would not change, due to the existing physical conditions. However, the extent of their distribution, their abundance, and the health of the biota would be likely to increase.

The present use designations of the Assabet River are sufficient to characterize the aquatic life use it is capable of supporting, while physical barriers prevent the year-round attainment of a "higher" aquatic life use. The potential aquatic life uses could include extension of the warm water and seasonal cold water fishery classifications to the entire length of the river, should the planned improvements to the wastewater treatment plants be implemented.

WATER BODY SURVEY AND ASSESSMENT
Blackwater River
Franklin, Virginia

I. INTRODUCTION

A. Site Description

The area of the Blackwater River which was chosen for this study extends from Joyner's Bridge (Southampton County, Route 611) to Cobb's Wharf near its confluence with the Nottoway River (Table 1 and Figure 1). In addition, data from the USGS gaging station near Burdette (river mile 24.57) provided information on some physical characteristics of the system.

TABLE 1

Sampling Locations for Blackwater River Use Attainability Survey

Station No.	Location	River Mile
1	Vicinity Joyner's Bridge, Route 611	20.90
2	Below Franklin Sewage Treatment Plant Discharge	13.77
3	Vicinity Cobb's Wharf, Route 687	2.59

The mean annual rainfall is 48 inches, much of which occurs in the summer in the form of thunderstorms. The SCS has concluded that approximately 41,000 tons of soil are transported to streams in the watershed due to rainfall induced erosion. Seventy (70) percent of this originates from croplands, causing a potential pollution problem from pesticides and from fertilizer based nutrients. In addition, 114,000 pounds of animal waste are produced annually, constituting the only other major source of non-point pollution.

There are two primary point source discharges on the Blackwater River. The Franklin Sewage Treatment Plant at Station 2 discharges an average of 1.9 mgd of municipal effluent. The discharge volume exceeds NPDES permit levels due to inflow and infiltration problems. The plant has applied for a federal grant to upgrade treatment. The second discharge is from Union Camp Corporation, an integrated kraft mill that produces bleached paper and bleached board products. The primary by-products are crude tall oil and crude sulfate turpentine. Union Camp operates at 36.6 mgd but retains its treated waste in lagoons until the winter months when it is discharged. The

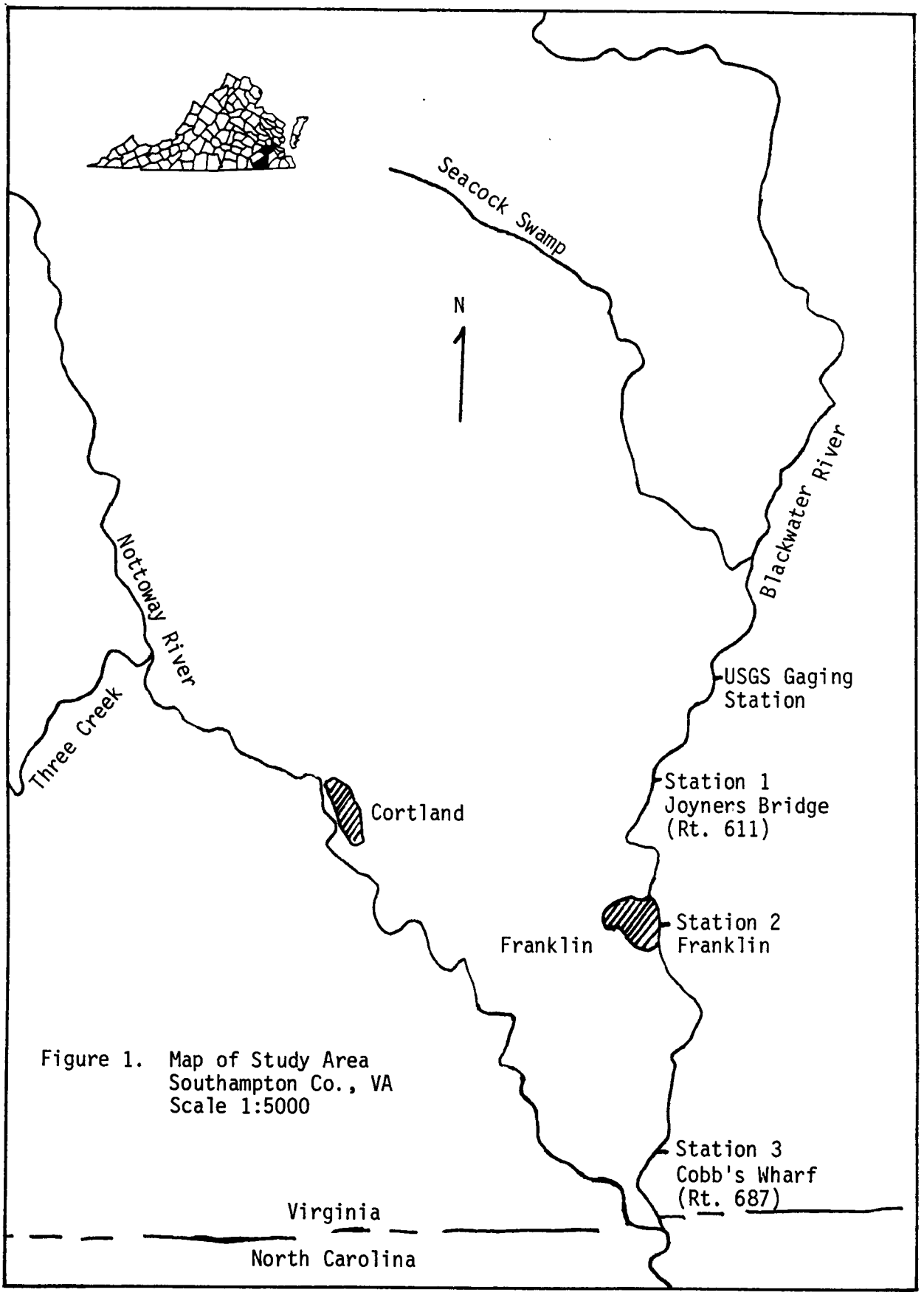


Figure 1. Map of Study Area
Southampton Co., VA
Scale 1:5000

Union Camp discharge point is downstream from Station 3 just above the North Carolina State line at river mile 0.70.

The topography surrounding the Blackwater River is essentially flat and the riparian zone is primarily hardwood wetlands. There is a good surface water supply from several swamps. At the USGS gaging station near Burdette, Virginia, the discharge for calendar year 1980 averaged 430 cfs.

The Blackwater River from Joyner's Bridge (Station 1) to Franklin is classified by the State Water Control Board (SWCB) as a Class III free flowing stream. This classification requires a minimum dissolved oxygen concentration of 4.0 mg/l and a daily average of 5.0 mg/l. Other applicable standards are maintenance of pH from 6.0 to 8.5 and a maximum temperature of 32°C. The riparian zone is heavily wooded wetlands with numerous channel obstructions. Near Franklin the canopy begins to open and there is an increasing presence of lily pads and other macrophytes. The water is dark, as is characteristic of tannic acid water found in swamplands.

Below Franklin the Blackwater River is dredged and channelized to permit barge traffic to reach Union Camp. The channel is approximately 40m wide and from 5m to 8m in depth. This reach of stream is classified by the SWCB as a Class II estuarine system requiring the same dissolved oxygen and pH limitation as in Class III but without a temperature requirement.

B. Problem Definition

The study area on the Blackwater River includes a Class III free-flowing stream and a Class II estuarine river. Part of the Class III section is a freshwater cypress swamp. The water is turbid, nutrient enriched and slightly acidic due to tannins.

In response to the EPA request for Virginia's involvement in the pilot Use Attainability studies, the State Water Control Board chose to examine the Blackwater River in the vicinity of Franklin, Virginia. There were several reasons for this choice. First, the major stress to the system is low dissolved oxygen (DO) concentrations which occur from May through November. Surveys conducted by SWCB staff, and officials from Union Camp in Franklin, found that during certain periods "natural" background concentrations of dissolved oxygen fell below the water quality standard of 4.0 mg/l. This has raised questions as to whether the current standard is appropriate. Virginia's water quality standards contain a swamp water designation which recognizes that DO and pH may be substantially different in some swamp waters and provides for specific standards to be set on a case by case basis. However, no site specific standards have been developed in Virginia to date. One of the goals of this project was to gather information which could lead to possible development of a site specific standard for the Blackwater River. Second, the Franklin STP has applied for a federal grant to provide for improved BOD removals from its effluent.

C. Approach to Use Attainability

On 20 April, 1982, staff of the SWCB met with several EPA officials and their consultant. After visiting the study area on the Blackwater River and reviewing the available information, it was determined that further data should be collected, primarily a description of the aquatic community. The SWCB staff has scheduled four quarterly surveys from June 1982, through March 1983, to collect physical, chemical, and biological information. Interim results are reported herein to summarize data from the first collection. Final conclusions will not be drawn until the data has been compiled for all four quarters.

II. ANALYSES CONDUCTED

A. Physical Analysis

Data on the physical characteristics of the Blackwater River were derived primarily from existing information and from general observations. The entire reach of the Blackwater River from Joyner's Bridge to Cobb's Wharf was traveled by boat to observe channel and riparian characteristics. A sediment sample was collected at each station for partical size analysis.

B. Chemical Analysis

Water samples were collected at Stations 1-3 for analysis of pH, alkalinity, solids, hardness, nutrients, five-day BOD, chemical oxygen demand, total organic carbon, phenols, pesticides, and heavy metals. In addition, previous data on dissolved oxygen concentrations collected by the SWCB and Union Camp were used to examine oxygen profiles in the river. The USGS Water Resources Data for Virginia (1981) provided some chemical data for the Blackwater River near Burdette.

C. Biological Analysis

Periphyton sampling for chlorophyll-a, biomass, and autotrophic index determination was conducted using floating plexiglass samplers anchored by a cement weight. The samplers were placed in the field in triplicate and remained in the river for 14 days. They were located in run areas in the stream. At the end of this two-week period, the samplers were retrieved and the slides removed for biomass determinations and chlorophyll analysis.

Both a cursory and a quantitative survey of macroinvertebrates were conducted at each station. The purpose of the cursory study was to rapidly identify the general water quality of each station by surveying the presence of aquatic insects, molluscs, crustaceans and worms and classifying them according to their pollution tolerance. A record was kept of all organisms found and these were classified to the family level as dominant, abundant, common, few or present. The cursory survey was completed with a qualitative evaluation of the density and diversity of aquatic organisms.

General knowledge of the pollution tolerance of various genera was used to classify the water quality at each station. The benthic macroinvertebrate samples were collected with Hester-Dendy multiplate artificial substrates. The substrates were attached to metal fence posts and held vertically at least 15 cm above the stream bottom. The substrates were left in place for six weeks to allow for colonization by macroinvertebrate organisms. In the laboratory the organisms were identified to the generic level whenever possible. Counts were made of the number of taxa identified and the number of individuals within each taxon.

Fish populations were surveyed at each station by electrofishing. Each station was shocked for 1,000 seconds: 800 seconds at the shoreline and 200 seconds at midstream. Fish collected were identified to species and the total length of each fish was recorded. In addition, general observations were made about the health status of the fish by observing lesions, hemorrhaging, and the presence of external parasites.

Diversity of species was calculated using the Shannon-Weaver index. Additionally, the fish communities were evaluated using an index proposed by Karr (1981) which classifies biotic integrity based on 12 parameters of the fish community.

III. FINDINGS

There are few physical factors which limit aquatic life uses. The habitat is characteristic of a hardwood wetland with few alterations. The major alteration is dredging and channelization below Franklin which eliminates much of the macrophyte community and the habitat it provides for other organisms. The substrate at each station was composed mostly of sand with a high moisture content. This is characteristic of a swamp but is not ideal habitat for colonization by periphyton and macroinvertebrates.

DO concentrations are typically below the Virginia water quality standards during the months of May through November. This is true upstream as well as downstream from the Franklin STP and appears to occur even without the impact of BOD loadings from Franklin. This phenomenon may be typical of enriched freshwater wetlands. However, during the winter months, DO concentrations may exceed 10 mg/l. Another survey conducted by SWCB showed that there were only small changes in DO concentration with depth.

Representatives from 17 families of macroinvertebrates were observed during a cursory investigation. These included mayflies, scuds, midges, operculate and non-operculate snails, crayfish, flatworms, and a freshwater sponge. The majority of these organisms were facultative at Stations 1 and 2. However, there were a few pollution sensitive forms at Station 1, and Station 3 was dominated by pollution sensitive varieties.

Twelve (12) species from seven families of fish were observed during the June 1982 study. Several top predators were present including the bowfin,

chain pickerel, largemouth bass and longnose gar. Other fish collected were the American eel, shiners, pirate perch, yellow perch, and five species of sunfish. None of the species are especially pollution sensitive. Results of the fish population survey are presented in Table 2.

TABLE 2

Results of Fish Population Survey in Blackwater River, 9 June 1982

Station	Number Collected	No. of Species	Diversity d	Proportion of Omnivores	Proportion of Carnivores
1. Joyner's Bridge	19	7	2.30	.000	.157
2. Franklin STP	51	6	2.35	.000	.098
3. Cobb's Wharf	44	6	2.35	.000	.114

Based on the EPA 304(a) criteria, low seasonal DO concentrations measured in the river should present a significant stress to the biotic community. Large fish tend to be less resistant to low DO yet large species such as the largemouth bass, American eel and some sunfishes were present in an apparently healthy condition. The explanation for this is unclear. The low dissolved oxygen concentrations are near the physiological limit for many species. Fish may be able to acclimate to low DO to a limited extent if the change in oxygen concentration occurs gradually. The fact that fish are present in a healthy condition suggests that there is a lack of other significant stressors in the system which might interact with low DO stress. It is worth noting that spawning probably occurs in most species before the summer months when dissolved oxygen concentration become critically low.

The autotrophic index determinations show the Joyner's Bridge and Franklin STP stations as having relatively healthy periphyton communities. In each case over 80 percent of the periphytic community was autotrophic in nature. Based on the autotrophic index, both of these stations were in better biological health than the most downstream station, Cobb's Wharf. At Cobb's Wharf the autotrophic index characterized an autotrophic community which was experiencing a slight decline in biological integrity (74 percent autotrophic as compared to greater than 80 percent upstream).

Chemical analyses conducted on water from the Blackwater River did not reveal any alarming concentration of toxicants when compared to EPA Water Quality Criteria Documents, although the zinc concentration at Station 1 was slightly above the 24-hour average recommended by EPA. One sample collected by the USGS had a zinc concentration which was twice this number. The source of this zinc is unknown. Any impact which exists from this problem should be sublethal, affecting growth and reproduction of primarily

the most sensitive species. The actual impact of zinc concentrations at Joyner's Bridge is unknown.

Analyses of the periphyton data as well as the water chemistry data indicate that the Blackwater River is nutrient enriched. Some of this nutrient load comes from inadequately protected crop lands and from domestic animal wastes. The Franklin STP also contributes to higher nutrient concentrations. Additionally, an SWCB report estimated that between river mile 20.0 and 6.0, 1,600 lb per day of non-point source carbonaceous BOD_u (ultimate) are added to the river. Consequently, these point and non-point sources appear to be contributing to both organic enrichment and lower dissolved oxygen concentrations.

IV. SUMMARY AND CONCLUSIONS

The Blackwater River from river mile 2.59 to 20.90 has been characterized as a nutrient enriched coastal river much of which is bordered by hardwood wetlands. Periphytic, macroinvertebrate, and fish communities are healthy with fair to good abundance and diversity. The major limitation to aquatic life appears to be low DO concentrations which are enhanced by point and non-point sources of nutrients and BOD. A secondary limitation may be elevated zinc concentrations at Joyner's Bridge.

The primary difficulty in assessing the attainability of aquatic life uses is locating a suitable reference reach to serve as an example of an unaffected aquatic community. Originally, Joyner's Bridge (Station 1) was selected for this purpose, but few major differences occur between populations at all three stations. However, the widespread non-point pollution in Southeastern Virginia makes the location of an undisturbed reference reach impossible. The only alternative, then, is to make the best possible judgment as to what organisms might reasonably be expected to inhabit the Blackwater.

In reference to the Blackwater River, it is probable that most fish species are present that should reasonably be expected to inhabit the river, although possibly in lower numbers. (No attempt has yet been made to assess this with regard to algal and invertebrate communities.) However, based on the 304(a) criteria, the low DO concentrations represent a significant stress of the ecosystem and the introduction of additional stressors could be destructive. It is also probable that higher oxygen concentrations during winter months play a major role in reducing the impact of this stress. Removal of point and non-point source inputs may alleviate some problems. However, DO concentrations may still remain low. The increased effect of oxygen concentrations should be an increase in fish abundance and increased size of individuals. Diversity would probably be unaffected. Nevertheless, no attempt has been made to estimate the magnitude of these changes.

Cairns (1977) has suggested a method for estimating the potential of a body of water to recover from pollutional stress. Although this analysis is only

semi-quantitative and subjective, it suggests that the chances of rapid recovery following a disturbance in the Blackwater River are poor.

The absence of an undisturbed reference reach and the difficulty in quantifying changes in dissolved oxygen, population structure, and population abundance make a definite statement regarding attainability of aquatic life uses difficult. However, to summarize, several points stand out. First, the aquatic communities in the Blackwater River are generally healthy with fair to good abundance and distribution. Dissolved oxygen concentrations are low for about half of the year which causes a significant stress to aquatic organisms. Oxygen concentrations are higher during the reproductive periods of many fishes. Because of these stresses and the physical characteristics of the river, the system does not have much resiliency or capacity to withstand additional stress. Although a quantitative statement of changes in the aquatic community with the amelioration of DO stress has not been made, it is probable that additional stresses would degrade the present aquatic community.

The occurrence of low dissolved oxygen concentrations throughout much of the Blackwater is, in part, a "natural" phenomenon and could argue for a reduction in the DO standard. However, if this standard were reduced on a year round basis it is probable that the aquatic community would steadily degrade. This may result in a contravention of the General Standard of Virginia State Law which requires that all waters support the propagation and growth of all aquatic life which can reasonably be expected to inhabit these waters. Because of the lack of resiliency in the system, a year round standards change could irreversibly alter the aquatic community.

WATER BODY SURVEY AND ASSESSMENT
Cuckels Brook
Bridgewater Township, New Jersey

I. INTRODUCTION

A. Site Description

Cuckels Brook, a small tributary of the Raritan River, is located entirely within Bridgewater Township in Somerset County, New Jersey. It is a perennial stream approximately four miles long, having a watershed area of approximately three square miles. The entire brook is classified as FW-2 Non-trout in current New Jersey Department of Environmental Protection (NJDEP) Surface Water Quality Standards.

