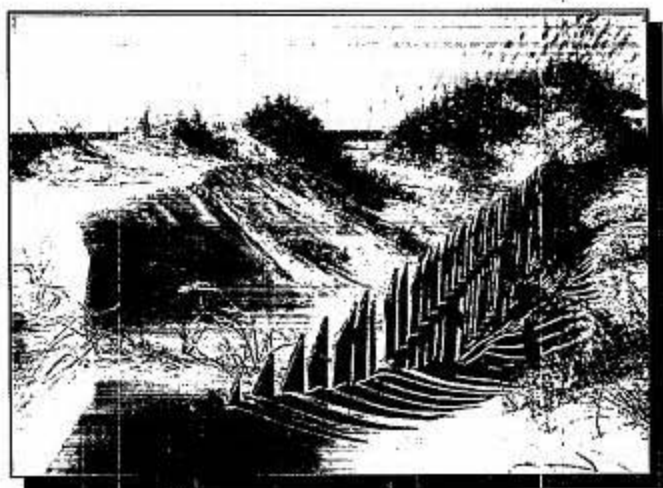




Elements of a State Water Monitoring and Assessment Program

March 2003



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March 2003

Assessment and Watershed Protection Division
Office of Wetlands, Oceans and Watershed
U.S. Environmental Protection Agency

EPA 841-B-03-003

Available on the web at

<http://www.epa.gov/owow/monitoring/repguid.html>

Elements of a State Water Monitoring and Assessment Program

EPA and States need comprehensive water quality monitoring and assessment information on environmental conditions and changes over time to help set levels of protection in water quality standards and to identify problem areas that are emerging or that need additional regulatory and non-regulatory actions to support water quality management decisions such as TMDLs, NPDES permits, enforcement, and nonpoint source management. This information also informs EPA and State decisionmakers, the Congress, the public, and other stakeholders of the progress that the Agency and State partners are making in protecting human health and the environment. Without this information, it is difficult for EPA and the States to set priorities, evaluate the success of programs and activities, and report on accomplishments in a credible and informed way (U.S. GAO 2000).

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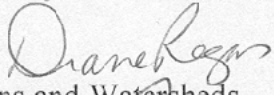
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

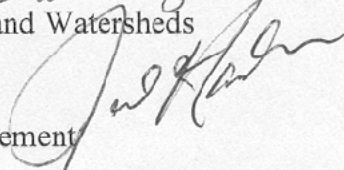
OFFICE OF
WATER

MAR 14 2003

MEMORANDUM

SUBJECT: Transmittal of the *Elements of a State Water Monitoring and Assessment Program*

FROM: Diane C. Regas, Director 
Office of Wetlands, Oceans and Watersheds

James A. Hanlon, Director 
Office of Wastewater Management

TO: Water Management Division Directors, Regions 1-10
Regional Science and Technology Division Directors, Regions 1-10

The Clean Water Act [CWA] gives States and Territories the primary responsibility for implementing programs to protect and restore water quality, including monitoring and assessing the nation's waters and reporting on their quality. CWA Section 106(e)(1) requires the Environmental Protection Agency (EPA) to determine that a State is monitoring the quality of navigable waters, compiling, and analyzing data on water quality and including it in the State's Section 305(b) report prior to the award of Section 106 grant funds. The attached document, *Elements of a State Water Monitoring and Assessment Program*, recommends the basic elements of a State water monitoring program and serves as a tool to help EPA and the States determine whether a monitoring program meets the prerequisites of CWA Section 106(e)(1).

It is not EPA's intent to use the *Elements* document to withhold a State's Section 106 grant funds, but rather to encourage a long term process of incremental improvement in monitoring programs, as needed. The *Elements* document is intended to provide a framework for States to clearly articulate their programmatic and resource needs and a reasonable time line for meeting those needs. EPA expects this effort will identify efficiencies to be gained through a holistic approach to program implementation.

For the Fiscal Year (FY) 2004 grant award, a State should, in addition to continuing to submit reports under Section 305(b) and annual data updates, have a monitoring program strategy¹ in place or commit to complete development of such a strategy. This strategy will be State specific, building on the State's existing monitoring capabilities, but will describe how the monitoring program will serve all water quality management needs and address all State waters over time. The monitoring program strategy is a long-term implementation plan and should include a timeline, not to exceed ten years², for completing implementation of the strategy. It is important that the strategy be comprehensive in scope and identify the technical issues and resource needs that are currently impediments to an adequate monitoring program.

States should begin implementation of the strategies upon receipt of the subsequent award of a Section 106 grant or Performance Partnership Grant that includes Section 106 funds. Beginning with the FY2005 Section 106 grant cycle, activities from a State's strategy needed to upgrade its monitoring program should be incorporated into work plans for Section 106 grants and Performance Partnership Grants (PPGs) that include Section 106 funds, consistent with the regulations governing the negotiation of work plans at 40 CFR 35.107. The State must continue to submit reports under Section 305(b) and annual data updates.

