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Office of Water
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PROCEDURES FOR INITIATING NARRATIVE BIOLOGICAL CRITERIA

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

PROCEDURES FOR INITIATING NARRATIVE BIOLOGICAL CRITERIA

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ACKNOWLEDGMENTS

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Fred Leutner, Kent Ballentine, and Robert Shippen of the Standards and Applied Sciences Division contributed advice and citations pertinent to the proper application of these criteria to EPA regulatory standards.

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 softshelled 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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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) 597-3359

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) 353-5524

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.*