Decades ago, the downstream section of Cuckels Brook (below the Raritan Valley Line Railroad, Figure 1), was relocated into an artificial channel. This channelized section of Cuckels Brook consists of an upstream subsection approximately 2,000 feet in length and a downstream subsection approximately 6,000 feet in length, with the Somerset-Raritan Valley Sewerage Authority (SRVSA) municipal discharge being the point of demarcation between the two. The downstream channelized subsection (hereinafter referred to as "Lower Cuckels Brook") is used primarily to convey wastewater to the Raritan River from SRVSA and the American Cyanamid Company, which discharges approximately 200 feet downstream of SRVSA. At its confluence with the Raritan River, flow in Lower Cuckels Brook is conveyed into Calco Dam, a dispersion dam which distributes the flow across the Raritan River. Except for railroad and pipeline rights-of-way, all the land along Lower Cuckels Brook is owned by the American Cyanamid Company. Land use in the Cuckels Brook watershed above the SRVSA discharge is primarily suburban but includes major highways.

B. Problem Definition

Lower Cuckels Brook receives two of the major discharges in the Raritan River Basin. SRVSA is a municipal secondary wastewater treatment plant which had an average flow in 1982 of 8.8 mgd (design capacity = 10 mgd). The American Cyanamid wastewater discharge is a mixture of process water from organic chemical manufacturing, cooling water, storm water, and sanitary wastes. This mixed waste receives secondary treatment followed by activated carbon treatment. In 1982 American Cyanamid's average flow was 7.0 mgd (design capacity 20 mgd). These two discharges totally dominate the character of Lower Cuckels Brook.

Over 90 percent of the flow in Cuckels Brook is wastewater (except after heavy rainfall). The mean depth is estimated to be between 1 and 2 feet, and the channel bottom at observed locations is covered with deposits of

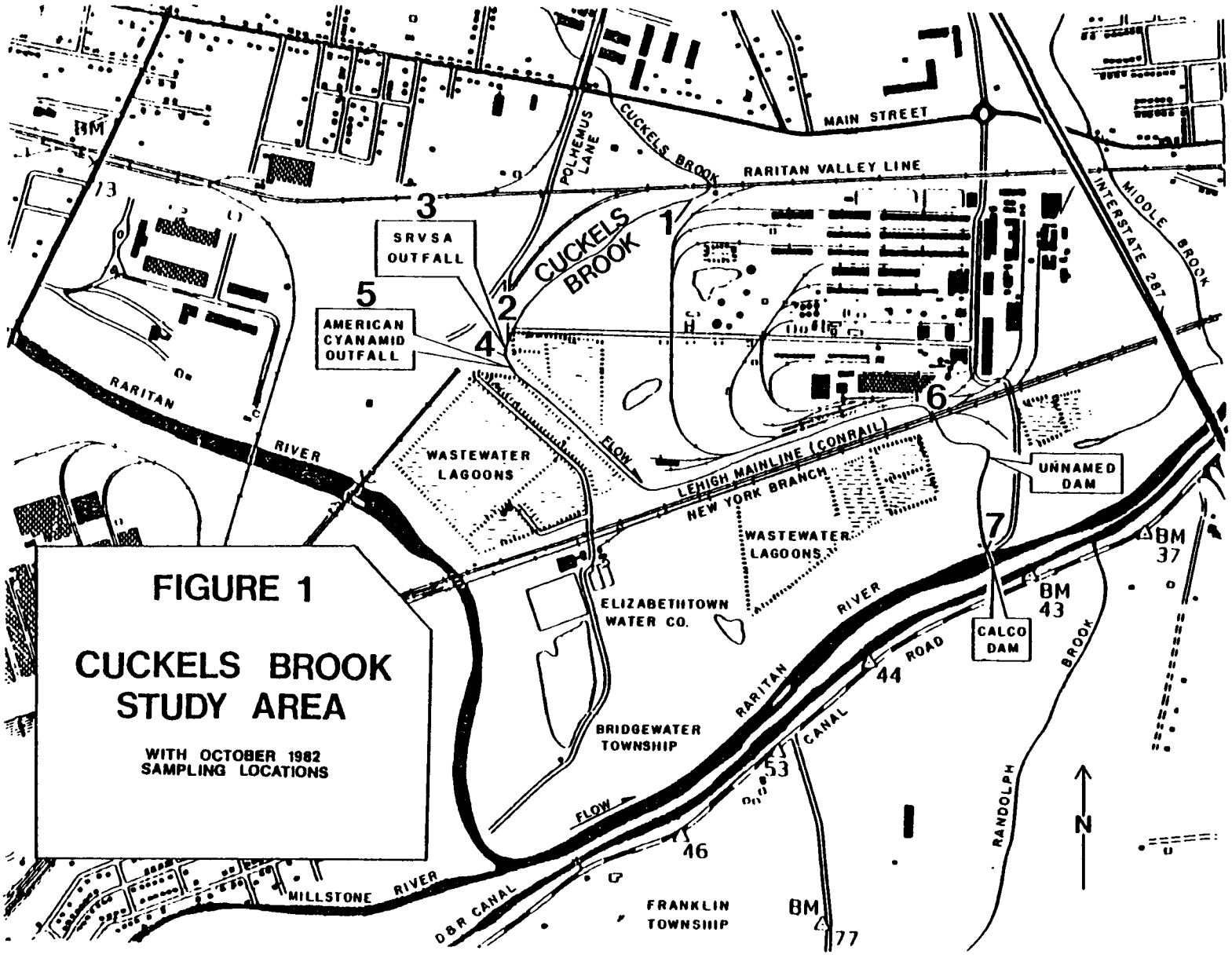


FIGURE 1
CUCKELS BROOK
STUDY AREA
WITH OCTOBER 1982
SAMPLING LOCATIONS
BM
MAIN STREET
POLHEMUS LANE
CUCKELS BROOK
RARITAN VALLEY LINE
INTERSTATE 287
MIDDLE BROOK
SRVSA OUTFALL
AMERICAN CYANAMID OUTFALL
CUCKELS BROOK
RARITAN RIVER
WASTEWATER LAGOONS
FLOW
LEHIGH MAINLINE (CONRAIL)
NEW YORK BRANCH
UNNAMED DAM
WASTEWATER LAGOONS
ELIZABETHTOWN WATER CO.
CALCO DAM
BM 37
BM 43
RARITAN RIVER
44 ROAD
BROOK
BRIDGEWATER TOWNSHIP
RARITAN CANAL
RANDOLPH
FLOW
MILLSTONE RIVER
D&R CANAL
FRANKLIN TOWNSHIP
BM 77
N
1
2
3
4
5
6
7
13
46
53

black sludge, apparently derived from solids in the SRVSA and Cyanamid discharges (primarily the SRVSA discharge). In contrast, the channelized subsection of Cuckels Brook above the SRVSA discharge is often only inches deep with a bottom of bedrock, rubble, gravel and silt.

Cuckels Brook (including Lower Cuckels Brook) is classified as FW-2 Non-trout in the NJDEP Surface Water Quality Standards. The FW-2 classification provides for the following uses:

1. Potable water supply after such treatment as shall be required by law or regulation;

2. Maintenance, migration, and propagation of natural and established biota (not including trout);

3. Primary contact recreation;

4. Industrial and agricultural water supply; and

5. Any other reasonable uses.

The attainment of these uses is currently prevented by the strength and volume of wastewaters currently discharged to Cuckels Brook. The size of the stream also limits primary contact recreation and other water uses, and physical barriers currently prevent the migration of fish between Cuckels Brook and the Raritan River.

C. Approach to Use Attainability

In response to an inquiry from EPA, Criteria and Standards Division, the State of New Jersey offered to participate in a demonstration Water Body Survey and Assessment. The water body survey of Cuckels Brook was conducted by the New Jersey Department of Environmental Protection, Bureau of Systems Analysis and Wasteload Allocation; with assistance from the EPA Region II Edison Laboratory.

The assessment is based primarily on the results of a field sampling program designed and conducted jointly by NJDEP and EPA-Edison in October 1982. Additional sources of information include self-monitoring reports furnished by the dischargers, and earlier studies conducted by the NJDEP on Cuckels Brook and the Raritan River. Based on this assessment, NJDEP developed a report entitled "Lower Cuckels Brook Water Body Survey and Use Attainability Analysis, 1983."

II. ANALYSES CONDUCTED

A. Chemical Analysis

The major impact of the SRVSA discharge is attributed to un-ionized ammonia and TRC levels, whose concentrations at Station 4, 100 feet below the discharge point were 0.173 and 1.8 mg/l respectively, which are 3.5 and 600

times higher than the State criteria. The un-ionized ammonia concentration of the Cyanamid effluent was low, but stream concentrations at Stations 6 and 7 were relatively high (though below the State criterion of 0.05 mg/l).

The Cyanamid discharge contained 0.8 mg/l TRC. Concentrations at both Stations 6 and 7 were 0.3 mg/l TRC, lower than at Station 4 but still 100 times the State criterion of 0.003 mg/l. The other major impact of the Cyanamid effluent was on instream filterable residue levels. Concentrations at Stations 6 and 7 exceeded 1,100 mg/l, over three times the State criterion (133 percent of background).

The effluents apparently buffered the pH of Lower Cuckels Brook which was approximately pH 7 at Stations 4, 6 and 7, and the pH of the upstream reference stations was markedly alkaline. Dissolved oxygen concentrations decreased in the downstream direction despite low BOD5 concentrations both in the effluents and instream. This suggests an appreciable sediment oxygen demand in Lower Cuckels Brook. Dissolved oxygen levels were greater in the two effluents than in the stream at Stations 6 and 7. The dissolved oxygen concentration at Station 7 of 4.1 mg/l nearly violated the State criterion of 4.0 mg/l; this suggests the potential for unsatisfactory dissolved oxygen conditions during the summer.

The results of the water body survey are generally in good agreement with other available data sources. Recent self-monitoring data for both American Cyanamid and SRVSA agree well with the data collected in this survey. In particular they show consistantly high TRC concentrations in both effluents. High average dissolved solids (filterable residue) concentrations are reported for the Cyanamid effluent. Total ammonia levels as high as 33.5 mg/l NH_3 (27.6 mg/l N) were reported for the SRVSA effluent. The pH of the Cyanamid and SRVSA effluents is sometimes more alkaline than the water body survey values indicating that toxic un-ionized ammonia concentrations may sometimes be higher than measured during the water body survey.

B. Biological Analysis

Fish and macroinvertebrate surveys were conducted in the channelized subsection of Cuckels Brook above the SRVSA discharge. Only three fish species were found: the banded killifish, the creek chub and the blacknose dace. One hundred and eighty-six (186) out of the total 194 specimens collected were banded killifish. Killifish are very hardy and are common in both estuarine and freshwater systems. The largest fish found, a creek chub, was 146 mm long.

The results of the macroinvertebrate survey are discussed in detail in a separate report (NJDEP, 1982). Four replicate surber samples were collected at Stations 1 and 2 above the SRVSA discharge. Diversity indices indicate the presence of similar well-balanced communities at both stations. Species diversity and equitability were 3.9 and 0.7 respectively at Station 1, and 4.3 and 0.7 respectively at Station 2. Productivity at Stations 1 and 2 was

low, with mean densities of 59 and 89 individuals per square foot, respectively. The majority of species found at both stations have organic pollution tolerance classifications of tolerant (dominant at Station 1) or facultative (dominant at Station 2).

Overall, the biological data indicate that the upstream channelized subsection of Cuckels Brook supports a limited fish community and a limited macroinvertebrate community of generally tolerant species. The water quality data indicates nothing that would limit the community. One possible limiting factor is that, as a result of channelization, the substrate consists of unconsolidated gravel and rubble on bedrock, which might easily be disturbed by high flow conditions.

Both the chemical data and visual observations at various locations suggest that virtually no aquatic life exists along Lower Cuckels Brook: not even algae were seen. The discharges have seriously degraded water quality. Unionized ammonia concentrations at Station 4 were close to acute lethal levels, while concentrations of TRC were above acute levels at Stations 4, 6 and 7 (EPA, 1976). The sludge deposits which apparently cover most of the bottom of lower Cuckels Brook could exert negative physical (i.e. smothering) and chemical (i.e. possible toxics) effects on any benthic organisms. No biological survey of the lower brook was made because of concern about potential hazards to sampling personnel. Supplemental sampling of the sediments is planned to ascertain levels of toxics accumulation.

As part of their self-monitoring requirements, American Cyanamid performs weekly 96-hour modified flow-through bioassays with fathead minnows using unchlorinated effluent. Of 63 bioassays conducted between 1 May, 1981 and 31 August, 1982, results from eight bioassays had 96-hour LC50 values at concentrations of effluent less than 100 percent (i.e. 26 percent, 58 percent, 77 percent, 83.5 percent, 88 percent, 92 percent, and 95.5 percent). These results suggest that the American Cyanamid effluent would not be extremely toxic if it were reasonably diluted by its receiving waters. Within Lower Cuckels Brook, however, the effluent receives only approximately 50 percent dilution and the potential exists for toxic effects on any aquatic life that may be present. These effects would be in addition to the toxicity anticipated from the TRC concentrations which result from the chlorination of the effluent.

III. FINDINGS

Practically none of the currently designated uses are now being achieved in Lower Cuckels Brook. The principal current use of Lower Cuckels Brook is the conveyance of treated wastewater and upstream runoff to the Raritan River. Judging from the indirect evidence of chemical data and visual observations, virtually no aquatic life is maintained or propagated in Lower Cuckels Brook. It has been well documented that fish avoid chlorinated waters (Cherry and Cairns, 1982; Fava and Tsai, 1976). Any aquatic life that does reside in Lower Cuckels Brook would be sparse and stressed. Migration of aquatic life through Lower Cuckels Brook would probably only occur during periods of high storm water flow when some flow occurs over the

un-named dam (Figure 1) which is designed to direct the flow of Cuckels Brook toward Calco Dam. Calco Dam and its associated structures, including the un-named dam, normally prevent the migration of fish between Cuckels Brook and the Raritan River.

Lower Cuckels Brook currently does not support any primary or secondary contact recreation. No water is currently diverted from Lower Cuckels Brook for potable water supply, industrial or agricultural water supply, or any other purpose.

Because Lower Cuckels Brook receives large volumes of wastewater and because there is practically no dilution, water quality in Lower Cuckels Brook has been degraded to the quality of wastewater. Moreover, the bottom of Lower Cuckels Brook has been covered at observed locations with wastewater solids. As a result, Lower Cuckels Brook is currently unfit for aquatic life, recreation, and most other water uses. The technology-based effluent limits required by the Clean Water Act are not adequate to protect the currently designated water uses in Lower Cuckels Brook. SRVSA already provides secondary treatment (except for bypassed flows in wet weather), and American Cyanamid already provides advanced treatment with activated carbon. Because the Raritan River provides far more dilution than does Cuckels Brook, effluent limits which may be developed to protect the Raritan River would not be adequate to protect the currently designated water uses in Lower Cuckels Brook. The only practical way to restore water quality in Lower Cuckels Brook would be to remove the wastewater discharges. However, there are several factors that would limit the achievement of currently designated uses even if the wastewater discharges were completely separated from natural flow.

If it were assumed that the wastewater discharges and sludge were absent, and that the seepage of contaminated groundwater from the American Cyanamid property was insignificant or absent, then the following statements could be made about attainable uses in Lower Cuckels Brook:

Aquatic Life - The restoration of aquatic life in Lower Cuckels Brook would be limited to some extent by the small size and lower flow of the stream, by channelization, and by contaminants in suburban and highway runoff from the upstream watershed. Lower Cuckels Brook could support a limited macroinvertebrate community of generally tolerant species, and some small fish as were found in the reference channelized subsection above the SRVSA discharge (Stations 1 and 2). Unless it were altered or removed, the Calco Dam complex would continue to prevent fish migration.

Wildlife typical of narrow stream corridors could inhabit the generally narrow strips of land between Lower Cuckels Brook and nearby railroad tracks and waste lagoons. Restoration of aquatic life in Lower Cuckels Brook would be expected to have little impact on aquatic life in the Raritan River.

Recreation - Lower Cuckels Brook would be too shallow for swimming or boating, and its small fish could not support sport fishing. The industrial surroundings of Lower Cuckels Brook, including waste lagoons and active manufacturing facilities and railroads, severely reduces the potential for other recreational activities such as streamside trails and picnic areas, wading, and nature appreciation. As Lower Cuckels Brook is on private industrial property, trespassing along this brook and in the surrounding area is discouraged.

It would appear unlikely that any of the landowners, or any government agency, would develop recreational facilities along lower Cuckels Brook or even remove some of the brush which impairs access to most of the Brook. Recreation along Lower Cuckels Brook would be limited, occasional, and informal.

Other Water Uses - Although water quality in Lower Cuckels Brook would generally meet FW-2 Nontrout criteria, the volume of natural flow in Lower Cuckels Brook would be insufficient for potable water supply or for industrial or agricultural water use.

In general, Lower Cuckels Brook would become a small channelized tributary segment flowing through a heavily industrialized area, free of gross pollution and capable of supporting a modest aquatic community and very limited recreational use.

IV. SUMMARY AND CONCLUSIONS

This use-attainability analysis has discussed the present impairment of the currently designated uses of Lower Cuckels Brook, the role of wastewater discharges in such impairment, and the extent to which currently designated water uses might be achieved if the wastewater discharges were removed. Further analysis, outside the scope of this survey, will be required: to document the costs of removing SRVSA and American Cyanamid effluent from Lower Cuckels Brook, and to evaluate the impact of the SRVSA and American Cyanamid discharges on the Raritan River. These analyses may lead to the development of site-specific water quality standards for Lower Cuckels Brook (designated uses limited to the conveyance of wastewater and the prevention of nuisances), or to the removal of the wastewater discharges from Lower Cuckels Brook. In either case, effluent limits would be established to protect water quality in the Raritan River.

WATER BODY SURVEY AND ASSESSMENT
Deep Creek And Canal Creek
Scotland Neck, North Carolina

I. INTRODUCTION

A. Site Description

The Town of Scotland Neck is located in Halifax County in the lower coastal plain of North Carolina. The Town's wastewater, made up mostly of domestic waste with a small amount of textile waste, is treated in an oxidation ditch of 0.6 mgd design capacity. The treatment plant is located two-tenths of a mile southwest of Scotland Neck off U.S. Highway 258, as seen in Figure 1. The effluent (0.323 mgd average) is discharged to Canal Creek which is a tributary to Deep Creek.