The EPA Region, in conjunction with the State, will review the State's monitoring program to determine whether progress has been adequate and reflects commitments negotiated in work plans for Section 106 grants or Performance Partnership Grants (PPGs) that include Section 106 funds. This evaluation will take into consideration the effects of funding shortfalls on a State's implementation of its monitoring program strategy. EPA Headquarters will collaborate with the EPA Regional offices to assess overall State progress from a national perspective.

If you have any questions, please contact Charles Sutfin, Director, Assessment and Watershed Protection Division at 202-566-1155, or Margarete Heber, Chief, Monitoring Branch at 202-566-1189.

Attachment

cc: Regional Monitoring/305(b) coordinators
Regional TMDL coordinators
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¹ see Section II, Part A, "Monitoring Program Strategy," of this *Elements* document

² i.e., no later than the end of FY2014

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Environmental Council of the States

Executive Summary

Clean Water Act §106(e)(1) and 40 CFR Part 35.168(a) provide that EPA award Section 106 funds to a State only if the State has provided for, or is carrying out as part of its program, the establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor and to compile and analyze data on the quality of navigable waters in the State³, and provision for annually updating the data and including it in the Section 305(b) report.⁴ This document recommends the basic elements of a State water monitoring program and serves as a tool to help EPA and the States determine whether a monitoring program meets the prerequisites of CWA Section 106(e)(1).

Because these elements have not been clearly defined in the past, there is a lot of variability in existing State programs. EPA expects that State water monitoring programs will evolve over the next 10 years so that ultimately all States will have a common foundation of water quality monitoring programs that support State decision needs. EPA expects that most States will employ an iterative process to fully implement a monitoring program that reflects the elements described in this document, and will work with States to identify annual monitoring milestones.

States should develop, over time, a monitoring program addressing the 10 elements summarized below and described in greater detail in the full text of this document. The first of these elements is a long-term state monitoring strategy. This strategy will be State specific, be designed from the monitoring capabilities each State already has, and should include a timeline not to exceed 10 years to complete implementation. EPA believes that state monitoring programs can be upgraded to include all of the elements described below within the next 10 years.

For the FY2004 grant award, a State, in addition to continuing to submit reports under Section 305(b) and annual data updates, should have a monitoring program strategy⁵ in place or commit to complete development of such a strategy. Beginning with the FY2005 Section 106 grant cycle, activities from a State's strategy needed to upgrade its monitoring program should be incorporated into work plans for Section 106 grants and Performance Partnership Grants (PPGs) that include Section 106 funds, consistent with the regulations governing the negotiation of work plans at 40 CFR 35.107. The State must continue to submit reports under Section 305(b) and annual data. EPA expects that the State will have fully implemented its strategy by 2014.

³ The term "State waters" is used in this document to refer to navigable waters as defined under Section 502 of the Clean Water Act.

⁴ This document uses the term "State" to refer to States, the District of Columbia and Territories, as defined under Section 502 of the Clean Water Act. Under the CWA and EPA's implementing regulations this requirement applies only to States and not to Interstate Agencies or Tribes (40 CFR §§ 35.168(b), 35.588). However, non-State recipients of 106 funds may be required to submit monitoring reports pursuant to the grant. EPA encourages these recipients to follow the recommendations of this guidance to the extent practicable.

⁵ see Section II, Part A, "Monitoring Program Strategy," of this *Elements* document

The recommended 10 elements of a state water monitoring and assessment program are:

A. Monitoring Program Strategy

The State has a comprehensive monitoring program strategy that serves its water quality management needs and addresses all State waters, including streams, rivers, lakes, the Great Lakes, reservoirs, estuaries, coastal areas, wetlands, and groundwater. The strategy should contain or reference a description of how the State plans to address each of the remaining nine elements. The monitoring program strategy is a long-term implementation plan and should include a timeline, not to exceed ten years⁶, for completing implementation of the strategy. EPA believes that state monitoring programs can be upgraded to include all of the elements described below within the next 10 years. It is important that the strategy be comprehensive in scope and identify the technical issues and resource needs that are currently impediments to an adequate monitoring program.

B. Monitoring Objectives

The State has identified monitoring objectives critical to the design of a monitoring program that is efficient and effective in generating data that serve management decision needs. EPA expects the State to develop a strategy and implement a monitoring program that reflects a full range of State water quality management objectives including, but not limited to, Clean Water Act goals. For example, monitoring objectives could include helping establish water quality standards, determining water quality status and trends, identifying impaired waters, identifying causes and sources of water quality problems, implementing water quality management programs, and evaluating program effectiveness. Consistent with the Clean Water Act, monitoring objectives should reflect the decision needs relevant to all types of State waters.

C. Monitoring Design

The State has an approach and rationale for selection of monitoring designs and sample sites that best serve its monitoring objectives. The State monitoring program will likely integrate several monitoring designs (e.g., fixed station, intensive and screening-level monitoring, rotating basin, judgmental and probability design) to meet the full range of decision needs. The State monitoring design should include a probability-based network for making statistically valid inferences about the condition of all State water types, over time. EPA expects the State to use the most efficient combination of monitoring designs to meet its objectives.