Canal Creek is a channelized stream which passes through an agricultural watershed, but also receives some urban runoff from the western sections of Scotland Neck. It is a Class C stream with a drainage area of 2.4 square miles, an average stream flow of 3.3 cfs, and a 7Q10 of 0.0 cfs. The Creek retains definite banks for about 900 feet below the outfall at which point it splits into numerous shifting channels and flows 800 to 1400 feet through a cypress swamp before reaching Deep Creek. During dry periods the braided channels of Canal Creek can be visually traced to Deep Creek. During wet periods Canal Creek overflows into the surrounding wetland and flow is no longer restricted to the channels.

Deep Creek is a typical tannin colored Inner Coastal Plain stream that has a heavily wooded paludal flood plain. The main channel is not deeply entrenched. In some sections streamflow passes through braided channels, or may be conveyed through the wetland by sheetflow. During dry weather flow periods the main channel is fairly distinct and the adjacent wetland is saturated, but not inundated. During wet weather periods the main channel is less distinct, adjacent areas become flooded and previously dry areas become saturated.

B. Problem Definition

The Town of Scotland Neck is unable to meet its final NPDES Permit limits and is operating with a Special Order by Consent which specifies interim limits. The Town is requesting a 201 Step III grant to upgrade treatment by increasing hydraulic capacity to 0.675 mgd with an additional clarifier, an aerobic digestor, tertiary filters, a chlorine contact chamber, post aeration and additional sludge drying beds. The treated effluent from Scotland Neck is discharged into Canal Creek. The lower reaches of Canal Creek are part of the swamp through which Deep Creek passes.

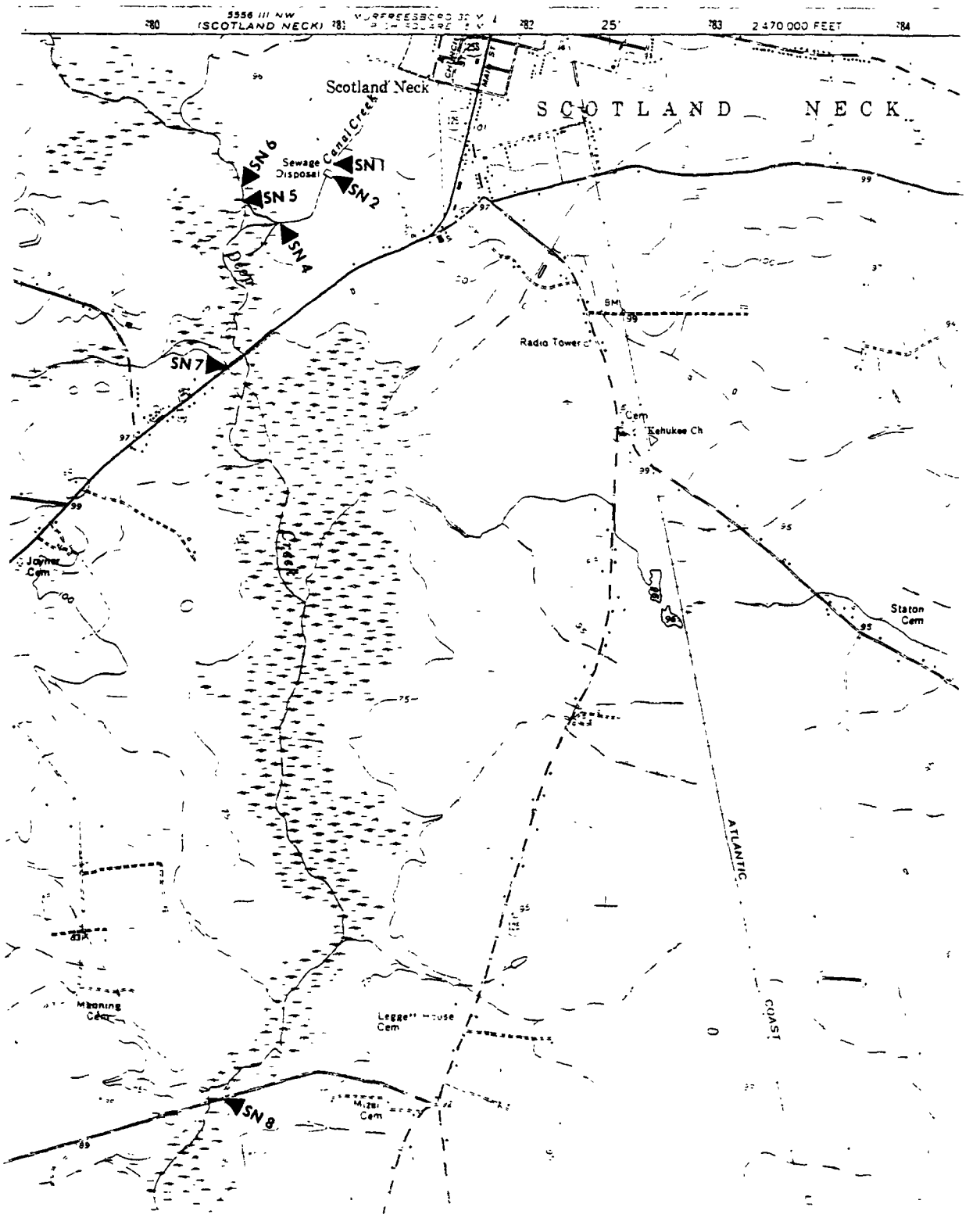


Figure 1. Study Area, Deep Creek and Canal Creek

Deep Creek carries a "C" classification, but due to naturally low dissolved oxygen and other conditions imposed by the surrounding swamp, it is felt that reclassification to "C-Swamp" should be considered. Deep Creek should be classified C-Swamp because its physical characteristics meet the C-Swamp classification of the North Carolina Administrative Code for Classifications and Water Quality Standards. The Code states: Swamp waters shall mean those waters which are so designated by the Environmental Management Commission and which are topographically located so as to generally have very low velocities and certain other characteristics which are different from adjacent streams draining steeper topograpy. The C-Swamp classification provides for a minimum pH of 4.3 (compared to a range of pH 6.0 to pH 8.5 for C waters), and allows for low (unspecified) DO values if caused by natural conditions. DO concentrations in Deep Creek are usually below 4.0 mg/l.

C. Approach to Use Attainability Analysis

1. Data Available

1. Self Monitoring Reports from Scotland Neck.
2. Plant inspections by the Field Office.
3. Intensive Water Quality Survey of Canal Creek and Deep Creek at Scotland Neck in September, 1979. Study consisted of time-of-travel dye work and water quality sampling.

2. Additional Routine Data Collected

Water quality survey of Canal Creek and Deep Creek at Scotland Neck in June 1982. Water quality data was collected to support a biological survey of these creeks. The study included grab samples and flow measurements.

Benthic macroinvertebrates were collected from sites on Canal Creek and Deep Creek. Qualitative collection methods were used. A two-member team spent one hour per site collecting from as many habitats as possible. It is felt that this collection method is more reliable than quantitative collection methods (kicks, Surbers, ponars, etc.) in this type of habitat. Taxa are recorded as rare, common, and abundant.

II. ANALYSES CONDUCTED

A. Physical Factors

Sampling sites were chosen to correspond with sites previously sampled in a water quality survey of Canal and Deep Creeks. Three stations were selected on Canal Creek. SN-1 is located 40 feet above the Town of Scotland Neck Wastewater Treatment Plant outfall. This site serves as a reference station. The width at SN-1 is 7.0 feet and the average discharge (two flows were recorded in the September 1979 survey and one flow in the June 1982

survey) is 0.65 cubic feet per second. Canal Creek at SN-1 has been channelized and has a substrate composed of sand and silt. SN-4 is located on Canal Creek 900 feet below the discharge point. This section of Canal Creek has an average cross-sectional area of 11.8 feet and an average flow of 1.33 cubic feet per second. The stream in this section is also channelized and also has a substrate composed of sand and silt. There is a canopy of large cypress at SN-4 below the plant, while the canopy above SN-1 is reduced to a narrow buffer zone. The potential uses of Deep Creek are limited by its inaccessability in these areas.

A third station (SN-5) was selected on one of the lower channels of Canal Creek at the confluence with Deep Creek 3200 feet upstream of the U.S. Highway 258 bridge. Discharge measurements could not be accomplished at this site during this survey because of the swampy nature of the stream with many ill-defined, shallow, slow moving courses. Benthic macroinvertebrates were collected from this site.

Three stations were chosen on Deep Creek. SN-6 is approximately 300 feet upstream of SN-5 on Canal Creek at its confluence with Deep Creek and is a reference site. SN-7 is located at the U.S. Highway 258 bridge and SN-8 is located further downstream at the SR 1100 bridge. SN-7 and SN-8 are below Canal Creek. There are some differences in habitat variability among these three sites. The substrate at both SN-6 and SN-7 is composed mostly of a deep layer of fine particulate matter. Usable and productive benthic habitats in this area are reduced because of the fine particulate layer. It is possible that the source of this sediment is from frequent overbank flows and from upstream sources. Productive benthic habitats include areas of macrophyte growth, snags, and submerged tree trunks. Discharge measurements were not taken at any of these three sites during this survey.

B. Chemical Factors

Chemical data from two water quality surveys show that the dissolved oxygen in Canal Creek is depressed while BOD_5, solids and nutrient levels are elevated. The 1982 study indicates, however, that the water quality is better than it was during the 1979 survey. Such water quality improvements may be due to the addition of chlorination equipment and other physical improvements as well as to the efforts of a new plant operator.

Both above and below its confluence with Canal Creek, Deep Creek shows poor water quality which may be attributed to natural conditions, but not to any influence from the waste load carried by Canal Creek. Canal Creek exhibited higher DO levels than Deep Creek.

C. Biological Factors

The impact of the effluent on the fauna of Canal Creek is clear. A 63 percent reduction in taxa richness from 35 at SN-1 to only 13 at SN-4 indicates severe stress as measured against criteria developed by biologists of the Water Quality Section. The overwhelming dominance of Chironomus at SN-4

is indicative of a low DO level and high concentrations of organic matter. To what extent this condition is attributable to the effluent or to natural swamp conditions is not clear. No impact to the benthos of Deep Creek was discerned which could be attributed to the effluent.

III. FINDINGS

Deep Creek is currently designated as a class C warm water fishery but due to naturally low dissolved oxygen concentrations may not be able to satisfy the class C dissolved oxygen criteria. The DO criterion for class C waters stipulates a minimum value of 4 ppm, yet the DO in Deep Creek, in both the 1979 and the 1982 studies, was less than 4 ppm. Thus from the standpoint of aquatic life uses, Deep Creek may not be able to support the forms of aquatic life which are intended for protection under the class C standards. Because of prevailing natural conditions, there are no higher potential uses of Deep Creek than now exist; yet because of prevailing natural conditions and in light of the results of this water body assessment, the C-swamp use designation appears to be a more appropriate designation under existing North Carolina Water Quality Standards.

Canal Creek is degraded by the effluent from the Scotland Neck wastewater treatment plant. The BOD_5, fecal coliform, solids and nutrient levels are elevated while the DO concentration is depressed. The reach immediately below the outfall is affected by an accumulation of organic solids, by discoloration and by odors associated with the wastewater.

IV. SUMMARY AND CONCLUSIONS

The water body survey of Deep Creek and Canal Creek included a consideration of physical, chemical and biological factors. The focus of interest was those factors responsible for water quality in Deep Creek, including possible deliterious effects of the Scotland Neck wastewater on this water body. The analyses indicate that the effluent does not appear to affect Deep Creek. Instead, the water quality of Deep Creek reflects natural conditions imposed by seasonal low flow and high temperature, and reflects the nutrient and organic contribution of the surrounding farmland and wetland. It is concluded that the C-Swamp designation more correctly reflects the uses of Deep Creek than does the C designation.

In contrast to Deep Creek, Canal Creek is clearly affected by the treated effluent. Further examination would be required to determine the extent of recovery that might be expected in Canal Creek if the plant were to meet current permit requirements or if the proposed changes to the plant were incorporated into the treatment process.

WATER BODY SURVEY AND ASSESSMENT
Malheur River
Malheur County, Oregon

I INTRODUCTION

A. Site Description

The Malheur River, in southeastern Oregon, flows eastward to the Snake River which separates Oregon from Idaho. Most of Malheur County is under some form of agricultural production. With an average annual precipitation of less than 10 inches, the delivery of irrigation water is essential to maintain the high agricultural productivity of the area.

The Malheur River system serves as a major source of water for the area's irrigation requirements (out of basin transfer of water from Owyhee Reservoir augments the Malheur supply). Reservoirs, dams, and diversions have been built on the Malheur and its tributaries to supply the irrigation network. The first major withdrawal occurs at the Namorf Dam and Diversion, at Malheur River Mile 69. Figure 1 presents a schematic of the study area.

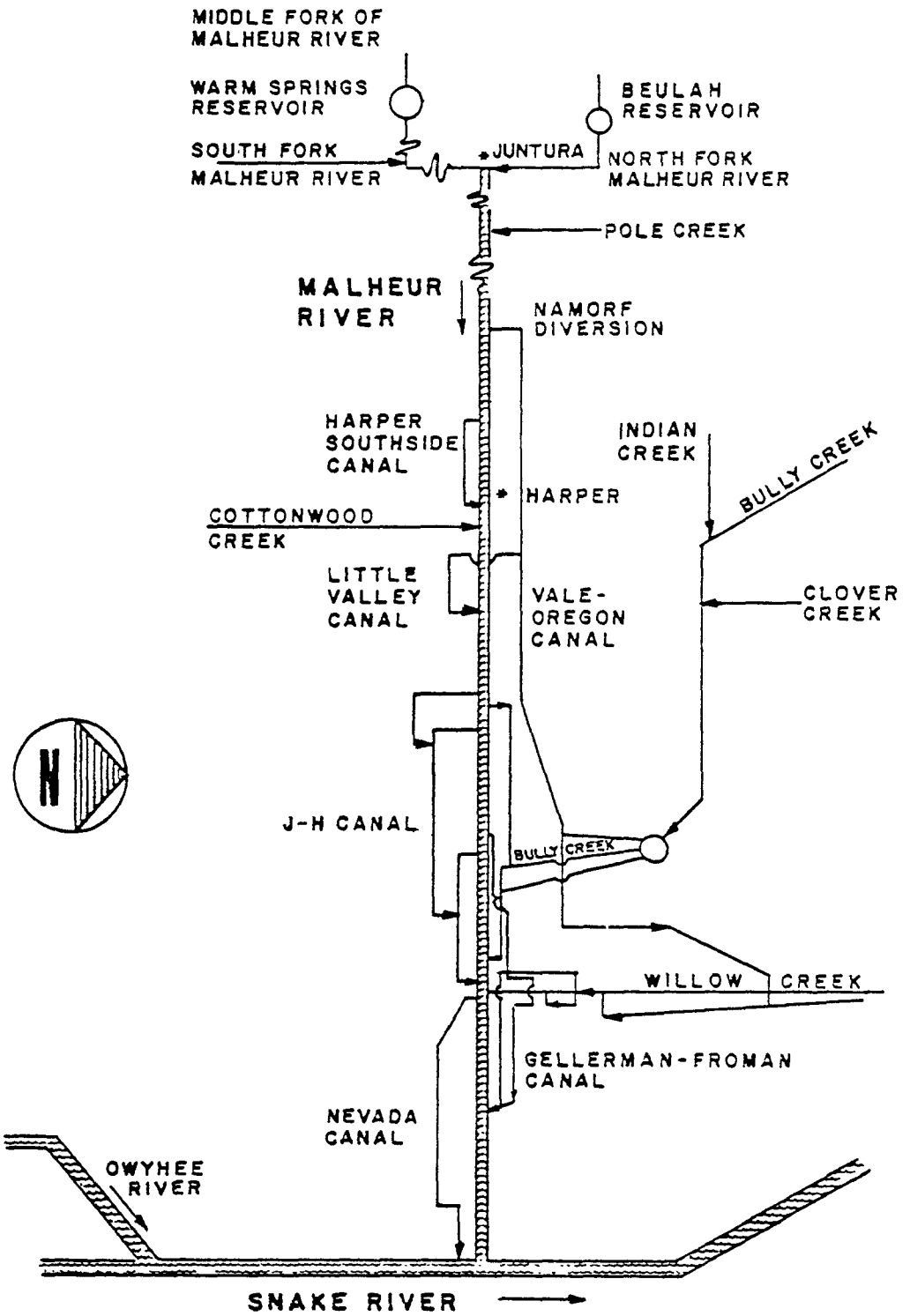
Irrigation water is delivered to individual farms by a complicated system of canals and laterals. Additional water is obtained from drainage canals and groundwater sources. An integral part of the water distribution system is the use and reuse of irrigation return flows five or six times before it is finally discharged to the Snake River.

B. Problem Definition

The Malheur River above Namorf Dam and Diversion is managed primarily as a trout fishery, and from Namorf to the mouth as a warm-water fishery. The upper portion of the river system is appropriately classified. Below Namorf Dam, however, the river is inappropriately classified as supporting a cold-water fishery, and therefore was selected for review. This review was conducted as part of the U.S. Environmental Protection Agency's field test of the draft "Water Body Survey and Assessment Guidance" for conducting a use attainability analysis. The guidance document supports the proposed rule to revise and consolidate the existing regulation governing the development, review, and approval of water quality standards under Section 303 of the Clean Water Act.

C. Approach to Use Attainability Analysis

Assessment of the Malheur River is based on a site visit which included meetings with representatives of the Malheur County Citizen's Water Resources Committee, the USDA-Soil Conservation Service, the Oregon Department of Environmental



SIMPLIFIED FLOW SCHEMATIC
MALHEUR RIVER IRRIGATION SYSTEM

- FIGURE 1 -

Quality (ODEQ), the Oregon Department of Fish and Wildlife (ODFW), and the U.S. Environmental Protection Agency (EPA): and upon the findings reported in two studies:

Final Report, Two Year Sampling Program, Malheur County Water Quality Management Plan, Malheur County Planning Office, Vale, Oregon, 1981.

Bowers, Hosford and Moore, Stream Surveys of the Lower Owyhee and Malheur Rivers, A Report to the Malheur County Water Resources Committee, Oregon Department of Fish and Wildlife, January, 1979.

The first report, prepared under amendments to Section 208 of the Clean Water Act, contains extensive information on the quantity, quality and disposition of the areas' water resources. The second document gives the fish populations found in the lower 69 miles of the Malheur River during June and July, 1978. Information in the ODFW report is incorporated in the 208 report. Additional fisheries information supplied by ODFW was also considered.

A representative of ODEQ, Portland, and the Water Quality Standards Coordinator, EPA Region X, Seattle, Washington, agreed that the data and analyses contained in these two reports were sufficient to re-examine existing designated uses of the Malheur River.

II ANALYSES CONDUCTED

Physical, chemical, and biological data were reviewed to determine: (1) whether the attainment of a salmonid fishery was feasible in the lower Malheur; and (2) whether some other designated use would be more appropriate to this reach. The elements of this review follow:

A. Physical Factors

Historically, salmonid fish probably used the lower Malheur (lower 50 miles) mainly as a migration route, because of the warm water and poor habitat. The first barrier to upstream fish migration was the Nevada Dam near Vale, constructed in 1880. Construction of the Warm Springs Dam in 1918, ended the anadromous fish runs in the Middle Fork Malheur. The construction of Beulah Dam in 1931, befell the remainder of anadromous fish runs on the North Fork Malheur. Finally, the construction of Brownlee Reservoir in 1958 completely blocked salmonid migrants destined for the upper Snake River System.

With the construction of the major irrigation reservoirs on the Malheur River and its tributaries, the natural flow characteristics in the lower river have changed. Instead of high early summer flows, low summer and fall flows and steady winter flow, the peak flows may occur in spring, if and when the upstream reservoirs spill. Also, a high sustained flow exists all summer as water is released from the dams for irrigation. A significant change limiting fish production in the Malheur River below Namorf is the extreme low flow that occurs when the reservoirs store water during the fall and winter for the next irrigation season.

Two other physical conditions affect the maintenance of salmonids in the lower Malheur. One is the high suspended solids load carried to the river by irrigation return flows. High suspended solids also occur during wet weather when high flows erode the stream bank and re-suspend bottom sediments. The seasonal range of suspended solids content is pronounced, with the highest concentrations occurring during irrigation season and during periods of wet weather. Observed peaks in lower reaches of the river, measured during the two-year 208 Program, reached 1300 mg/l, while background levels rarely dropped below 50 mg/l. A high suspended solids load in the river adversely affects the ability of sight-feeding salmonids to forage, and may limit the size of macroinvertebrate populations and algae production which are important to the salmonid food chain. A second factor is high summer water temperature which severely stresses salmonids. The high temperatures result from the suspended particles absorbing solar radiation.

B. Biological Factors

The biological profile of the river is mainly based on fisheries information, with some macroinvertebrate samples gathered by the Oregon Department of Fish and Wildlife (ODFW) in 1978. During the site visit, the participants agreed additional information on macroinvertebrates and periphyton would not be needed because the aquatic insect numbers and diversity were significantly greater in the intensively irrigated reach of the river than for the upper river where agricultural activity is sparse.

Although the Malheur River from Namorf to the mouth is managed as a warm water fishery, ODFW has expended little time and few resources on this stretch of the river because it is not a productive fish habitat. Survey results in summer of 1978 showed a low ratio of game fish to rough fish over the lower 69 miles of the Malheur River.

In the section between Namorf and the Gellerman-Froman Diversion Dam there was little change in water quality although water temperatures were elevated. Only three game fish were captured but non-game fish sight-feeders were common. Low winter flows over a streambed having few deep pools for overwinter survival appears to limit fish production in this reach of river.

In the stretch from the Gellerman-Froman Diversion to the mouth, the river flows through a region of intensive cultivation. The river carries a high silt load which affects sight-feeding fish. Low flows immediately below the Gellerman-Froman Dam also limit fish production in this area.

C. Chemical Factors

A considerable amount of chemical data exist on the Malheur River. However, since the existing and potential uses of the river are dictated largely by physical constraints, dissolved oxygen was the only chemical parameter considered in the assessment.

The Dissolved Oxygen Standard established for the Malheur River Basin calls for a minimum of 75 percent of saturation at the seasonal low and 95 percent of saturation in spawning areas or during spawning, hatching, and fry stages of salmonid fishes. One sample collected at Namorf fell below the standard to 73 percent of saturation or 8.3 mg/l in November, 1978. All other samples were above this content, reaching as high as 170 percent of saturation during the summer due to algae. Data collected by the ODEQ from Malheur River near the mouth between 1976 and 1979 showed the dissolved oxygen content ranged from 78 to 174 percent saturation. The dissolved oxygen content in the lower Malheur River is adequate to support a warm-water fishery.

III FINDINGS

A. Existing Uses

The lower Malheur River is currently designated as a salmonid fishery, but it is managed as a warm water fishery. Due to a number of physical constraints on the lower river, conditions are generally unfavorable for game fish, so rough fish predominate. In practice, the lower Malheur River serves as a source and a sink for irrigation water. This type of use contributes to water quality conditions which are unfavorable to salmonids.

B. Potential Uses

Salmonid spawning and rearing areas generally require the highest criteria of all the established beneficial uses. It would be impractical, if not impossible in some areas, to improve water quality to the level required by salmonids. However, even if this could be accomplished, high summer temperatures and seasonal low flows would still prevail. While salmonids historically moved through the Malheur River to spawn in the headwater areas, year-round resident fish populations probably did not exist in some of these areas at the time.

The Malheur River basin can be divided into areas, based upon differing major uses. Suggested divisions are: (1) headwater areas above the reservoirs; (2) reservoirs; (3) reaches below the reservoirs and above the intensively irrigated areas; (4) intensively irrigated areas; and (5) the Snake River.

In intensively irrigated areas, criteria should reflect the primary use of the water. Higher levels of certain parameters (i.e., suspended solids, nutrients, temperature, etc.) should be allowed in these areas since intensively irrigated agriculture, even under ideal conditions, will unavoidably contribute higher levels of these parameters. Criteria, therefore, should be based on the conditions that exist after Best Management Practices have been implemented.

IV SUMMARY AND CONCLUSIONS

Malheur River flows have been extensively altered through the construction of several dams and diversion structures designed to store and distribute water for agricultural uses. These dams, as well as others on the Snake River, to which the Malheur is tributary, block natural fish migrations in the river and, thus, have permanently altered the river's fisheries. In addition, water quality below Namorf Dam has been affected, primarily through agricultural practices, in a way which severely restricts the type of fish that can successfully inhabit the water. One important factor which affects fish populations below Namorf is the high suspended solids loading which effectively selects against sight-feeding species. Other conditions which could affect the types and survival of fish species below Namorf include low flow during the fall and winter when reservoirs are being filled in preparation for the coming irrigation season, as well as high suspended solids, and high temperatures during the summer irrigation season.

Realistically, the Malheur River could not be returned to its natural state unless a large number of hydraulic structures were removed. Removal of these structures would result in the demise of agriculture in the region, which is the mainstay of the

county's economy. Furthermore, removal of these structures is out of the question due to the legal water rights which have been established in the region. These water rights can only be satisfied through the system of dams, reservoirs, and diversions which have been constructed in the river system. Thus, the changes in the Malheur River Basin are irrevocable.

Physical barriers to fish migration coupled with the effects of high sediment loads and the hydraulics of the system have for years established the uses of the river. Given the existing conditions and uses of the Malheur River below the Namorf Diversion, classification of this river each should be changed from a salmonid fishery, a use that cannot be achieved, to achievable uses which are based on the existing resident fish populations and aquatic life to reflect the present and highest future uses of the river. Such a change in designated beneficial uses would not further jeopardize existing aquatic life in the river, nor would it result in any degradation in water quality.

WATER BODY SURVEY AND ASSESSMENT
Pecan Bayou
Brownwood, Texas

I. INTRODUCTION

A. Site Description

Segment 1417 of the Colorado River Basin (Pecan Bayou) originates below the Lake Brownwood Dam and extends approximately 57.0 miles to the Colorado River (Figure 1). The Lake Brownwood Dam was completed in 1933. Malfunction of the dam's outlet apparatus led to its permanent closure in 1934. Since that time, discharges from the reservoir occur only infrequently during periods of prolonged high runoff conditions in the watershed. Dam seepage provides the base flow to Pecan Bayou (Segment 1417). The reservoir is operated for flood control and water supply. The Brown County WID transports water from the reservoir via aqueduct to Brownwood for industrial distribution, domestic treated water distribution to the Cities of Brownwood and Bangs and the Brookesmith Water System, and irrigation distribution. Some irrigation water is diverted from the aqueduct before reaching Brownwood.

Pecan Bayou meanders about nine miles from Lake Brownwood to the City of Brownwood. Two small dams impound water within this reach, and Brown County WID operates an auxilliary pumping station in this area to supply their system during periods of high demand.

Two tributaries normally provide inflow to Pecan Bayou. Adams Branch enters Pecan Bayou in Brownwood. The base flow consists of leaks and overflow in the Brown County WID storage reservoir and distribution system. Willis Creek enters Pecan Bayou below Brownwood. The base flow in Willis Creek is usually provided by seepage through a soil conservation dam.

The main Brownwood sewage treatment plant discharges effluent to Willis Creek one mile above its confluence with Pecan Bayou. Sulfur Draw, which carries brine from an artesian salt water well and wastewater from the Atchison, Topeka and Santa Fe Railroad Co., enters Willis Creek about 1,700 feet below the Brownwood sewage treatment plant. Below the Willis Creek confluence, Pecan Bayou meanders about 42.6 miles to the Colorado River, and receives no additional inflow during dry weather conditions. Agricultural water withdrawals for irrigation may significantly reduce the streamflow during the growing season.

The Pecan Bayou drainage basin is composed primarily of range and croplands. The stream banks, however, are densely vegetated with trees, shrubs and grasses. The bayou is typically 10-65 feet wide, 2-3 feet deep, and is generally sluggish in nature with soft organic sediments.

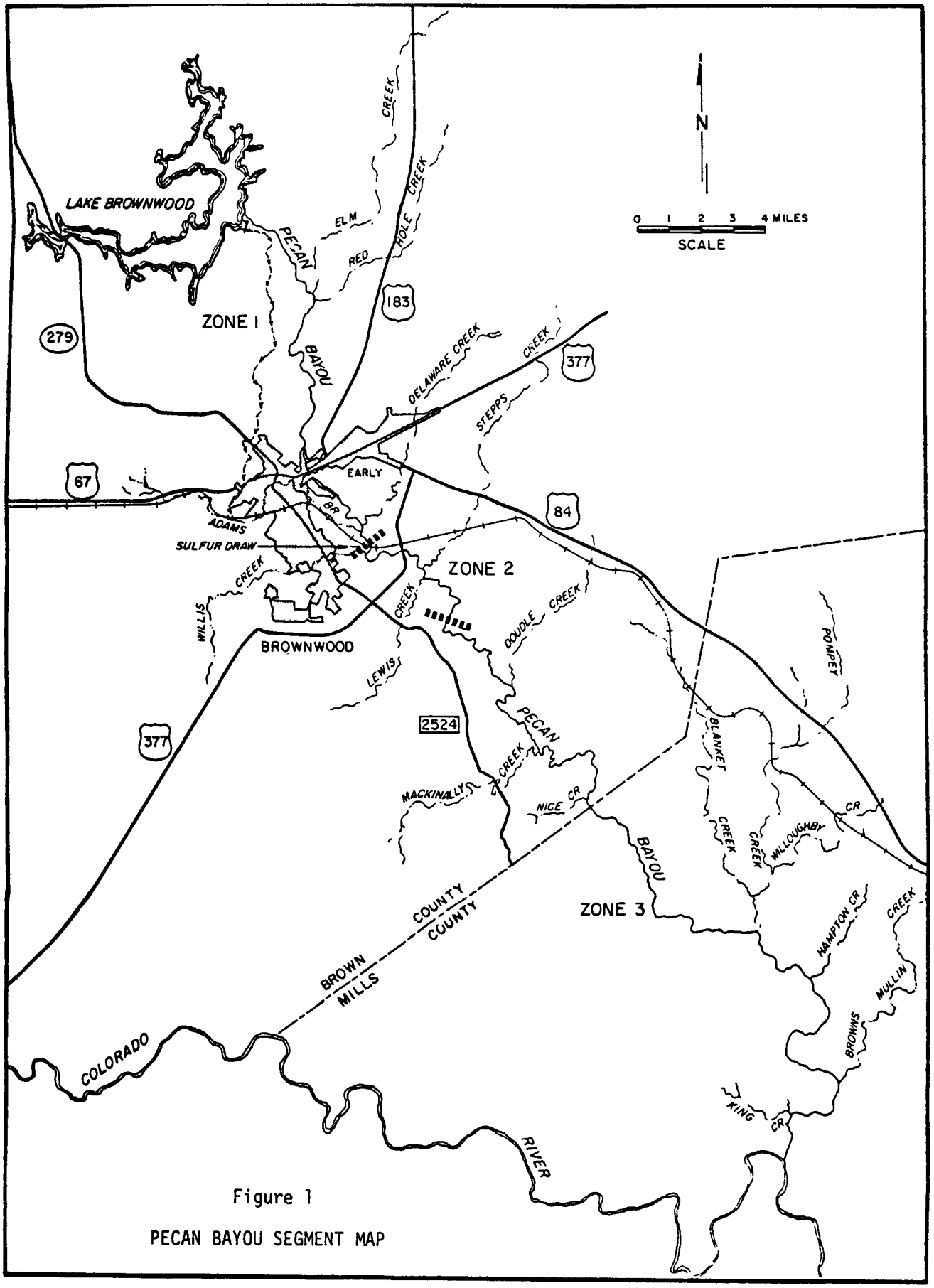


Figure 1

PECAN BAYOU SEGMENT MAP

B. Problem Definition

The designated water uses for Pecan Bayou include noncontact recreation, propagation of fish and wildlife, and domestic raw water supply. Criteria for dissolved oxygen (minimum of 5.0 mg/l), chlorides, sulfates, and total dissolved solids (annual averages not to exeed 250, 200, and 1000 mg/l, respectively), pH (range of 6.5 to 9.0) fecal coliform (log mean not to exceed 1000/100 ml), and temperature (maximum of 90°F) have been established for the segment.

Historically, Pecan Bayou is in generally poor condition during summer periods of low flow, when the Brownwood STP contributes a sizeable portion of the total stream flow. During low flow conditions, the stream is in a highly enriched state below the sewage outfall.

Existing data indicate that instream dissolved oxygen concentrations are frequently less than the criterion, and chloride and total dissolved solids annual average concentrations occasionally exceed the established criteria. The carbonaceous and nitrogenous oxygen deficencies in Pecan Bayou. The major cause of elevated chlorides in Pecan Bayou is the artesian brine discharge in to Sulfur Draw.

Toxic compounds (PCB, DDT, DDD, DDE, Lindane, Heptachlor epoxide, Dieldrin, Endrin, Chlordane, Pentachlorophenol, cadmium, lead, silver, and mercury) have been observed in water, sediment and fish tissues in Pecan Bayou (mainly below the confluence with Willis Creek). It has been determined that the major source was the Brownwood STP, but attempts to specifiy the points of origin further have been unsuccessful. However, recent levels show a declining trend.

C. Approach to Use Attainability

Assessment of Pecan Bayou is based on a site visit which included meetings with representatives of the State of Texas, EPA (Region VI and Headquarters) and Camp Dresser & McKee Inc., and upon information contained in a number of reports, memos and other related materials.

It was agreed by those present during the site visit that the data and analyses contained in these documents were sufficient for an examination of the existing designated uses of Pecan Bayou.

II. ANALYSES CONDUCTED

An extensive amount of physical, chemical, and biological data has been collected on Pecan Bayou since 1973. Most of the information was gathered to assess the impact of the Brownwood STP on the receiving stream. In order to simplify the presentation of these data, Pecan Bayou was divided into three zones (Figure 1): Zone 1 is the control area and extends from the Lake Brownwood Dam (river mile 57.0) to the Willis Creek confluence (river mile 42.6); Zone 2 is the impacted area and extends 9.0 miles below the Willis Creek confluence.

A. Physical Evaluation

With the exception of stream discharge, the physical characteristics of Pecan Bayou are relatively homogeneous by zone. Average width of the stream is about 44-50 feet, and average depth ranges from 2.1 to 3.25 feet. The low gradient (2.8 to 3.9 ft/mile) causes the bayou to be sluggish (average velocity of about 0.1 ft/sec), reaeration rates to be low (K_2 of 0.7 per day at 20°C), and pools to predominate over riffles (96% to 4%). Stream temperature averages about 18°C and ranges from 1-32°C. The substrate is composed primarily of mud (sludge deposits dominate in Zone 2), with small amounts of bedrock, gravel and sand being exposed in riffle areas.

Base flow in Pecan Bayou is provided by dam seepage (Zone 1) and the treated sewage discharge from the City of Brownwood (Zones 2 and 3). Median flow increases in a downstream direction from 2.5 cfs in Zone 1 to 17.4 cfs in Zone 3. Significantly higher mean flows (118 cfs in Zone 1 and 125 cfs in Zone 3) are the result of periodic high rainfall runoff conditions in the watershed.

B. Chemical Evaluation

Existing chemical data of Pecan Bayou characterize the degree of water quality degradation in Zone 2. Average dissolved oxygen levels are about 2.0 mg/l lower in the impact zone, and approximately 50% of the observations have been less than 5.0 mg/l. BOD_5, ammonia, nitrite, nitrate, and phosphorus levels are much higher in the impact zone as compared to the control and recovered zones. Un-ionized ammonia levels are also higher in Zone 2, but most of the concentrations were below the reported chronic levels allowable for warm water fishes. None of the levels exceeded the reported acute levels allowable for warm water fishes, and less than 4% of the levels were between the acute and chronic levels reported. Total dissolved solids, chlorides and sulfates were higher in Zones 2 and 3, mainly as a result of the brine and sewage discharges into Sulfur Draw and Willis Creek.

PCB, DDT, DDD, DDE and Lindane in water, and PCB, DDD, and DDE, Heptachlor epoxide, Dieldrin, Endrin, Chlordane, and Pentachlorophenol in sediment have been detected in Zone 2. PCB, DDT, DDD, and DDE concentrations in water have exceeded the criteria to protect freshwater aquatic life. The Brownwood STP was the suspected major source of these pesticides. Most of the recent levels, however, show a declining trend. PCB was detected also in Zones 1 and 3.

Heavy metals have not been detected in the water. Heavy metals in the sediment have shown the highest levels in Zone 2 for arsenic (3.7 mg/kg), cadmium (1.1 mg/kg), chromium (17.4 mg/kg), copper (9.5 mg/kg), lead (25.1 mg/kg), silver (1.5 mg/kg), zinc (90 mg/kg), and mercury (0.18 mg/kg).