⁶i.e., no later than the end of FY2014

D. Core and Supplemental Water Quality Indicators

The State uses a tiered approach to monitoring that includes core indicators selected to represent each applicable designated use, plus supplemental indicators selected according to site-specific or project-specific decision criteria. Core indicators for each water resource type include physical/habitat, chemical/toxicological, and biological/ecological endpoints as appropriate, and can be used routinely to assess attainment with applicable water quality standards throughout the State. Supplemental indicators are used when there is a reasonable expectation that a specific pollutant may be present in a watershed, when core indicators indicate impairment, or to support a special study such as screening for potential pollutants of concern.

E. Quality Assurance

Quality management plans and quality assurance program/project plans are established, maintained, and peer reviewed in accordance with EPA policy to ensure the scientific validity of monitoring and laboratory activities, and to ensure that State reporting requirements are met.

F. Data Management

The State uses an accessible electronic data system for water quality, fish tissue, toxicity, sediment chemistry, habitat, biological data, with timely data entry (following appropriate metadata and State/Federal geo-locational standards) and public access. In the future, EPA will require all States to directly or indirectly make their monitoring data available through the new STORET system. For States that do not currently operate STORET, their monitoring strategies should provide for use of STORET as soon as is practicable. For the 2004 305(b) reports and 303(d) lists, EPA strongly recommends that all States store assessment information using the EPA Assessment Database or an equivalent relational database and define the geographic location of assessment units using the National Hydrography Dataset (NHD).

G. Data Analysis/Assessment

The State has a methodology for assessing attainment of water quality standards based on analysis of various types of data (chemical, physical, biological, land use) from various sources, for all waterbody types and all State waters. The methodology includes criteria for compiling, analyzing, and integrating all readily available and existing information (e.g., volunteer monitoring data, discharge monitoring reports).

H. Reporting

The State produces timely and complete water quality reports and lists called for under Sections 305(b), 303(d), 314, and 319 of the Clean Water Act and Section 406 of the Beaches Act. EPA issued “2002 Integrated Water Quality Monitoring and Assessment Report Guidance” on November 19, 2001, to encourage integration and consistency in the development and submission of Section 305(b) water quality reports and Section 303(d) impaired waters lists. EPA will continue to support the use of this integrated reporting framework for future reporting cycles.

Under current regulations, Section 303(d) lists and Section 305(b) reports are due no later than

April 1 of even-numbered years. To remain eligible for Section 106 grants, the State also must submit annual updates of water quality information. This requirement may be satisfied by annually updating 305(b) assessment information or by annually uploading monitoring data to the national STORET warehouse.

I. Programmatic Evaluation

The State, in consultation with its EPA Region, conducts periodic reviews of each aspect of its monitoring program to determine how well the program serves its water quality decision needs for all State waters, including all waterbody types. This should involve evaluating the monitoring program to determine how well each of the elements is addressed and determining how needed changes and additions are incorporated into future monitoring cycles.

J. General Support and Infrastructure Planning

The State identifies current and future resource needs it requires to fully implement its monitoring program strategy. This needs assessment should describe funding, staff, training, laboratory resources, and upcoming improvements.

I. Introduction

A. Background

Clean Water Act §106(e)(1) requires EPA, prior to awarding a Section 106 grant to a State, to determine that the State is monitoring the quality of navigable waters, compiling and analyzing data on the water quality, and including those data in the State's section 305(b) report.⁷ Historically, EPA has relied on submission of the 305(b) report to determine that States have satisfied the Section 106(e) eligibility requirement for the award of Section 106 grant funds. As explained in the FY2001 Clean Water Act Section 106 Grant Guidance, Regions have begun conducting reviews of State monitoring programs and are working with States to strengthen these programs over time [1].

States have taken very different approaches, within their resource limitations, to implement their monitoring programs. They have applied a range of monitoring and assessment approaches (e.g., water chemistry, sediment chemistry, biological monitoring) to varying degrees, both spatially and temporally, and at varying levels of sampling effort. It is not uncommon for the reported quality of a waterbody (i.e., attainment or nonattainment) to differ on either side of a State boundary. Although some differences can be attributed to differences in water quality standards, variations in data collection, assessment methods, and relative representativeness of the available data contribute more to differences in assessment findings. These differences adversely affect the credibility of environmental management programs.

EPA has issued national guidance to promote and structure consistency in State monitoring programs and to ensure that the Section 305(b) process provides nationally comparable data with known accuracy [2, 3]. However, experts charge that EPA remains unable to make credible statements about differences in environmental quality over time and across the Nation [4, 5]. Also, in 1998, the Federal Advisory Committee on the Total Maximum Daily Load (TMDL) Program recommended that EPA assure needed improvements in State efforts to monitor water, characterize the general health of aquatic systems, and determine (non)attainment of any component of water quality standards, including narrative criteria and designated uses [6]. A 2001 National Research Council report, *Assessing the TMDL Approach to Water Quality Management*, recommends, among other things, the development of a uniform, consistent approach to ambient monitoring and data collection; increased resources for water monitoring; the coordination of monitoring with program needs; endorsement of statistical approaches and explicit acknowledgment of uncertainty; and the combining of monitoring and modeling [7].