C. Biological Evaluation

Fish samples collected from Zone 1 are representative of a fairly healthy population of game fish, rough fish and forage species. Zone 2 supported a smaller total number of fish which were composed primarily of rough fish and forage species. A relatively healthy balance of game fish, rough fish and forage species reappeared in the recovered zone.

Macrophytes were sparse in Zones 1 and 3. They were most abundant in Zone 2 below the Willis Creek confluence and were composed of vascular plants (pondweed, coontail, false loosestrife and duckweed) and filamentous algae (Cladophora and Hydrodictyon). Macrophyte abundance below Willis Creek is most likely due to nutrient enrichment of the area from the Brownwood STP.

Zone 1 is represented by a fairly diverse macrobenthic community characteristic of a clean-water mesotrophic stream. Nutrient and organic enrichment in Zone 2 has a distinct adverse effect as clean-water organisms are replaced by pollution-tolerant forms. Some clean-water organisms reappeared in Zone 3 and pollution-tolerant forms were not as prevalent; however, recovery to baseline conditions (Zone 1) was not complete.

Net phytoplankton desnities are lowest in Zone 1. Nutrient and organic enrichment in Zone 2 promotes a marked increase in abundance. Peak abundance was observed in the upper part of Zone 3. The decline below this area was probably caused by biotic grazing and/or nutrient deficiencies.

Fish samples for pesticides analyses have revealed detectable levels of PCB, DDE and DDD in Zone 1. Fish collected from zone 2 contained markedly higher amounts of DDE, DDD, DDT, Lindane and Chlordane than Zones 1 or 3. PCB in fish tissue was highest in ZOne 3, and measureable concentrations of DDE and DDD have also been observed. Concentrations of total DDT in whole fish tissues from Zone 2 have exceeded the USFDA Action Level of 5.0 mg/kg for edible fish tissues. Species representing the highest concentrations.

Computer modeling simulation were made to predict the dissolved oxygen profile in the impact zone during the fish spawning season. The results indicate that about three miles of Pecan Bayou in April and May and about 4 1/2 miles in June will be unsuitable for propogation, considering a minimum requirement of 4.0 mg/l. The model predicts a minimum D.O. of 0.8 mg/l in April, 1.2 mg/l in May, and 0 mg/l in June.

D. Institutional Evaluation

Two institutional factors exist which constrain the situation that exists in Pecan Bayou. These are the irrigation water rights and the Brownwood sewage treatment plant discharge permits. Although the sewage treatment plant discharge permits will expire and the problems created by the effluent could be eliminated in the future, there is a need for the flow provided by the discharge to satisfy the downstream water rights used for irrigation. Currently, there are eight water users on Pecan Bayou downstream of the Brownwood STP discharge with water rights permits totaling 2,957 acre-feet/year. Obviously, the 0.1 cfs base flow which exists in Pecan Bayou upstream of the STP discharge is not sufficient to fulfill these downstream demands. Therefore, it appears that the STP flow may be required to supplement the base flow in Pecan Bayou to meet the downstream demands for water unless it could be arranged that water from Lake Brownwood could be released by the Brown Co. WID #1 to meet the actual downstream water needs.

Modeling studies show that although there would be some improvement in water quality as a result of the sewage treatment plant going to advanced waste treatment (AWT), there would still be D.O. violations in a portion of Pecan Bayou in Zone 2. The studies also show that there is minimal additional water quality improvement between secondary and advanced waste treatment, although the costs associated with AWT were significantly higher than the cost for secondary treatment. In this case, the secondary treatment alternative would be the recommended course of action.

III. FINDINGS

A. Existing Uses

Pecan Bayou is currently being used in the following ways:

- Domestic Raw Water Supply
- Propagation of Fish and Wildlife
- Noncontact Recreation
- Irrigation
- City of Brownwood STP discharge (not an acceptable or approved use designation)

Use as a discharge route for the City of Brownwood's sewage treatment plant effluent has contributed to water quality conditions which are unfavorable to the propagation of fish and wildlife in a portion of Pecan Bayou.

B. Potential Uses

The Texas Department of Water Resources has established water uses which are deemed desirable for Pecan Bayou. These uses include: noncontact recreation, propagation of fish and wildlife, and domestic raw water supply.

Of these uses, propagation of fish and wildlife is unattainable in a portion of Pecan Bayou due to the effects of low dissolved oxygen levels in the bayou primarily during the spawning season. If the Brownwood sewage treatment plant effluent could be removed from Pecan Bayou, the persistently low dissolved oxygen conditions which exist and are unfavorable to fish spawning could be alleviated and the propagation of fish and wildlife could be partially restored to Pecan Bayou.

Public hearings held on the proposed expansion of the sewage treatment plant indicate a reluctance from the public and the City to pay for higher treatment levels, since modeling studies show minimal water quality improvement in Pecan Bayou between secondary and advanced waste treatment. In addition, an affordability analysis performed by the Texas Department of Water Resources (Construction Grants) indicates excessive treatment costs per month would result at the AWT level.

It appears that the elimination of the waste discharge from Pecan Bayou is not presently a feasible alternative, since the Brownwood STP currently holds a discharge permit and the water rights issue seems to be the overriding factor. Therefore, in the future, the uses which are most likely to exist are those which exist at present.

IV. SUMMARY AND CONCLUSIONS

A summary of the findings from the use attainability analysis are listed below:

- The designated use "propagation of fish and wildlife" is impaired in Zone 2 of Pecan Bayou.
- Advanced Treatment will not attain the designated use in Zone 2, partially because of low dilution, naturally sluggish characteristics (X velocity 0.1 ft/sec) and as a result, low assimlitive capacity of the bayou (K_2 reaeration rate 0.7 per day at 20°C).
- Downstream water rights for agricultural irrigation are significant.
- Dissolved oxygen levels are frequently less than the criterion of 5.0 mg/l in Pecan Bayou.
- Total DDT in whole fish from Zone 2 exceeded the U.S. Food and Drug Administration's action level of 5.0 mg/kg for edible fish tissues.
- Annual average chloride concentrations in Pecan Bayou are occasionally not in compliance with the numerical criteria.

Dissolved oxygen levels less than 5.0 mg/l (about 50% of the measurements) observed in Zone 2 of Pecan Bayou result from the organic and nutrient loading contributed by the Brownwood STP and the corresponding low waste assimilative capacity of the bayou. As previously mentioned, the major source of toxics found in the water, sediment and fish tissues was also determined to be the Brownwood STP. PCB and DDT in water have exceeded the criteria to protect freshwater aquatic life in Zone 2. Although the toxics appear to be declining in the water and sediment, the levels of total DDT found in whole fish exceed the U. S. Food and Drug Administration's action level (5.0 mg/k) for DDT in edible fish tissue. Investigations are underway by the Texas Department of Water Resources to further evaluate the magnitude of this potential problem.

Primarily as a result of the oxygen deficiencies and possibly be cause of the presence of toxic substances, the designated use "propagation of fish and wildlife" is not currently attained in Zone 2 of Pecan Bayou. These problems could be eliminated only if the Brownwood STP ceased to discharges into Pecan Bayou because even with advanced waste treatment the water quality of the receiving stream is not likely to improve sufficiently to support this designated use. Other treatment alternatives such as land treatment or overland flow are not feasible because of the current discharge is necessary to satisfy downstream water rights for agricultural irrigation. If the flow required to meet the water rights could be augmented from other sources, then the sewage treatment plant discharge could be eliminated in the future.

The annual average chloride level in Pecan Bayou are occasionally not in compliance with the established criterion. The primary source has been determined to be a privately owned salt water artesian well. Since efforts to control this discharge have proved futile, some consideration should be given to changing the numerical criterion for chlorides in Pecan Bayou.

In conclusion, it appears that either the Brownwood STP discharge into Pecan Bayou should be eliminated (if an alternative water source could be found to satisy the downstream water rights) or the numerical criterion for dissolved oxygen and the propogation of fish and wildlife use designation should be changed to reflect attainable conditions.

WATER BODY SURVEY AND ASSESSMENT
Salt Creek
Lincoln, Nebraska

I. INTRODUCTION

A. Site Description

The Salt Creek drainage basin is located in east central Nebraska. The mainstem of Salt Creek originates in southern Lancaster County and flows northeast to the Platte River (Figure 1). Ninety percent of the 1,621 square mile basin is devoted to agricultural production with the remaining ten percent primarily urban. The basin is characterized by moderately to steeply rolling uplands and nearly level to slightly undulating alluvial lands adjacent to major streams, primarily Salt Creek. Drainage in the area is usually quite good with the exception of minor problems sometimes associated with alluvial lands adjacent to the larger tributaries. Soils of the basin are of three general categories. Loessial soils are estimated to make up approximately 60 percent of the basin, glacial till soils 20 percent, and terrace and bottomland soils 20 percent.

Frequent high intensity rainfalls and increased runoff from land used for crop production has, in past years, contributed to flood damage in Lincoln and smaller urbanized areas downstream. To help alleviate these problems, flood control practices have been installed in the watershed. These practices, including several impoundments and channel modifications to the mainstream of Salt Creek, were completed during the late 1960's. Channel realignment of the lower two-thirds of Salt Creek has decreased the overall length of Salt Creek by nearly 34 percent (from 66.9 to 44.3 miles) and increased the gradient of the stream from 1.7 feet/mile to 2.7 feet/mile.

Salt Creek is currently divided into three classified segments: (upper reach) LP-4, (middle reach) LP-3a, and (lower reach) LP-3b. (Figure 1). Segments LP-4 and LP-3b are designated as Warmwater Habitats whereas segment LP-3a is designated as a Limited Warmwater Habitat.

B. Problem Definition

"Warmwater Habitat" and "Limited Warmwater Habitat" are two subcategories of the Fish and Wildlife Protection use designation in the Nebraska Water Quality Standards. The only distinction between these two use classes is that for Limited Warmwater Habitat waters, reproducing populations of fish are "...limited by irretrievable man-induced or natural background conditions." Although segment LP-3a is classified Limited Warmwater Habitat and segment LP-3b as Warmwater Habitat, they share similar physical characteristics. Since the existing fisheries of both segments were not thoroughly evaluated when the standard was revised, it is possible that the use designation for one or other segments is incorrect. This study was initiated to determine (1) if the Warmwater Habitat use is attainable for segment LP-3a and (2) what, if any, physical habitat or water quality constraints preclude the attainment of this use.

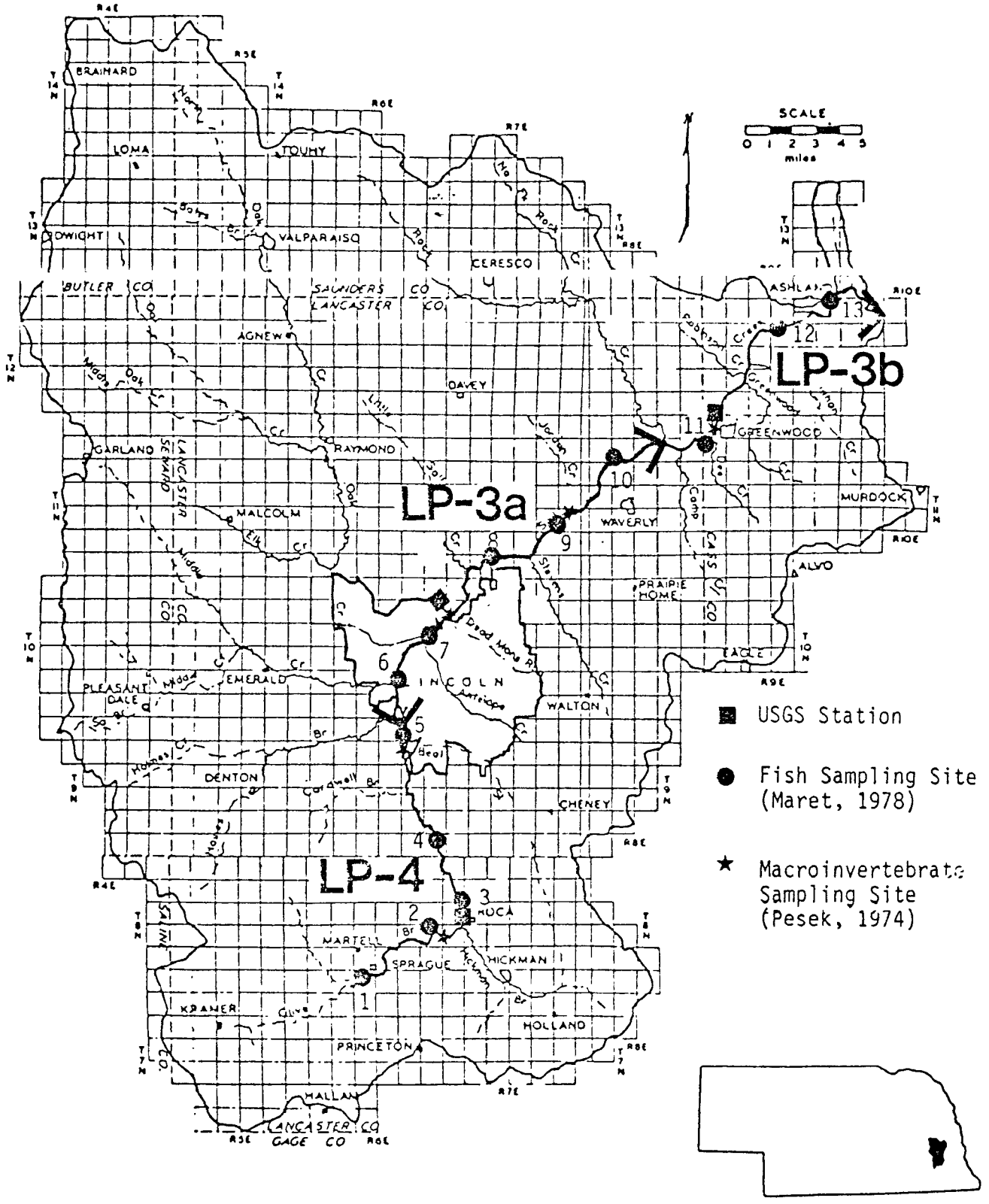


Figure 1. Monitoring sites from which data were used for Salt Creek attainability study.

C. Approach to Use Attainability Analysis

The analytical approach used in this study was a comparison of physical, chemical and biological parameters between the upper, middle, and lower Salt Creek segments with emphasis was on identifying limiting factors in the creek. The uppermost segment (LP-4) was used as the standard for comparison.

The data base used for this study included United States Geological Survey (USGS) and Nebraska Department of Environmental Control (NDEC) water quality data outlined in the US EPA STORET system, two Master of Science theses by Tom Pesek and Terry Maret, publications from the Nebraska Game and Parks Commission and USGS and personal observations by NDEC staff. No new data was collected in the study.

II. ANALYSES CONDUCTED

A review of physical, chemical and biological information was conducted to determine which aquatic life use designations would be appropriate. Physical characteristics for each of the three segments were evaluated and then compared to the physical habitat requirements of important warm water fish species. Characteristics limiting the fishery population were identified and the suitability of the physical habitat for maintaining a valued fishery was evaluated. General water quality comparisons were made between the upper reach of Salt Creek, and the lower reaches to establish water quality differences. A water quality index developed by the NDEC was used in this analysis to compare the relative quality of water in the segments. In addition, some critical chemical constituents required to maintain the important species were reviewed and compared to actual instream data to determine if water quality was stressing or precluding their populations.

The fish data collected by Maret was used to define the existing fishery population and composition of Salt Creek. This data was in turn used to determine the quality of the aquatic biota through the use of six biotic integrity classes of fish communities and the Karr Index tentative numerical index for defining class boundaries.

Macroinvertebrate data based on the study conducted by Pesek was also evaluated for density and diversity.

III. FINDINGS

Chemical data evaluated using the Water Quality Index indicated good water quality above Lincoln and degraded water quality at and below Lincoln. Non-point source contributions were identified as a cause of water quality degradation and have been implicated in fish kills in the stream. Dissolved solids in Salt Creek were found to be considerably higher than in other streams in the State. Natural background contributions are the major source of dissolved solids load to the stream. Water quality criteria violations monitored in Salt Creek during 1980 and 1981 were restricted to unionized ammonia and may

have adversely impacted the existing downstream fishery. Toxics which occasionally approach or exceed the EPA criteria are chromium and lindane. Since EPA criteria for both parameters are based on some highly sensitive organisms which are not representative of indigenous populations typically found in Nebraska, the actual impact of these toxics is believed to be minimal.

Channelization was found to be a limiting factor in establishing a fishery in middle and lower Salt Creek. Terry Maret, in his 1977 study, found that substrate changes from silt and clay in the upper non-channelized area to primarily sand in the channelized area causing substantial changes in fish communities. The Habitat Suitability Index (HSI) developed by the Western Energy and Land Use Team of the U.S. Fish and Wildlife Service was used to evaluate physical habitat impacts on one important species (Channel Catfish) of fish in Salt Creek. The results indicated that upper Salt Creek had the best habitat for the fish investigated and middle Salt Creek had the worst. These results support the conclusion that middle Salt Creek lacks the physical habitat to sustain a valued warm water fishery. The Karr numerical index used to evaluate the fish data revealed that none of the stations rated above fair, further indicating the fish community is significantly impacted by surrounding rural and urban land uses.

Analysis of the abundance and diversity of macroinvertebrates indicated that the water quality in Salt Creek became progressively more degraded going downstream. Stations in the upper reaches were relatively unpolluted as characterized by the highest number of taxa, the greatest diversity and the presence of "clean-water" organisms.

IV. SUMMARY AND CONCLUSIONS

Based on the evaluation of the physical, chemical and biological characteristics of Salt Creek, the following conclusions were drawn by the State for the potential uses of the various segments:

1) Current classifications adequately define the attainable uses for upper and middle Salt Creek.

2) The Warmwater Habitat designated use may be unattainable for lower Salt Creek.

3) Channelization has limited existing instream habitat for middle Salt Creek. Instream habitat improvement in middle Salt Creek could increase the fishery but would lessen the effectiveness of flood control measures. Since flood control benefits are greater than any benefits that could be realized by enhancing the fishery, instream physical habitat remained the limiting factor for the fishery.

4) Existing water quality does not affect the limited Warmwater Habitat classification of middle Salt Creek.

5) Uncontrollable background source impacts on existing water quality and the effects of channelization on habitat may preclude attainment of the classified use.

The recommendations of the State drawn from these conclusions are as follows:

1) Keep upper section classification of Warmwater Habitat and middle section classification of Limited Warmwater Habitat.