⁷See footnote 5 *infra*. §106(e) of the Clean Water Act provides that ... “the Administrator shall not make any grant under this section to any State which has not provided or is not carrying out as part of its program - the establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor, and to compile and analyze data on (including classification according to eutrophic condition), the quality of navigable waters and to the extent practicable, ground waters including biological monitoring; and provision for annually updating such data and including it in the report required under [section 305 of this Act]...”

And most recently, a 2002 National Academy of Public Administration report, *Understanding What States Need to Protect Water Quality*, notes that improved information on water quality conditions, pollution sources, and program results will help states make more effective use of limited resources [8].

B. Purpose

The purpose of this document is to recommend the elements of a State water monitoring program, to provide a framework for the State to articulate its programmatic and resource needs, and to serve as a tool to help EPA and the State determine whether a monitoring program meets the prerequisites of CWA Section 106(e)(1). EPA recognizes that full implementation of these elements will take time and resources and that currently many states do not fully meet these elements for all their waterbody types. For a State lacking many of the elements, this implementation process may extend over a period of up to 10 years. EPA expects the State to define annual milestones for incremental progress toward implementation of the ten elements and to include these in its work plans for Section 106 grants and Performance Partnership Grants (PPGs) that include Section 106 funds, consistent with the regulations governing the negotiation of work plans at 40 CFR 35.107.

C. References

1. U.S. Environmental Protection Agency (U.S. EPA). 2001. Memorandum on *FY 2001 Clean Water Act Section 106 Grant Guidance* signed February 16, 2001 by Michael B. Cook, Director, Office of Wastewater Management.
2. U.S. EPA. 1977. *Basic Water Monitoring Program*. U.S. Environmental Protection Agency Standing Work Group on Water Monitoring. EPA 440/9-76-0252.
3. U.S. EPA. 1997. *Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates*. U.S. Environmental Protection Agency, Office of Water. Washington, DC. EPA 841-R-97-002A and 002B.
4. National Academy of Sciences. 1977. *A Report to the U.S. Environmental Protection Agency from the Study Group on Environmental Monitoring, Committee on National Statistics, National Research Council*. National Academy of Sciences, Washington, DC.
5. General Accounting Office. March 2000. *Water Quality—Key EPA and State Decisions Limited by Inconsistent and Incomplete Data*. GAO/RCED-00-54.
6. National Advisory Council for Environmental Policy and Technology (NACEPT). 1998. *Final Report of the Federal Advisory Committee on the Total Maximum Daily Load (TMDL) Program*. <http://www.epa.gov/owow/tmdl/faca/tofc.htm>.

7. National Research Council. 2001. *Assessing the TMDL Approach to Water Quality Management, Committee to Assess the Scientific Basis of the Total Maximum Daily Load Approach to Water Pollution Reduction*. National Academy Press, Washington, D.C.
8. National Academy of Public Administration. December 2002. *Understanding What States Need to Protect Water Quality*. Academy Project Number 2001-001. <http://www.napawash.org>

II. The Recommended Elements of a State Monitoring Program

A. Monitoring Program Strategy

The State has a comprehensive monitoring program strategy that serves all water quality management needs and addresses all State water, including all waterbody types (e.g., streams, rivers, lakes, Great Lakes, reservoirs, estuaries, coastal areas, wetlands, and groundwater). The monitoring program strategy is a long-term implementation plan and should include a timeline, not to exceed ten years⁸, for completing implementation of the strategy. It is important that the strategy be comprehensive in scope and identify the technical issues and resource needs that are currently impediments to an adequate monitoring program.

The State's monitoring strategy should contain or reference a description of how the monitoring program elements described in the remainder of this document will be achieved.

EPA recommends that State monitoring program managers work with other State environmental managers and interested stakeholders (including EPA Regions, other Federal water quality and land management agencies, volunteer monitoring organizations, and academic institutions) as they develop their strategy. This collaboration provides the State water quality program an opportunity to maximize its use of other parties' data and effectively expand its monitoring resources. Many States have formed monitoring councils that help facilitate coordination of monitoring activities among various organizations.

B. Monitoring Objectives

The State has identified monitoring objectives critical to the design of a monitoring program that is efficient and effective in generating data that serve its management decision needs. EPA expects the State to develop a strategy and implement a monitoring program that reflects a full range of State water quality management objectives including, but not limited to, Clean Water Act goals. Consistent with the Clean Water Act, monitoring objectives should reflect the decision needs relevant to all types of waters of the United States, including streams, rivers, lakes, the Great Lakes, reservoirs, estuaries, coastal areas, wetlands and, to the extent possible, groundwater.

Clean Water Act objectives include:

- Establishing, reviewing, and revising water quality standards (Section 303(c)).
- Determining water quality standards attainment (Section 305(b)).
- Identifying impaired waters (Section 303(d)).
- Identifying causes and sources of water quality impairments (Sections 303(d), 305(b)).

⁸i.e., no later than the end of FY2014

- Supporting the implementation of water management programs (Sections 303, 314, 319, 402, etc.).
- Supporting the evaluation of program effectiveness (Sections 303, 305, 402, 314, 319, etc.).

The State may have additional objectives for its own purposes.

In general, a monitoring program that meets the Clean Water Act objectives should be able to answer the following five questions:

- 1. What is the overall quality of waters in the State?** Under Section 305(b) of the Act, the State determines the extent to which its waters meet the objectives of the Clean Water Act, attain applicable water quality standards, and provide for the protection and propagation of balanced populations of fish, shellfish, and wildlife (40 CFR 130.8).
- 2. To what extent is water quality changing over time?** The State assesses and reports on the extent to which control programs have improved water quality or will improve water quality for the purposes of “. . . the protection and propagation of a balanced population of shellfish, fish, and wildlife and . . . recreational activities in and on the water” (40 CFR 130.8(b)(2) and 130.8(b)(1)). Under Section 319(h)(11) of the Act, a State with Section 319 grants reports on reductions in nonpoint-source loadings and related improvements in water quality. Under Section 314(a)(1)(F), a State reports on the status and trends of water quality in lakes. The State may address these requirements through the use of models (for load estimations) and by tracking trends in use assessments. The State also should be able to identify emerging environmental issues related to new pollutants or changes in activities within watersheds.
- 3. What are the problem areas and areas needing protection?** Under Section 303(d), the State must identify impaired waters. The State should also identify waters that are currently of high quality and should be protected from degradation. In order to protect and restore waters, State monitoring and assessment programs should identify the causes and sources of impairment.
- 4. What level of protection is needed?** The State establishes the level of protection that is being monitored against. For example, the State uses data from monitoring programs to conduct triennial reviews of state water quality standards, conduct use attainability analyses, develop and adopt revised designated uses and water quality criteria, establish water quality-based effluent limits in NPDES permits, establish total maximum daily loads, and assess which levels of best management practices for nonpoint sources are most appropriate.
- 5. How effective are clean water projects and programs?** The State monitors to evaluate the effectiveness of specific projects and overall programs, including but not limited to Section 319 (nonpoint source control), Section 314 (Clean Lakes), Section 303(d) Total

Maximum Daily Loads (TMDLs), Section 402 NPDES permits, water quality standards modifications, compliance programs (Discharge Monitoring Report information), and generally to determine the success of management measures.

C. Monitoring Design

The State has an approach and rationale for selection of monitoring designs and sample sites that best serve its monitoring objectives. The State monitoring program will likely integrate several monitoring designs (e.g., fixed station, intensive and screening-level monitoring, rotating basin, judgmental and probability design) to meet the full range of decision needs. The State monitoring design should include probability-based networks (at the watershed or state-level) that support statistically valid inferences about the condition of all State water types, over time. EPA expects the State to use the most efficient combination of monitoring designs to meet its objectives.

When developing designs to meet specific objectives, the EPA encourages States to consider those designs used by EPA's Environmental Monitoring and Assessment Program (EMAP) (probabilistic site selection using simple random, stratified, or nested designs) and the U.S. Geological Survey's National Water Quality Assessment program (targeted, judgmental design based on land use, geological setting, and other natural and human influences). An integrated design for assessing water quality incorporates multiple tools in a tiered approach to address management decisions at multiple scales. These tools include probabilistic designs, landscape and water quality modeling, and targeted site-specific monitoring. This tiered approach enables States to make statistically valid inferences of the extent that waters meet water quality standards, to predict which waters are most likely degraded or at risk for degradation, and to target site-specific monitoring needed to address local water quality concerns. The efficiencies of an integrated design should extend beyond monitoring costs to program costs because it can help States prioritize which waterbodies need more immediate attention.

The monitoring design should address the objectives outlined in Section B, above. The design should include a comprehensive approach to assessment using multiple indicators [1,2], for all State waters on a continuing basis. The elements of the monitoring design should support the State's estimation of the amount or percentage of waters that are impaired Statewide, for each waterbody type, with a high degree of confidence. The State is encouraged to use a design that allows for estimations to within $\pm 10\%$ at a 90% confidence level for Statewide designs. EPA encourages the application of integrated monitoring designs that allow more intensive monitoring in specific areas of concern or interest for individual States.

To meet its monitoring objectives, States should ensure that the selected monitoring design yields scientifically valid results and meets the needs of the decision maker. The monitoring design should incorporate appropriate methods to control decision errors and balance the possibility of making incorrect decisions. The levels of precision and confidence should be appropriate to the monitoring objective and the type of data collected.

D. Core and Supplemental Water Quality Indicators

Because limited resources affect the design of water quality monitoring programs, the State should use a tiered approach to monitoring that includes a core set of baseline indicators selected to represent each applicable designated use, plus supplemental indicators selected according to site-specific or project-specific decision criteria [1, 2]. Using this tiered approach, the State should be able to make the best use of its resources to meet water quality decision needs, including assessing water quality standards attainment and designated use support, identifying needed changes to water quality standards, describing causes and sources of impairments, developing water quality-based source controls, and assessing whether physical, chemical, and biological integrity are supported.