2) Consider changing the lower section to a Limited Warmwater Habitat because of limited physical habitat and existing water quality.

WATER BODY SURVEY AND ASSESSMENT
South Fork Crow River
Hutchinson, Minnesota

I. INTRODUCTION

A. Site Description

The South Fork Crow River, located in south-central Minnesota, drains a watershed that covers approximately 1250 square miles. This river joins with the North Fork Crow to form the mainstem Crow River which flows to its confluence with the Mississippi River (Figure 1). Within the drainage basin, the predominant land uses are agricultural production and pasture land. The major soil types in the watershed are comprised of dark-colored, medium-to-fine textured silty loams, most of which are medium to well drained in character.

The physical characteristics of the South Fork Crow River are typical of many Minnesota streams flowing through agricultural lands. The upper portions of the river have been extensively channelized and at Hutchinson a forty foot wide, 12 foot high dam forms a reservoir west of the city. Downstream of the dam the river freely meanders through areas with light to moderately wooded banks to its confluence with the North Fork River Crow River. The average stream gradient for this section of the river is approximately two feet per mile and the substrate varies from sand, gravel and rubble in areas with steeper gradients to a silt-sand mixture in areas of slower velocities.

The average annual precipitation in the watershed is 27.6 inches. The runoff is greatest during the spring and early summer, after snowmelt, when the soils are generally saturated. Stream flow decreases during late summer and fall and is lowest in late winter. Small tributary streams in the watershed often go dry in the fall and winter because they have little natural storage and receive little ground water contribution. The seven-day ten year low flow condition for the South Fork below the dam at Hutchinson is approximately 0.7 cubic feet per second.

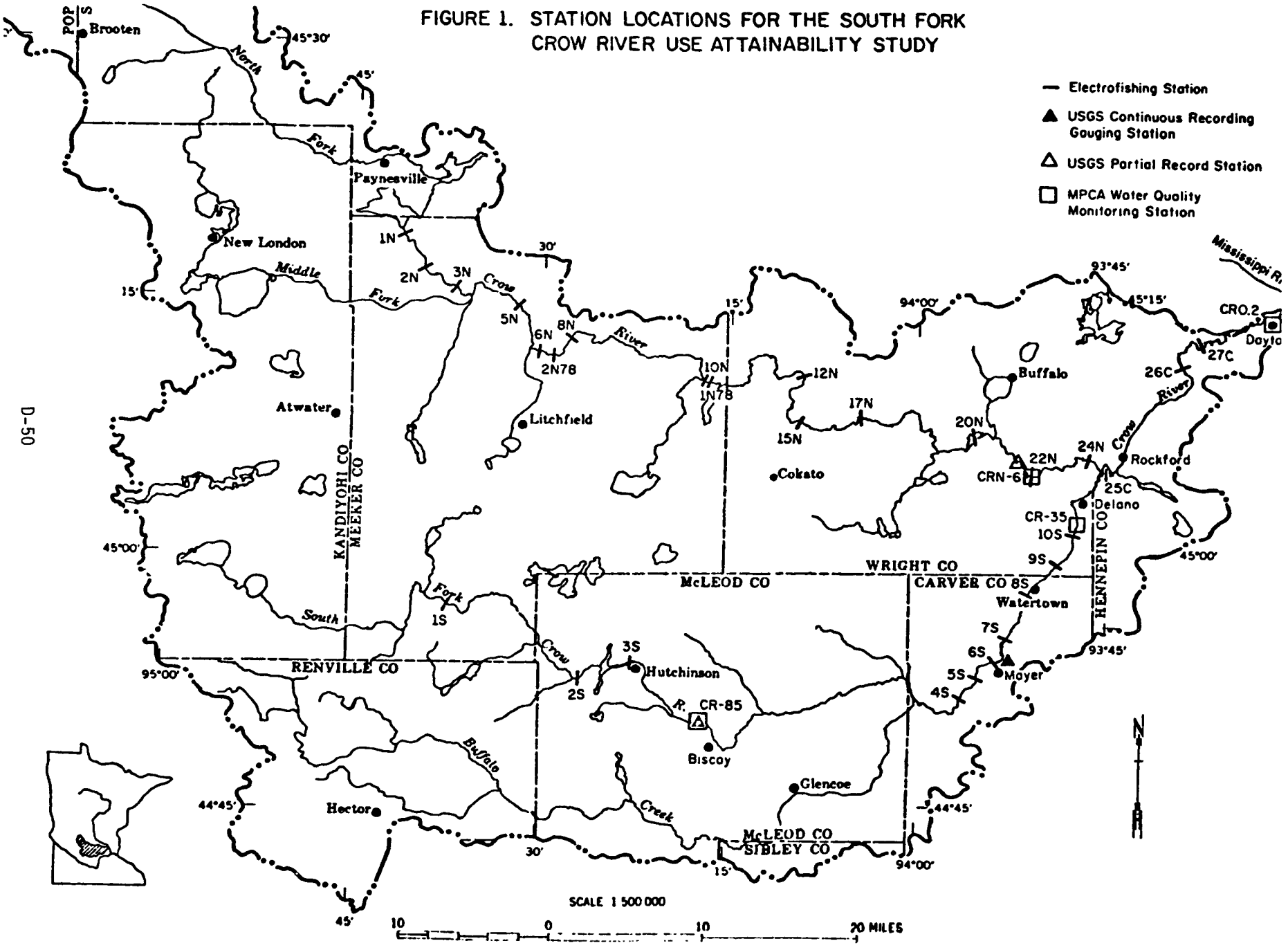
B. Problem Definition

The study on the South Fork Crow River was conducted in order to evaluate the existing fish community and to determine if the use designations are appropriate. At issue is the 2B fisheries and recreational use classification at Hutchinson. Is the water use classification appropriate for this segment?

C. Approach to Use Attainability

The analysis utilized an extensive data base compiled from data collected by the Minnesota Pollution Control Agency (MPCA), Minnesota Department of Natural Resources (MDNR) and United States Geological Survey (USGS). No new data was collected as part of the study. The USGS maintains partial or continuous flow record stations on both forks

FIGURE 1. STATION LOCATIONS FOR THE SOUTH FORK CROW RIVER USE ATTAINABILITY STUDY



and the mainstem Crow River with a data base of physical and chemical parameters available on STORET. The USGS data was used in the physical evaluation of the river. MPCA has a water quality monitoring data base on STORET for five stations in the Crow River watershed. The MPCA data plus analytical data from a waste load allocation study on the South Fork below Hutchinson was used in the chemical evaluation of the river. MDNR fisheries and stream survey data, a MDNR report on the analysis of the composition of fish populations in Minnesota rivers, and personal observations of MDNR personnel was used to evaluate the biological characteristics of the river.

The analytical approach used by the MPCA sought to 1) compare instream fish community health of the South Fork to that of the North Fork, the mainstem Crow River, and other warm water rivers in the State and 2) evaluate physical and chemical factors affecting fisheries and recreational uses. The North Fork of the Crow River was used for comparison because of sufficient fisheries data, similar land uses and morphologies, similar non-point source impacts and the lack of any significant point source dischargers.

II. ANALYSES CONDUCTED

Physical, chemical and biological factors were considered in this use attainability analysis to determine the biological health of the South Fork and to define the physical and chemical factors which may be limiting. A general assessment of the habitat potentials of the South Fork Crow River was performed using a habitat evaluation rating system developed by the Wisconsin Department of Natural Resources. In addition, the Tennant method for determining instream flow requirements was also employed in this study.

Fish species diversity, equitability and composition were used to define the biological health of the South Fork relative to that of the North Fork, the mainstem Crow and other warmwater rivers in Minnesota. Water quality monitoring data from stations above and below the point source discharges at Hutchinson were used to compare beneficial use impairment values pertaining to the designated fisheries and recreational uses of the South Fork Crow River. A computer data analysis program developed by EPA Region VIII was used to compute these values.

III. FINDINGS

The comparison of species diversity values for the North Fork and mainstem Crow River to the South Fork showed higher values for the North Fork and mainstem Crow. On the other hand, the South Fork had higher species equitability values. The percent species composition compared favorably to Peterson's (1975) estimates for median species diversity for a larger Minnesota river. Recruitment from tributaries, marshes, lakes and downstream rivers has given the South Fork a relatively balanced community which compares well to other warmwater rivers in the State. The calculated species diversity and equitability indices coupled with the analysis of species composition indicated that the South Fork of the Crow River does support a warmwater fishery with evidence of some degree of environmental stress.

The MPCA employed the Wisconsin habitat rating system and the Tennant method designated to quantify minimum instream fisheries flow requirements to identify any physical limiting factors. Based on the Wisconsin habitat evaluation assessment, habitat rating score were fair. The limiting factors identified via this assessment were: 1) lack of diverse streambed habitat suitable for reproduction, food production and cover and 2) instream water fluctuations (low flow may be a major controlling factor).

The State utilized EPA Region VIII's data analysis program to express stream water quality as a function of beneficial use. The closest downstream station to Hutchinson had the highest warmwater aquatic life use impairment values. Warmwater aquatic life use impairment values declined further downstream indicating that the point source dischargers were major contributors to this use impairment. However, primary contact recreational use impairment values were high throughout the stream. This led the State to believe that the impairment of primary contact recreational use is attributable to non-point sources.

IV. SUMMARY AND CONCLUSION

The State concluded from the study that: 1) the South Fork of the Crow River has a definite fisheries value although the use impairment values indicate some stress at Hutchinson on an already limited resource and 2) although the South Fork of the Crow River has a dominant rough fish population, game and sport fish present are important component species of this rivers' overall community structure.

From these conclusions the State recommended that the South Fork of the Crow River retain its present 2B fisheries and recreational use classification. Furthermore, efforts should continue to mitigate controllable factors that contribute to impairment of use. The effort should entail a reduction of marsh tilling and drainage, acceptance and implementation of agricultural BMP's and an upgrade of point source dischargers in Hutchinson.

WATER BODY SURVEY AND ASSESSMENT

South Platte River
Denver, Colorado

I. INTRODUCTION

A. Site Description

Segment 14 of the South Platte River originates north of the Chatfield Lake at Bowles Avenue in Arapahoe County and extends approximately 16 miles, through metro Denver, in a northerly direction to the Burlington ditch diversion near the Denver County-Adams County line. A map of the study area is presented in Figure 1. Chatfield Lake was originally constructed for the purposes of Flood control and recreation. The reservoir is owned by the U.S. Army Corps of Engineers and is essentially operated such that outflow equals inflow, up to a maximum of 5,000 cfs. In addition, water is released to satisfy irrigation demands as authorized by the State Engineers Office. There is also an informal agreement between the State Engineers Office and the Platte River Greenway Foundation for timing releases of water to increase flows during periods of high recreational use. The Greenway Foundation has played an important role in the significant improvement of water quality in the South Platte River.

There are several obstructions throughout Segment 14 including low head dams, kayak chutes (at Confluence Park and 13th Avenue), docking platforms, and weir diversion structures which alter the flow in the South Platte River. There are four major weir diversion structures in this area which divert flows for irrigation; one is located adjacent to the Columbine Country Club, a second near Union Avenue, a third upstream from Oxford Avenue, and a fourth at the Burlington Ditch near Franklin Street.

Significant dewatering of the South Platte River can occur due to instream diversions for irrigation and water supply and pumping from the numerous ground water dwells along the river.

Eight tributaries normally provide inflow to the South Platte River in Segment 14. These include Big Dry Creek, Little Dry Creek, Bear Creek, Harvard Gulch, Sanderson Gulch, Weir Gulch, Lakewood Gulch, and Cherry Creek.

There are several municipal and industrial facilities which discharge either directly to or into tributaries of the South Platte River in this reach. The major active discharges into the segment are the Littleton-Englewood wastewater treatment plant (WWTP), the Glendale WWTP, the City Ice Company, two Public Service company power plants (Zuni and Arapahoe), and Gates Rubber.

The South Platte River drainage basin in this area (approximately 120,000 acres) is composed primarily of extensively developed urban area (residential, industrial, commercial, services, roads), parks and recreational areas, gravel mining areas, and rural areas south of the urban centers for farming and grazing.

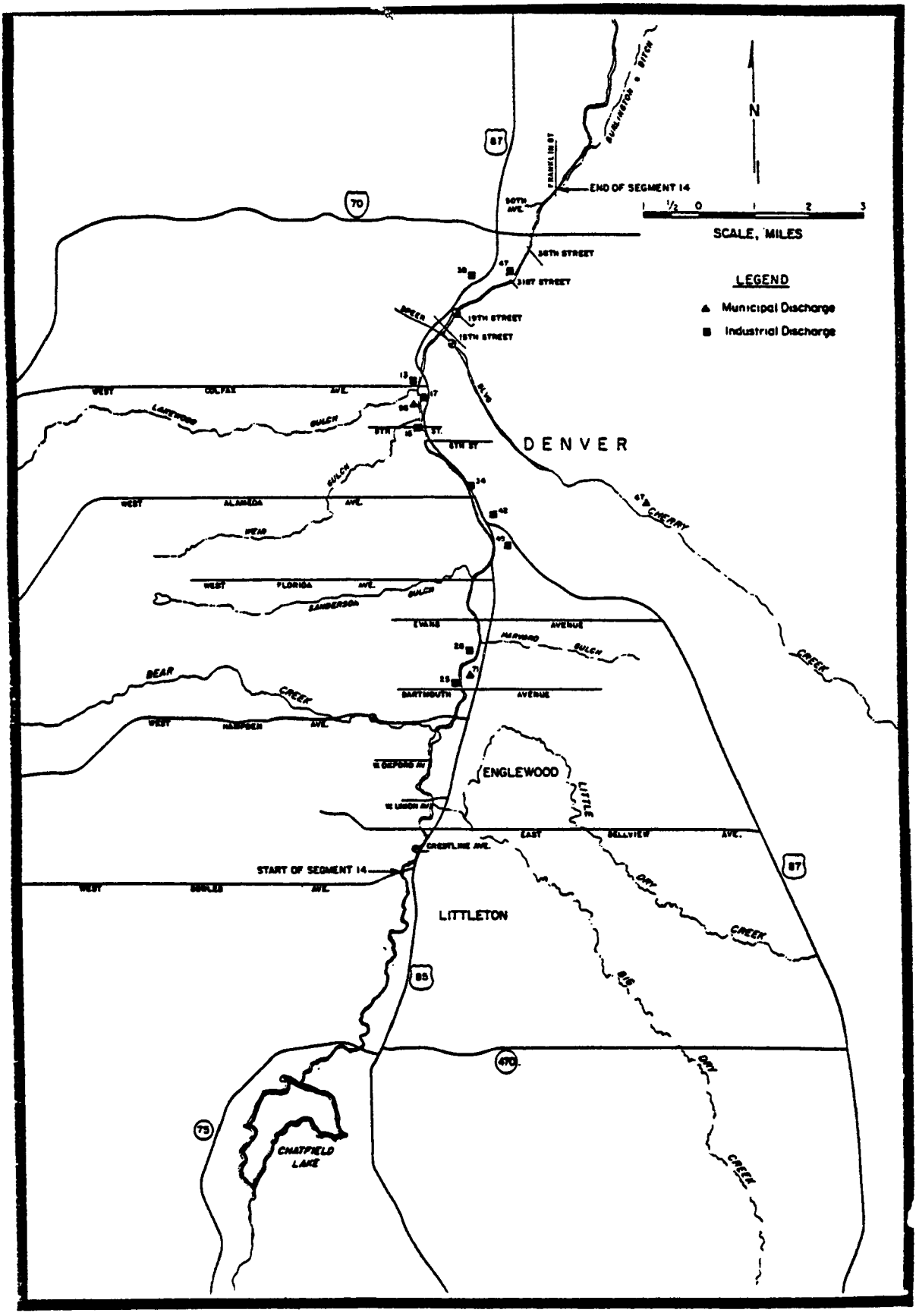


Figure 1

SOUTH PLATTE RIVER STUDY AREA MAP

In the study area, the South Platte River is typically 50-150 feet wide and 1-16 feet deep (typically 1-2 feet) and has an average channel bed slope of 12.67 feet per mile, with alternating riffle and pool reaches. The channel banks are composed essentially of sandy-gravelly materials that erode easily when exposed to high-flow conditions. The stream banks are generally sparsely vegetated with trees, shrubs, and grasses (or paving in the urban centers.)

B. Problem Definition

The following use classifications have been designated for Segment 14 of the South Platte River:

- Recreation - Class 2 - secondary contact
- Aquatic Life - Class 1 - warm water aquatic life
- Agriculture
- Domestic Water Supply

Following a review of the water quality studies and data available for Segment 14 of the South Platte River, several observations and trends in the data have been noted, including:

- Fecal coliform values exceeded the recommended limits for recreational uses in the lower portion of Segment 14.

- Un-ionized ammonia levels exceeded the water quality criterion for the protection of aquatic life in the lower portion of the segment.

- Levels of total recoverable metals (lead, zinc, cadmium, total iron, total manganese, and total copper) have been measured which exceed the water quality criteria for the protection of aquatic life.

Although the exact points of origin have not been specified, it is generally felt that the source of the ammonia is municipal point sources, and the sources of the metals are industrial point sources.

In addition, the cities of Littleton and Englewood have challenged the Class I warm water aquatic life use on the basis that the flow and habitat are unsuitable to warrant the Class I designation, and they have also challenged the apporopriateness of the 0.06 mg/l un-ionized ammonia criteria on the basis of new toxicity data. The Colorado Water Quality Control Commission in November, 1982 approved the Class I aquatic life classification and the 0.06 mg/l un-ionized ammonia criteria.

C. Approach to Use Attainability

Assessment of Segment 14 of the South Platte River was based on a site visit (May 3-4, 1982) which included meetings with representatives of the Colorado Department of Health, EPA (Region VIII and Headquarters) and Camp Dresser & McKee Inc., and upon information contained in a number of reports, hearing transcripts and the other related materials. Most of the physical, chemical and biological data was obtained from the USGS, EPA (STORET), DRURP, and from

studies. It was agreed that there was sufficient chemical, physical and biological data to proceed with the assessment, even though physical data on the aquatic habitat was limited.

II. ANALYSES CONDUCTED

A. Physical Factors

Streamflow in the South Platte River (Segment 14) is affected by several factors including releases from Chatfield Dam, diversions for irrigation and domestic water supply, irrigation return flows, wastewater discharges, tributary inflows, pumping from ground water wells in the river basin, evaporation from once-through cooling at the two power plants in Segment 14, and natural surface water evaporation. Since some of these factors (particularly ground water pumping, evaporation and irrigation diversions) are variable, flow in the South Platte River is used extensively for irrigation and during the irrigation season diversions and return flows may cause major changes in streamflow within relatively short reaches. During the summer, low-water conditions prevail because of increased evaporation, lack of rainfall, and the various uses made of the river water (e.g. irrigation diversions). Municipal, industrial, and storm-water discharges also contributes to the streamflow in the South Platte River.