The monitoring strategy should define a **core** set of indicators (e.g., water quality parameters) for each water resource type that include physical/habitat, chemical/toxicological, and biological/ecological endpoints as appropriate, that reflect designated uses, and that can be used routinely to assess attainment with applicable water quality standards throughout the State. This core set of indicators is monitored to provide Statewide or basin/watershed level information on the fundamental attributes of the aquatic environment and to assess water quality standards attainment/impairment status. Previously, chemical and physical indicators were emphasized; however, biological monitoring and assessment should assume a more prominent role in State monitoring. [2, 3].

The strategy should also describe a process for identifying **supplemental** indicators to monitor when there is a reasonable expectation that a specific pollutant may be present in a watershed, when core indicators indicate impairment, or to support a special study such as screening for potential pollutants of concern. Supplemental indicators are often key to identifying causes and sources of impairments and targeting appropriate source controls. These supplemental indicators may include each water quality criteria in the State's water quality standards, any pollutants controlled by the National Pollutant Discharge Elimination System (NPDES), and any other constituents or indicators of concern.

Table 1 presents examples of recommended core and supplemental water quality indicators. The *Consolidated Assessment and Listing Methodology* [4] provides additional information on considerations for selection of supplemental indicators (see <http://www.epa.gov/owow/monitoring/calm.html>, Chapter 11).

E. Quality Assurance

Quality Management Plans and Quality Assurance Project Plans are developed, maintained, and peer reviewed in accordance with EPA policy to ensure the scientific validity of monitoring and laboratory activities. The Quality Management Plan (QMP)

Table 1. Recommended water quality indicators for general designated use categories

Recommended Core and Supplemental Indicators				
	Aquatic Life & Wildlife	Recreation	Drinking Water	Fish/Shellfish Consumption
Recommended Core Indicators	<ul style="list-style-type: none"> *Condition of biological communities (EPA recommends the use of at least two assemblages) *Dissolved oxygen *Temperature *Conductivity *pH *Habitat assessment *Flow *Nutrients *Landscape conditions (e.g., % cover of land uses) Additional indicators for lakes: <ul style="list-style-type: none"> *Eutrophic condition Additional indicators for wetlands: <ul style="list-style-type: none"> *Wetland hydrogeomorphic settings and functions 	<ul style="list-style-type: none"> *Pathogen indicators (<i>E. coli</i>, enterococci) *Nuisance plant Growth *Flow *Nutrients *Chlorophyll *Landscape conditions (e.g., % cover of land uses) Additional indicators for lakes: <ul style="list-style-type: none"> *Secchi depth Additional indicators for wetlands: <ul style="list-style-type: none"> *Wetland hydrogeomorphic settings and functions 	<ul style="list-style-type: none"> *Trace metals *Pathogens *Nitrates *Salinity *Sediments/TDS *Flow *Landscape conditions (e.g., % cover of land uses) 	<ul style="list-style-type: none"> *Pathogens *Mercury *Chlordane *DDT *PCBs *Landscape conditions (e.g., % cover of land uses)
Supplemental Indicators	<ul style="list-style-type: none"> *Ambient toxicity *Sediment toxicity *Other chemicals of concern in water column or sediment *Health of organisms 	<ul style="list-style-type: none"> *Other chemicals of concern in water column or sediment *Hazardous chemicals *Aesthetics 	<ul style="list-style-type: none"> *VOCs (in reservoirs) *Hydrophyllic pesticides *Nutrients *Other chemicals of concern in water column or sediment *Algae 	<ul style="list-style-type: none"> *Other chemicals of concern in water column or sediment

documents how the State monitoring program will plan, implement, and assess the effectiveness of its quality assurance and quality control operations. Quality Assurance Project Plans (QAPPs) document the planning, implementation, and assessment procedures for a particular project, as well as any specific quality assurance and quality control activities. EPA guidance on developing QMPs and QAPPs is available at www.epa.gov/quality.

These plans should reflect the level of data quality that is appropriate for the specific uses of the data, such as comprehensive assessment and listing of impaired waters, TMDL development, NPDES permit issuance, and NPS effectiveness. Data quality and quantity needs are expected to vary according to the consequences of the resulting water quality decisions.

Under 40 CFR 130.4(b), State monitoring programs are to include collection and analysis of physical, chemical, and biological data, and quality assurance and control programs to ensure the data are scientifically valid. Under 40 CFR 31.45, if a grantee's project involves environmentally related measurements or data generation, the grantee must develop and implement quality assurance practices consisting of policies, procedures, specifications, standards, and documentation sufficient to produce data of adequate quality to meet project objectives and minimize loss of data due to out-of-control conditions or malfunctions.