Natural pools in the South Platte River are scarce and the shifting nature of the channel bed results in temporary pools, a feature which has a tendency to greatly limit the capacity for bottom food production. There are approximately 3-4 pools per river mile with the majority being backwater pools upstream of diversion structures, bridge crossings, low head dams, docking platforms, drop-off structures usually downstream of wastewater treatment plant outfalls, kayak chutes, and debris. The hydraulic effect of each obstruction is generally to cause a backwater condition immediately upstream from the structure, scouring immediately downstream, and sandbar development below that. These pools act as settling basins for silt and debris which no longer get flushed during the high springs flows once Chatfield Lake was completed.

In the plains, channels of the South Platte River and lower reaches of tributaries cut through deep alluvial gravel and soil deposits. Sparse vegetation does not hold the soils, so stream bank erosion and channel bed degredation is common during periods of high flow, particularly during the spring snowmelt season. The high intensity - low duration rainstorms which occur during the summer (May, June, and July) also temporarily muddy the streams.

An evaluation of the physical streambed characteristics of Segment 14 to determine the potential of the Segment to maintain and attract warm water aquatic life was conducted by Keeton Fisheries Consultants, Inc. The study concluded that the sediment loads in this reach of the South Platte River could pose a severe problem to the aquatic life forms present, however, further study needs to be conducted to substantiate this conclusion. Furthermore, some gravel mining operations have recently been discontinued thus the sediment problem may have been reduced.

The temperature in the South Platte River is primarily a function of releases from the bottom of Chatfield Lake, the degree of warming that takes place in the shallow mainstream and isolated pools, and the warming that occurs through the mixing of power plant cooling water with the South Platte River.

B. Chemical Factors

Water quality conditions in the South Platte River are substantially affected by municipal and industrial wastewater discharges, irrigation return flows and other agricultural activities, and non-point sources of pollution (primarily during rainfall-runoff events). Irrigation and water supply diversions also exert a major influence on water quality by reducing the stream flow, and thereby reducing the dilution assimilative capacity of the river.

- Dissolved oxygen levels were above the 5.0 mg/l criteria acceptable for the maintenance of aquatic life.

- Average concentrations of un-ionized ammonia exceeded the State water quality criteria of 0.06 mg/l NH_3-N only in the lower portion of Segment 14 (north of Speer Blvd.)

- Average total lead concentrations exceeded the water quality criteria of 25 ug/l in Big Dry Creek, Cherry Creek, and the South Platte River north of Cherry Creek, ranging from 30-72 ug/l.

- Average total zinc concentrations exceeded the criteria of 11 ug/l at all the DRURP sampling stations, ranging from 19-179 ug/l.

- Average total cadmium concentrations exceeded the criteria of 1 ug/l in Beer Creek, Cherry Creek and several sites in the South Platte, ranging from 2.2-3.6 ug/l.

- Average total iron concentrations exceeded the criteria of 1,000 ug/l in Cherry Creek and several locations on the South Platte River, ranging from 1129-9820 ug/l.

- Average soluble manganese concentrations exceeded the criteria of 50 ug/l in the South Platte River north of (and including) 19th Street and in Cherry Creek, ranging from 51-166 ug/l.

- Average total copper concentrations equalled or exceeded the criteria of 25 ug/l at all but two of the DRURP sampling sites, ranging from 25-83 ug/l.

C. Biological Factors

Several electrofishing studies have been conducted on the South Platte River in recent years. Most of the sampling took place in the fall with the exception of the study in the spring (1979). The data was reviewed by Colorado Department of Health personnel and it was generally agreed that the overall health of the existing warm water fishery is restricted by temperature extremes (very cold and shallow during the winter and low flow and high temperatures during the summer),

the lack of sufficient physical habitat (i.e. structures for cover including rocks and dams, and deep pools) and the potentially stressful conditions created by the wastewater discharges (i.e. silt and organic and inorganic enrichment).

Following a review of the physical, chemical, and biological data available on the South Platte River, it was concluded that a fair warm water fishery could exist with only modest habitat improvements and maintenance of the existing ambient water quality and strict regulation prevent overfishing. With large habitat and water quality improvements, brown trout could potentially become a part of the fishery in Segment 14 of the South Platte River.

III. FINDINGS

A. Existing Uses

Segment 14 of the South Platte River is currently being used in the following ways:

- Irrigation Diversions and Return Flows
- Municipal and Industrial Water Supply
- Ground Water Recharge
- Once-through Cooling
- Municipal, Industrial, and Stormwater Discharges
- Recreation
- Warm Water Fishery

The irrigation diversions, water supply, ground water recharge, and cooling uses have primarily affected the flow in the South Platte River, resulting in significant dewatering at times. Irrigation return flows and wastewater dishcharges, on the other hand, exert their effects on the ambient and storm water quality in the River. These previous uses ultimately affect the existing warm water fishery and how the public perceives the river for recreation purposes.

B. Potential Uses

With the exception of a potential for increased recreation and the improvement of a limited warm water fishery, it is anticipated that the existing uses are likely to exist in the future. The increased recreational use will result from future Platte River Greenway Foundation projects. The improvement of a limited warm water fishery may come about in the future as the result of habitat improvements (pools, cover) control of toxic materials (un-ionized ammonia, heavy metals, cynanide), and the prevention of extensive sedimentation. However, the success of the fishery would rely on strict fishery regulations to prevent overfishing.

IV. SUMMARY AND CONCLUSIONS

A summary of the findings from the use attainability analysis are listed below:

- There is evidence to indicate that a warm water aquatic life community does exist and the potential for an improved fishery could be attained with slight habitat modifications (i.e. cover, pool).

- Elevated un-ionized ammonia levels were exhibited in the lower portion of Segment 14, although this cannot be attributed to the Littleton-Englewood WWTP discharge upstream. However, at the present time there is no basis for a change in the existing un-ionized ammonia criterion, particularly if EPA's methodology for determining site specific criteria becomes widely accepted.

- Increased turbidity exists in the South Platte River during a good portion of the fish spawning season, which represents a potential for problems associated with fish spawning.

- Increased sedimentation and siltation in the South Platte River could pose a potential threat to the aquatic life present; however, this condition might be reduced if Chatfield Lake could be operated to provide periodic flushing of the river.

- Elevated levels of heavy metals were observed in water and sediment samples, which could potentially affect the existing aquatic life.

- Insufficient data existed to determine the possible effects of chlorine and cyanide on the aquatic life present.

- Fecal coliform levels were extremely high in the lower portion of the South Platte River and Cherry Creek during periods of both low and high flow. The source in the South Platte River is apparently Cherry Creek, but the origin in Cherry Creek is unknown at this time.

On the basis of the preceding conclusions and recommendations, the warmwater fishery use classification and the un-ionized ammonia criterion (0.06 mg/l) recommended for Segment 14 of the South Platte should remain unchanged until there is further evidence to support making those changes.

APPENDIX U

List of EPA Regional Water Quality Standards Coordinators

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

WATER QUALITY STANDARDS COORDINATORS

Eric Hall, WQS Coordinator
EPA Region 1
Water Division
JFK Federal Building
Boston, MA 02203
617-565-3533

Wayne Jackson, WQS Coordinator
EPA Region 2
Water Division
26 Federal Plaza
New York, NY 10278
212-264-5685

Helene Drago, WQS Coordinator
EPA Region 3
Water Division
841 Chestnut Street
Philadelphia, PA 19107
215-597-9911

--or--

Evelyn MacKnight, WQS Coordinator
EPA Region 3
Water Division
841 Chestnut Street
Philadelphia, PA 19107
215-597-4491

Fritz Wagener, WQS Coordinator
EPA Region 4
Water Division
345 Courtland Street, N.E.
Atlanta, GA 30365
404-347-3396

David Pfiefer, WQS Coordinator
EPA Region 5
Water Division
77 West Jackson Boulevard
Chicago, IL 60604-3507
312-353-9024

Cheryl Overstreet, WQS Coordinator
EPA Region 6
Water Division
1445 Ross Avenue
First Interstate Bank Tower
Dallas, TX 75202
214-655-7145

Larry Shepard, WQS Coordinator
EPA Region 7
Water Compliance Branch
726 Minnesota Avenue
Kansas City, KS 66101
913-551-7441

Jim Luey, WQS Coordinator
EPA Region 8
Water Division
999 18th Street
Denver, CO 80202-2405
303-293-1455

Phil Woods, WQS Coordinator
EPA Region 9
Water Division
75 Hawthorne Street
San Francisco, CA 94105
415-744-1997

Sally Marquis, WQS Coordinator
EPA Region 10
Water Division (WS-139)
1200 Sixth Avenue
Seattle, WA 98101
206-442-2116

--or--

Marcia Lagerloef
EPA Region 10
Water Division (WS-139)
1200 Sixth Avenue
Seattle, WA 98101
206-553-0176

APPENDIX V

Water Quality Standards Program
Document Request Forms

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

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COMPLETE REQUESTOR PROFILE BELOW:

STANDARDS & APPLIED SCIENCE DIVISION/WATER QUALITY STANDARDS BRANCH

REQUESTOR PROFILE	___ Check here if requestor wants to be placed on SASD's mailing list
NAME	Date request made
POSITION/TITLE	Date submitted to EPA
ORGANIZATION	
STREET ADDRESS	
CITY/STATE/ZIP CODE	
TELEPHONE NUMBER	DATE REQUEST RECEIVED

DUE TO RESOURCE LIMITATIONS, ONLY ONE (1) COPY OF EACH DOCUMENT CAN BE PROVIDED TO A REQUESTOR.

TITLE	CHECK DOCUMENT REQUESTED
1. **Water Quality Standards Regulation, Part II, Environmental Protection Agency, Federal Register, November 8, 1983** *Regulations that govern the development, review, revision and approval of water quality standards under Section 303 of the Clean Water Act.*	
2. **Water Quality Standards Handbook, December 1983** *Contains the guidance prepared by EPA to assist States in implementing the revised water quality standards regulation (48 FR 51400, November 8, 1983). The handbook provides a general description of the overall standards setting process followed by information on general program administrative policies and procedures and a description of the analyses used in determining appropriate uses and criteria. The handbook contains updated policies issued since 1983. These include the following three documents:*	
• **Questions and Answers on Antidegradation, August 1985**	
• **Nonpoint Source Controls and Water Quality Standards, August 19, 1987**	
• **Variances in Water Quality Standards, March 1985**	
3. **Water Quality Standards for the 21st Century, 1989** *Summary of the proceedings from the first National Conference on water quality standards held in Dallas, Texas, March 1-3, 1989.*	
4. **Water Quality Standards for the 21st Century, 1991** *Summary of the proceedings from the second National Conference on water quality standards held in Arlington, Virginia, December 10-12, 1990.*	

STANDARDS & APPLIED SCIENCE DIVISION/WATER QUALITY STANDARDS BRANCH	
TITLE	**CHECK DOCUMENT REQUESTED**
5. Compilation of Water Quality Standards for Marine Waters, November 1982 *Consists of marine water quality standards required by Section 304(a)(6) of the Clean Water Act. The document identifies marine water quality standards, the specific pollutants associated with such water quality standards and the particular waters to which such water quality standards apply. The compilation should not in any way be construed as Agency opinion as to whether the waters listed are marine waters within the meaning of Section 301(h) of the Clean Water Act or whether discharges to such waters are qualified for a Section 301(h) modification.*	
6. Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses, November 1983 *Contains technical guidance to assist States in implementing the revised water quality standards regulation (48 FR 51400, November 8, 1983). The guidance assists States in answering three key questions:* *a. What are the aquatic protection uses currently being achieved in the waterbody?* *b. What are the potential uses that can be attained based on the physical, chemical and biological characteristics of the waterbody?* *c. What are the causes of any impairment of the uses?*	
7. Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses, Volume II: Estuarine Systems *Contains technical guidance to assist States in implementing the revised water quality standards regulation (48 FR 51400, November 8, 1983). This document addresses the unique characteristics of estuarine systems and supplements the Technical Support Manual: Waterbody Summary and Assessments for Conducting Use Attainability Analyses (EPA, November 1983).*	
8. Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses, Volume III: Lake Systems, November 1984 *Contains technical guidance to assist States in implementing the revised water quality standards regulation (48 FR 51400 November 8, 1983). The document addresses the unique characteristics of lake systems and supplements two additional guidance documents: Technical Support Manual: Waterbody Survey and Assessments for Conducting Use Attainability Analyses EPA, (November 1983) and Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses, Vol II: Estuarine Systems.*	
9. Health Effects Criteria for Marine Recreational Waters, EPA 600/1-80-031, August 1983 *This report presents health effects quality criteria for marine recreational waters and a recommendation for a specific criterion. The criteria were among those developed using data collected from an extensive in-house extramural microbiological research program conducted by the U.S. EPA over the years 1972-1979.*	
10. Health Effects Criteria for Fresh Recreational Waters, EPA 660/1-84-004, August 1984 *This report presents health effects criteria for fresh recreational waters and a criterion for the quality of the bathing water based upon swimming - associated gastrointestinal illness. The criterion was developed from data obtained during a multi-year freshwater epidemiological-microbiological research program conducted at bathing beaches near Erie, Pennsylvania and Tulsa, Oklahoma. Three bacterial indications of fecal pollution were used to measure the water quality: E. Coli, enterococci and fecal coliforms.*	
11. Introduction to Water Quality Standards, EPA 440/5-88-089, September 1988 *A primer on the water quality standards program written in question and answer format. The publication provides general information about various elements of the water quality standards program.*	
12. Ambient Water Quality Criteria for Bacteria - 1986 EPA 440/5-84-002 *This document contains bacteriological water quality criteria. The recommended criteria are based on an estimate of bacterial indicator counts and gastro-intestinal illness rates.*	

STANDARDS & APPLIED SCIENCE DIVISION/WATER QUALITY STANDARDS BRANCH	
TITLE	**CHECK DOCUMENT REQUESTED**
13. Test Methods for Escherichia Coil and Enterococci; In Water by the Membrane Filter Procedure, EPA 600/4-85/076, 1985 *Contains methods used to measure the bacteriological densities of E. coli and enterococci in ambient waters. A direct relationship between the density of enterococci and E. coli in water and the occurrence of swimming - associated gastroenteritis has been established through epidemiological studies of marine and fresh water bathing beaches. These studies have led to the development of criteria which can be used to establish recreational water standards based on recognized health effects-water quality relationships.*	
14. Twenty-Six Water Quality Standards Criteria Summaries, September 1988 *These documents contain summaries of State/Federal criteria. Twenty-six summaries have been compiled which contain information extracted from State water quality standards. Titles of the twenty-six documents are: Acidity-Alkalinity, Antidegradation, Arsenic, Bacteria, Cadmium, Chromium, Copper, Cyanide, Definitions, Designated Uses, Dissolved Oxygen, Dissolved Solids, General Provisions, Intermittent Streams, Iron, Lead, Mercury, Mixing Zones, Nitrogen-Ammonia/Nitrate/Nitrite, Organics, Other Elements, Pesticides, Phosphorus, Temperature, Turbidity, and Zinc.*	
15. Fifty-Seven State Water Quality Standards Summaries, September 1988 *Contains fifty-seven individual summaries of State water quality standards. Included in each summary is the name of a contact person, use classifications of water bodies, mixing zones, antidegradation policies and other pertinent information.*	
16. State Water Quality Standards Summaries, September 1988 (Composite document) *This document contains composite summaries of State water quality standards. The document contains information about use classifications, antidegradation policies and other information applicable to a States' water quality standards.*	
17. Transmittal of Final "Guidance for State Implementation of Water Quality Standards for CWA Section 303(c)(2)(B)", December 12, 1988 *Guidance on State adoption of criteria for priority toxic pollutants. The guidance is designed to help States comply with the 1987 Amendments to the Clean Water Act which requires States to control toxics in water quality standards.*	
18. Chronological Summary of Federal Water Quality Standards Promulgation Actions, January 1993 *This document contains the date, type of action and Federal Register citation for State water quality standards promulgated by EPA. The publication also contains information on Federally promulgated water quality standards which have been withdrawn and replaced with State approved standards.*	
19. Status Report: State Compliance with CWA Section 303(c)(2)(b) as of February 4, 1990 *Contains information on State efforts to comply with Section 303(c)(2)(B) of the Clean Water Act which requires adoption of water quality standards for priority pollutants. The report identifies the States that are compliant as of February 4, 1990, summarizes the status of State actions to adopt priority pollutants and briefly outlines EPA's plan to federally promulgate standards for noncompliant States.*	
20. Water Quality Standards for Wetlands: National Guidance, July 1990 *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. By the end of FY 1993, States are required as a minimum 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.*	
21. Reference Guide for Water Quality Standards for Indian Tribes, January 1990 *Booklet provides an overview of the water quality standards program. Publication is designed primarily for Indian Tribes that wish to qualify as States for the water quality standards program. The booklet contains program requirements and a list of reference sources.*	

STANDARDS & APPLIED SCIENCE DIVISION/WATER QUALITY STANDARDS BRANCH	
TITLE	**CHECK DOCUMENT REQUESTED**
22. Developing Criteria to Protect Our Nation's Waters, EPA, September 1990 (Pamphlet) *Pamphlet which briefly describes the water quality standards program and its relationship to water quality criteria, sediment criteria and biological criteria.*	
23. Water Quality Standards for the 21st Century, EPA 823-R-92-009, December 1992 *Summary of the proceedings from the Third National Conference on Water Quality Standards held in Las Vegas, Nevada, August 31-September 3, 1992*	
24. Biological Criteria: National Program Guidance for Surface Waters, EPA-440/5-90-004, April 1990 *This document provides guidance for development and implementation of narrative biological criteria.*	
25. Amendments to the Water Quality Standards Regulation that Pertain to Standards on Indian Reservations - Final Rule. Environmental Protection Agency, Federal Register, December 12, 1991 *This final rule amends the water quality standards regulation by adding: 1) procedures by which an Indian Tribe may qualify for treatment as a State for purposes of the water quality standards and 401 certification programs and 2) a mechanism to resolve unreasonable consequences that may arise when an Indian Tribe and a State adopt different water quality standards on a common body of water.*	
26. Guidance on Water Quality Standards and 401 Certification Programs Administered by Indian Tribes, December 31, 1991 *This guidance provides procedures for determining Tribal eligibility and supplements the final rule "Amendments to the Water Quality Standards Regulation that Pertain to Standards on Indian Reservations".*	
27. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants; State's Compliance - Final Rule, Environmental Protection Agency, Federal Register, December 22, 1992 *This regulation promulgates for 14 States, the chemical specific, numeric criteria for priority toxic pollutants necessary to bring all States into compliance with the requirements of Section 303(c)(2)(B) of the Clean Water Act. Staates determined by EPA to fully comply with Section 303(c)(2)(B) requirements are not affected by this rule.*	

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U.S. ENVIRONMENTAL PROTECTION AGENCY
STANDARDS AND APPLIED SCIENCE DIVISION (OST)

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CITY	STATE	ZIP CODE
ORGANIZATION CATEGORY: (Select the two digit code at the bottom of this form which best describes your organization). Place two digit code in this space _____		

please check	**REQUESTED TITLES**
[ ]	1. *Introduction to Water Quality Standards*
[ ]	2. *Antidegradation Policy: A Means to Maintain and Protect Existing Uses and Water Quality*
[ ]	3. *Development of Water Quality Criteria and Its Relationship to Water Quality Standards*
[ ]	4. *Enumeration Methods for E. Coli and Enterococci*
[ ]	5. *Water Quality-Based Approach to Pollution Control*
[ ]	6. *Water Quality Standards and 401 Certification*
[ ]	7. *Economic Considerations in Water Quality Standards*
[ ]	8. *Water Quality Standards on Indian Lands*
[ ]	9. *Development of Biological Criteria for Use in Water Quality Standards*

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01 Indian Tribes	08 State Governments
02 Public Interest Groups	09 Local Governments (County/Municipalities)
03 Environmental Organizations/Conservations Groups	10 Industrial Organizations/Trade Groups
04 Educational (local school systems, colleges, universities)	11 Foreign Governments
05 Contracting Firms	12 Engineering
06 Law Firms	13 Agricultural
07 Other Federal Agencies	14 Other

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DUE TO RESOURCE LIMITATIONS, ONLY ONE (1) COPY OF EACH DOCUMENT CAN BE PROVIDED TO A REQUESTOR.

TITLE	CHECK DOCUMENT REQUESTED
1. **Guidance for Water Quality-based Decisions: The TMDL Process, EPA 440/4-91-001, April 1991** *This document defines and clarifies the requirements under Section 303(d) of the Clean Water Act. Its purpose is to help State water quality program managers understand the application of total maximum daily loads (TMDLs) through an integrated, basin-wide approach to controlling point and nonpoint source pollution. The document describes the steps that are involved in identifying and prioritizing impaired waters and developing and implementing TMDLs for waters listed under Section 303(d).* **Contact: Don Brady (202) 260-5368**	
2. **Technical Guidance Manual for Performing Waste Load Allocations - Book II Streams and Rivers - Chapter 1 Biochemical Oxygen Demand/Dissolved Oxygen, EPA 440/4-84-020, September 1983** *This chapter presents the underlying technical basis for performing WLA and analysis of BOD/DO impacts. Mathematical models to calculate water quality impacts are discussed, along with data needs and data quality.* **Contact: Bryan Goodwin (202) 260-1308**	
3. **Technical Guidance Manual for Performing Waste Load Allocations - Book II Streams and Rivers - Chapter 2 Nutrient/Eutrophication Impacts, EPA 440/4-84-021, November 1983** *This chapter emphasizes the effect of photosynthetic activity stimulated by nutrient discharges on the DO of a stream or river. It is principally directed at calculating DO concentrations using simplified estimating techniques.* **Contact: Bryan Goodwin (202) 260-1308**	
4. **Technical Guidance Manual for Performing Waste Load Allocations - Book II Streams and Rivers - Chapter 3 Toxic Substances, EPA 440/4-84-022, June 1984** *This chapter describes mathematical models for predicting toxicant concentrations in rivers. It covers a range of complexities, from dilution calculations to complex, multi-dimensional, time-varying computer models. The guidance includes discussion of background information and assumptions for specifying values.* **Contact: Bryan Goodwin (202) 260-1308**	

STANDARDS & APPLIED SCIENCE DIVISION/EXPOSURE ASSESSMENT BRANCH	
TITLE	CHECK DOCUMENT REQUESTED
5. **Technical Guidance Manual for Performing Waste Load Allocations - Simplified Analytical Method for Determining NPDES Effluent Limitations for POTWs Discharging into Low-Flow Streams** *This document describes methods primarily intended for "desk top" WLA investigations or screening studies that use available data for streamflow, effluent flow, and water quality. It is intended for circumstances where resources for analysis and data acquisition are relatively limited.* **Contact: King Boynton (202) 260-7013**	
6. **Technical Guidance Manual for Performing Waste Load Allocations - Book IV Lakes and Impoundments - Chapter 2 Nutrient/Eutrophication Impacts, EPA 440/4-84-019, August 1983** *This chapter discusses lake eutrophication processes and some factors that influence the performance of WLA analysis and the interpretation of results. Three classes of models are discussed, along with the application of models and interpretation of resulting calculations. Finally, the document provides guidance on monitoring programs and simple statistical procedures.* **Contact: Bryan Goodwin (202) 260-1308**	
7. **Technical Guidance Manual for Performing Waste Load Allocations - Book IV Lakes, Reservoirs and Impoundments - Chapter 3 Toxic Substances Impact, EPA 440/4-87-002, December 1986** *This chapter reviews the basic principles of chemical water quality modeling frameworks. The guidance includes discussion of assumptions and limitations of such modeling frameworks, as well as the type of information required for model application. Different levels of model complexity are illustrated in step-by-step examples.* **Contact: Bryan Goodwin (202) 260-1308**	
8. **Technical Guidance Manual for Performing Waste Load Allocations - Book VI Design Conditions - Chapter 1 Stream Design Flow for Steady-State Modeling, EPA 440/4-87-004, September 1986** *Many state water quality standards (WQS) specify specific design flows. Where such design flows are not specified in WQS, this document provides a method to assist in establishing a maximum design flow for the final chronic value (FCV) of any pollutant.* **Contact: Bryan Goodwin (202) 260-1308**	
9. **Final Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling, December 1988** *WQS for many pollutants are written as a function of ambient environmental conditions, such as temperature, pH or hardness. This document provides guidance on selecting values for these parameters when performing steady-state WLAs.* **Contact: Bryan Goodwin (202) 260-1308**	
10. **Technical Guidance Manual for Performing Waste Load Allocations - Book VII: Permit Averaging, EPA 440/4-84-023, July 1984** *This document provides an innovative approach to determining which types of permit limits (daily maximum, weekly, or monthly averages) should be specified for the steady-state model output, based on the frequency of acute criteria violations.* **Contact: Bryan Goodwin (202) 260-1308**	
11. **Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water - Part I - EPA 600/6-85-022a, September 1985** *This document provides a range of analyses to be used for water quality assessment. Chapters include consideration of aquatic fate of toxic organic substances, waste loading calculations, rivers and streams, impoundments, estuaries, and groundwater.* **Contact: Bryan Goodwin (202) 260-1308**	

STANDARDS & APPLIED SCIENCE DIVISION/EXPOSURE ASSESSMENT BRANCH	
TITLE	CHECK DOCUMENT REQUESTED
12. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water - Part II - EPA 600/6-85-022b, September 1985 *This document provides a range of analyses to be used for water quality assessment. Chapters include consideration of aquatic fate of toxic organic substances, waste loading calculations, rivers and streams, impoundments, estuaries, and ground water.* **Contact: Bryan Goodwin (202) 260-1308**	
13. Handbook - Stream Sampling for Waste Load Allocation Applications, EPA 625/6-86/013, September 1986 *This handbook provides guidance in designing stream surveys to support modeling applications for waste load allocations. It describes the data collection process for model support, and it shows how models can be used to help design stream surveys. In general, the handbook is intended to educate field personnel on the relationship between sampling and modeling requirements.* **Contact: Bryan Goodwin (202) 260-1308**	
14. EPA's Review and Approval Procedure for State Submitted TMDLs/WLAs, March 1986 *The step-by-step procedure outlined in this guidance addresses the administrative (i.e., non-technical) aspects of developing TMDLs/WLAs and submitting them to EPA for review and approval. It includes questions and answers to focus on key issues, pertinent sections of WQM regulations and the CWA, and examples of correspondence.* **Contact: Bryan Goodwin (202) 260-1308**	
15. Guidance for State Water Monitoring and Wasteload Allocation Programs, EPA 440/4-85-031, October 1985 *This guidance is for use by States and EPA Regions in developing annual section 106 and 205(j) work programs. The first part of the document outlines the objectives of the water monitoring program to conduct assessments and make necessary control decisions. The second part describes the process of identifying and calculating total maximum daily loads and waste load allocations for point and nonpoint sources of pollution.* **Contact: King Boynton (202) 260-7013**	
16. Technical Guidance Manual for Performing Waste Load Allocations Book III Estuaries - Part 1 - Estuaries and Waste Load Allocation Models, EPA 823-R-92-002, May 1990 *This document provides technical information and policy guidance for preparing estuarine WLA. It summarizes the important water quality problems, estuarine characteristics, and the simulation models available for addressing these problems.* **Contact: Bryan Goodwin (202) 260-1308**	
17. Technical Guidance Manual for Performing Waste Load Allocations Book III Estuaries - Part 2 - Application of Estuarine Waste Load Allocation Models, EPA 823-R-92-003, May 1990 *This document provides a guide to monitoring and model calibration and testing, and a case study tutorial on simulation of WLA problems in simplified estuarine systems.* **Contact: Bryan Goodwin (202) 260-1308**	

STANDARDS & APPLIED SCIENCE DIVISION/EXPOSURE ASSESSMENT BRANCH	
TITLE	CHECK DOCUMENT REQUESTED
18. Technical Guidance Manual for Performing Waste Load Allocations Book III: Estuaries - Part 3: Use of Mixing Zone Models in Estuarine Waste Load Allocations, EPA 823-R-92-004, U.S. EPA, August 1992 *This document summarizes initial dilution and mixing zone processes and their application in WLA. It provides a basis for understanding the concept of mixing zones and the base modeling framework for computing mixing zone boundaries.* **Contact: Bryan Goodwin (202) 260-1308**	
19. Technical Guidance Manual for Performing Wasteload Allocations Book III: Estuaries - Part 4: Critical Review of Coastal Embayment and Estuarine Wasteload Allocation Modeling, EPA 823-R-92-005, U.S. EPA, August 1992 *This document summarizes several historical case studies, with critical review by noted experts.* **Contact: Bryan Goodwin (202) 260-1308**	
20. Technical Support Document for Water Quality-based Toxics Control, EPA 505/2-90-001, March, 1991 *This document discusses assessment approaches, water quality standards, derivation of ambient criteria, effluent characterization, human health hazard assessment, exposure assessment, permit requirements, and compliance monitoring. An example is used to illustrate the recommended procedures.* **Contact: King Boynton (202) 260-7013**	
21. Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling (Second Edition), U.S. EPA 600/3-85/040, June 1985 *This manual serves as a reference on modeling formulations, constants and rates commonly used in surface water quality simulations. This manual also provides a range of coefficient values that can be used to perform sensitivity analyses.* **Contact: Bryan Goodwin (202) 260-1308**	
22. Dynamic Toxics Waste Load Allocation Model (DYNTOX), User's Manual, September 13, 1985 *A user's manual which explains how to use the DYNTOX model. It is designed for use in wasteload allocation of toxic substances.* **Contact: Bryan Goodwin (202) 260-1308**	
23. De Minimis Discharges Study: Report to Congress, U.S. EPA 440/4-91-002, November 1991 *This report to Congress addresses the requirements of Section 516 by identifying potential de minimis discharges and recommends effective and appropriate methods of regulating those discharges.* **Contact: Rich Healy (202) 260-7812**	
24. Technical Guidance Manual for Performing Wasteload Allocations - Book III - Estuaries - Part 4 - Critical Review of Coastal Embayment and Estuarine Wasteload Allocation Modeling, EPA 823-R-92-002, August 1992 *This document summarizes several historical case studies of model use in one freshwater coastal embayment and a number of estuarine discharge situations.* **Contact: Bryan Goodwin (202) 260-1308**	
25. Technical Guidance Manual for Performing Wasteload Allocations-Book III: Estuaries - Part 3 - Use of Mixing Zone Models in Estuarine Wasteload Allocations, EPA 823-R-92-004 *This technical guidance manual describes the initial mixing wastewater in estuarine and coastal environments and mixing zone requirements. The important physical processes that govern the hydrodynamic mixing of aqueous discharges are described, followed by application of available EPA supported mixing zone models to four case study situations.* **Contact: Bryan Goodwin (202) 260-1308**	

STANDARDS & APPLIED SCIENCE DIVISION/EXPOSURE ASSESSMENT BRANCH	
26. National Study of Chemical Residues in Fish. Volume I, U.S. EPA 823-R-92-008 a, September 1992 *This report contains results of a screening study of chemiocal residues in fish taken from polluted waters.* **Contact: Richard Healy (202) 260-7812**	
27. National Study of Chemical Residues in Fish. Volume II. U.S. EPA 823-R-92-008 b, September 1992 *This report contains results of a screening Study of Chemical residues in fish taken from polluted waters.* **Contact: Richard Healy (202) 260-7812**	

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CITY/STATE/ZIPCODE	
TELEPHONE NUMBER	DATE REQUEST RECEIVED

DUE TO RESOURCE LIMITATIONS, ONLY ONE (1) COPY OF EACH DOCUMENT CAN BE PROVIDED TO A REQUESTOR.

TITLE	CHECK DOCUMENT REQUESTED
1. **Biological Criteria - National Program Guidance for Surface Water. EPA-440/5-90-004. April 1990** Contact: George Gibson (202) 260-7580 / Susan Jackson (202) 260-1800	
2. **Biological Criteria - State Development and Implementation Efforts. EPA-440/5-91-003.** Contact: George Gibson (202) 260-7580 / Susan Jackson (202) 260-1800	
3. **Biological Criteria - Guide to Technical Literature. EPA-440/5-91-004. April 1991** Contact: George Gibson (202) 260-7580 / Susan Jackson (202) 260-1800	
4. **Biological Criteria - Research and Regulation, Proceedings of a Symposium. EPA-440/5-91-005. April 1991.** Contact: George Gibson (202) 260-7580 / Susan Jackson (202) 260-1800	
5. **Biological Criteria - Procedures for Initiating Narrative Biological Criteria. EPA-882-B92-002.** Contact: George Gibson (202) 260-7580 / Susan Jackson (202) 260-1800	
6. **Interim Guidance on Interpretation and Implementation of Aquatic Life Criteria for Metals. May 1992.** Contact: Maria Gomez-Taylor (202)260-1639	
7. **Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses. July 1985.** Contact: Charles Delos (202) 260-7039	
8. **Technical Basis for Establishing Sediment Quality Criteria for Non-ionic Chemicals using Equilibrium Partitioning. (Draft) April 1993.** Contact: Mary Reiley (202) 260-9456	
9. **Sediment Quality Criteria for the Protection of Benthic Organisms: Acenaphthene. (Draft) November 1991.** Contact: Mary Reiley (202) 260-9456	

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10. **Sediment Quality Criteria for the Protection of Benthic Organisms: Dieldrin. (Draft) November 1991.** Contact: Mary Reiley (202) 260-9456	
11. **Sediment Quality Criteria for the Protection of Benthic Organisms: Endrin. (Draft) November 1991.** Contact: Mary Reiley (202) 260-9456	
12. **Sediment Quality Criteria for the Protection of Benthic Organisms: Fluoranthene. (Draft) November 1991.** Contact: Mary Reiley (202) 260-9456	
13. **Sediment Quality Criteria for the Protection of Benthic Organisms: Phenanthrene. (Draft) November 1991.** Contact: Mary Reiley (202) 260-9456	
14. **Analytical Method for Determination of Acid Volatile Sulfide in Sediment. (Final Draft).** Contact: Mary Reiley (202) 260-9456	
15. **An SAB Report: Review of Sediment Criteria Development Methodology for Non-Ionic Organic Contaminants. (September 1992).** contact: Mary Reilly (202) 260-9456	
16. **Water Quality Criteria to Protect Wildlife Resources - December 1989. EPA 600/3-89-067.** Topic areas include legislative authority for wildlife criteria development, strategy to incorporate into current regulatory framework, strategy for choosing chemicals, research strategies, summary of research efforts, Contact: Cynthia Nolt (202) 260-1940.	
17. **Great Lakes Water Quality Initiative Criteria Documents for the Protection of Wildlife DDT, Mercury, 2,3,7,8-TCDD and PCB's. April 1993. EPA-822-R-93-007.** This document presents the derivation of the Great Lakes Water Quality Initiative wildlife criteria for four chemicals: DDT, Mercury, 2,3,7,8-TCDD, PCB's. Contact: Cynthia Nolt (202) 260-1940.	
18. **Wildlife Criteria Portions of the Proposed Water Quality Guidance for the Great Lakes System. July 1993. EPA-822-R-93-006.** Excerpts from the Great Lakes Water Quality Guidance specific to the derivation of wildlife criteria. This document will facilitate review of and comment on the proposed wildlife criteria approach by persons who may not keep abreast of Federal Register notices. Contact: Cynthia Nolt (202) 260-1940.	
19. **Interim Guidance on Interpretation and Implementation of Aquatic Life Criteria for Metals. May 1992.** This guidance addresses the use of EPA metals criteria in water quality standards intended to protect aquatic life. This guidance also addresses the derivation of NPDES permit limits from such criteria. Contact: Charles Delos (202) 260-7039.	
20. **Six DRAFT Ambient Water Quality Criteria documents for, Antimony III, Phenanthrene, Silver, Hexachlorobenzene, 2,4,5-Trichlorophenol, Di-2-Ethylhexylphthlate.** These proposed 304(a) criteria were originally noticed in the Federal Register on May 14, 1990, (FR 55 19986). Contact: Amy Leaberry (202) 260-6324.	

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21. DRAFT Ambient Water Quality Criteria for Tributyltin, (TBT). This draft 304(a) criteria was originally noticed on June 6, 1989 (54 FR 23529). Contact: Kennard Potts (202) 260-7893.	
22. Water Quality Criteria Summary. May 1, 1991. This summary is in the form of a wall poster. This poster summarizes all criteria released up to May 1, 1991. Contact: Kennard Potts (202) 260-7893.	

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APPENDIX W

Update Request Form for
Water Quality Standards Handbook
Second Edition

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

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