A grantee that uses Section 106 funds for monitoring activities should include, in its Quality Assurance Program Plan (QAPP) or equivalent document, a description of how:

- Each study or monitoring program objective is defined in specific qualitative and quantitative terms and linked to an environmental management decision or reporting requirement associated with the goals of the Clean Water Act.
- Selected indicators offer the most direct means of assessing the environmental attribute under study, based upon the associated requirement and goals of the Clean Water Act.
- The uncertainty associated with estimates and conclusions drawn from each component of the monitoring program are understood, quantified, and limited to a reasonable extent, commensurate with the potential costs (both monetary and environmental) of decision errors.
- The proposed sampling scheme will yield data that are representative of the environmental attribute under study, with consideration of statistical probabilities associated with sampling.
- The quality of the data is assessed and validated to ensure that the data quality objectives of the programs were met.

F. Data Management

The State uses an accessible electronic data system for water quality, fish tissue, toxicity, sediment chemistry, habitat, and biological data (following appropriate metadata and State/Federal geo-locational standards) with timely data entry and public access.

EPA's new STORET (STORage and RETrieval) system provides an accessible, nationwide central repository of water information of known quality. In the future, EPA will require that all States use STORET either directly or indirectly (e.g., via the Central Data Exchange (CDX) which will include the Monitoring Data Standard). For States that do not currently operate STORET, their monitoring strategies should provide for the use of STORET as soon as is practicable. EPA is committed to providing updates and improvements to STORET to meet user needs and to providing the State with training and other technical support. See

www.epa.gov/storet for further information on STORET, including system updates for users and instructions on how to download data via the Web.

In addition, the State should store its assessment information in an accessible electronic database. For the 2004 305(b) reports and 303(d) lists, EPA strongly recommends that all States use either the Assessment Database (ADB) or an equivalent relational database for storing WQS attainment status for each assessment unit. See Appendix B of the 2002 *Integrated Water Quality Monitoring and Assessment Report Guidance* [5] for further information on the electronic reporting format. This guidance is available at: www.epa.gov/owow/tmdl/2002wqma.html

The State also provides appropriate geospatial data to enable the use of current Geographic Information System (GIS) tools. The 2002 *Integrated Water Quality Monitoring and Assessment Report Guidance*, Appendix B, asks states to define the geographic location of assessment units using the National Hydrography Dataset (NHD). The use of NHD is strongly recommended for the 2004 305(b) reports and 303(d) lists. The 1998 Content Standard for Digital Geospatial Metadata [6] to label geospatial datasets applies to States and EPA. It provides for characterizing geospatial data so that users can determine the data's fitness for their purpose. For more information, visit <http://www.fgdc.gov/metadata/metadata.html>.

G. Data Analysis/Assessment

The State has a methodology for assessing attainment of water quality standards based on analysis of various types of data (chemical, physical, biological, land use) from various sources, for all waterbody types and all State waters. The methodology should describe how existing and available data and information relevant to applicable water quality standards, including both core and supplemental indicators, will be compiled and analyzed to make attainment decisions about State waters. The methodology describes how the state integrates its primary data – collected specifically for making attainment decisions according to a State QAPP – with data from secondary sources, collected for a variety of purposes under a variety of quality control practices. (Secondary data could include, for example, volunteer monitoring data or discharge monitoring reports.) The methodology should:

- Identify the required or likely sources of existing and available data and information and procedures for collecting or assembling it;
- Describe or reference requirements relating to data quality and representativeness, such as analytical precision, temporal and geographical representation, and metadata documentation needs;
- Include or reference procedures for evaluating the quality of datasets; and
- Explain data reduction procedures (e.g., statistical analyses) appropriate for comparing data to applicable water quality standards.

For more information on developing assessment methodologies, see 40 CFR 130.7(b)(6)(iv) and www.epa.gov/owow/monitoring/calm.html.

H. Reporting

The State produces timely and complete water quality reports and lists. The Clean Water Act requires the State to provide certain reports and lists, including those listed below. EPA encourages consolidation of reports wherever possible.

- The Section 305(b) water quality inventory report, which includes Section 314 Lakes Assessments, characterizes the condition and quality trends of monitored waters within the State and is due on April 1 of even-numbered years. This is the primary State monitoring program report to EPA and draws upon information from the Clean Lakes program, nonpoint source program, TMDLs, and other national, State, and local assessments.
- The Section 303(d) list identifies all impaired waters based on existing and readily available information. The list is also due on April 1 of even-numbered years.
- Section 406 of the Clean Water Act, as amended by the Beaches Environmental Assessment and Coastal Health Act of 2000, requires States with Section 406 grants to submit information on monitoring and notification programs for coastal recreation waters.

Other reports and products resulting from water monitoring program activities include, for example, reports or analyses to support triennial reviews, use attainability analyses (UAAs), standards revisions, water quality based effluent limits (WQBELs) in permits, total maximum daily loads (TMDLs), nonpoint source programs, and watershed plans.

The *2002 Integrated Water Quality Monitoring and Assessment Report Guidance* (November 19, 2001) provides States, Territories, and authorized Tribes with guidance for integrating the development and submission of 2002 305(b) water quality reports and Section 303(d) lists of impaired waters. The Integrated Report will satisfy CWA reporting requirements for both Section 305(b) water quality reports and Section 303(d) lists.

As explained in the FY 2001 Clean Water Act Section 106 Grant Guidance and the March 1, 2002 memorandum, “2002 Integrated Section 305(b) Reports and 303(d) Lists and the impact of the 305(b) Reports on Annual S106 Grant Funding Targets”, EPA will not award any Section 106 funding under a Section 106 grant or performance partnership grant (PPG) unless a State has annually updated its monitoring data in accordance with Section 106(e), and submitted the most recently required Section 305(b) report [7, 8]. The annual update requirement may be satisfied by uploading monitoring data to the national STORET warehouse or updating the 305(b) assessment information in the National Assessment Database.

The State is encouraged to report to the public on water quality, taking into account the needs of interested audiences. Many States use various formats and media such as technical reports, brochures, posters and other visual aids, oral presentations, newspaper articles, and the Internet.

I. Programmatic Evaluation

The State, in consultation with its EPA Region, conducts periodic reviews of each aspect of its monitoring program to determine how well the program serves its water quality decision needs for all State waters, including all waterbody types. This should involve evaluating the monitoring program to determine how well each of the 10 elements is addressed, and determining how needed changes and additions are incorporated into future monitoring cycles. This evaluation will take into consideration the effects of funding shortfalls on a State's implementation of its monitoring program strategy. EPA and States recognize the importance of a nationally consistent approach for evaluating state monitoring programs.

Since water quality monitoring programs are effective only when they meet the information needs of water quality resource managers, the State should have a feedback mechanism for reporting useful information to water quality managers and incorporating their input on future data needs. Information needs may include site-specific criteria modification studies, support for enforcement actions, validation of the success of control measures, modeling for TMDLs, monitoring unassessed waters, and other activities. Decision-makers at the national, regional, State, and local levels should be considered in this process.

The State should evaluate its overall monitoring program as part of a continuous improvement feedback loop. This may include, for example, undertaking audits of the monitoring program, quality assurance protocols, laboratory procedures, and data assessment procedures. See 40 CFR 130.5 and 130.6.

J. General Support and Infrastructure Planning

The State identifies current and future monitoring resources it needs to fully implement its monitoring program strategy.

As part of an ongoing integrated planning process, the following needs (staff and training, laboratory resources, and funding) should be assessed, considering current conditions and planned improvements, and discussed with the Regions during negotiation for Section 106 grants and PPGs that include Section 106 funds (Note: States may rely on workload models to assess needs).

Staff and Training: The State should identify the required number of staff needed for a State monitoring program, as well as needed training for field, laboratory, data management, and data assessment staff, and should document adequacies and shortfalls. States should also address staff and staff training needs for unassessed waterbody types.

Laboratory Resources: The State should identify needed laboratory support (and should document adequacies and shortfalls) to satisfy scientifically appropriate documented methods, such as methods listed in 40 CFR Part 136, published in *Standard Methods for the Examination of Water and Wastewater*, or published by the U.S. Geological Survey. U.S. EPA also encourages the use of performance-based methods (i.e., scientifically appropriate methods that meet established criteria for accuracy, sensitivity, bias, and precision and comply with specified data quality needs or requirements).

Funding: The State should identify required funding (e.g., for salaries, training, travel, equipment, laboratory analysis) for a State monitoring program, along with anticipated sources and amounts of funding and the effects of any shortfalls.

K. References

1. Intergovernmental Task Force on Monitoring Water Quality. February 1995. *The Strategy for Improving Water Quality Monitoring in the United States: Final Report of the Intergovernmental Task Force on Monitoring Water Quality*. <http://water.usgs.gov/wicp/itfm.html>
2. Yoder, C.O. 1997. *Important Concepts and Elements of an Adequate State Watershed Monitoring and Assessment Program*. ASIWPCA Standards and Monitoring Task Force. Prepared for U.S. EPA Office of Water Cooperative Agreement CX825484-01-0. Washington, DC.
3. National Research Council. 2001. *Assessing the TMDL Approach to Water Quality Management, Committee to Assess the Scientific Basis of the Total Maximum Daily Load Approach to Water Pollution Reduction*. National Academy Press, Washington, D.C.
4. U.S. EPA. 2002. *Consolidated Assessment and Listing Methodology - Toward a Compendium of Best Practices*. <http://www.epa.gov/owow/monitoring/calm.html>
5. U.S. EPA. November 19, 2002. *2002 Integrated Water Quality Monitoring and Assessment Report Guidance*. <http://www.epa.gov/owow/tmdl/2002wqma.html>
6. Federal Geographic Data Committee. June 1998. *Content Standard for Digital Geospatial Metadata* (FGDC-STD-001-1998). <http://www.fgdc.gov/metadata/metadata.html>
7. U.S. EPA. 2001. Memorandum on *FY 2001 Clean Water Act Section 106 Grant Guidance* signed February 16, 2001 by Michael B. Cook, Director, EPA Office of Wastewater Management.

8. U.S. EPA. 2002. Memorandum on 2002 *Integrated Section 305(b) Reports and 303(d) Lists and the impact of the 305(b) Reports on Annual S106 Grant Funding Targets* signed March 1, 2002 by Michael B. Cook, Director, EPA Office of Wastewater Management.