STATE APPROACHES AND NEEDS FOR MEASURING, TRACKING, AND REPORTING ON WATER QUALITY IMPROVEMENTS

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EXECUTIVE SUMMARY

The Government Performance and Results Act (GPRA) requires that EPA develop a 5-year strategic plan every three years. EPA's National Water Program Guidance Measure SP-12 under the current strategic plan has established a goal of reporting on improved water quality conditions in 250 impaired (generally 12-digit HUC) watersheds nationwide by 2012; this goal is broken down into EPA region specific reporting targets (e.g., 5 per state). EPA has asked states to meet the 2012 reporting goals for Measure SP-12. EPA defines "improved" as either: 1) The removal of one or more of the water body/impairment causes identified in the Clean Water Act Section 303(d) 2002 List for at least 40% of the impaired water bodies or impaired stream miles/lake acres in the watershed; or 2) A significant watershed-wide improvement, as demonstrated by valid scientific information, in one or more water quality parameters or related indicators associated with the impairments. Achieving Measure SP-12 goals will require a collaborative effort on the part of EPA, state agencies, and local partners.

Achieving Measure SP-12 goals will require a collaborative effort on the part of EPA, state agencies, and local partners. States should explore opportunities to utilize all potential sources of funding to support efforts to monitor water quality improvements, including EPA programs funded to implement Clean Water Action Sections 106, 208, 319, and 604(b). Also, states should pursue opportunities to leverage funding from other agencies such as U.S. Department of Agriculture (e.g., Farm Bill), U.S. Geological Survey, U.S. Forest Service, and programs such as the National Shellfish Sanitation Program. Numerous state and local agencies and groups may conduct effectiveness monitoring activities including Departments of Health, Tribes, watershed groups, universities, etc.

In 2008, the U.S. Environmental Protection Agency (EPA) funded a project and hired a contractor to collect information on how states are measuring and demonstrating water quality improvements and attainment with water quality standards for use in reporting measures such as National Water Program Guidance Measure SP-12. Nine states participated in the project, including: Alaska, Iowa, North Carolina, Oregon, Texas, Virginia, Washington, Wisconsin, and Wyoming. These specific states were chosen from multiple EPA regions to capture diversity in various characteristics (e.g., size, geography, climate, hydrology, land use).

The goal of this report is to present a synthesis of key technical, programmatic, and resource information obtained from the nine states on current approaches and state needs for measuring and demonstrating water quality improvements and attainment with water quality standards for SP-12 Watersheds (and all watersheds in general). Further, in response to challenges identified by the nine participating states, this report also provides strategic planning recommendations for potential ways to improve the ability to measure and demonstrate water quality improvements.

This report includes the following:

- A summary of how each of nine states is measuring and demonstrating water quality improvements and attainment with water quality standards for SP-12 Watersheds, as well as other watersheds;
- An overview of the type of data being used by states to satisfy reporting requirements for Measure SP-12 and other performance measures;
- Discussion of protocols, approaches, and viable options for effectiveness monitoring while considering the diverse geographic, land use, and pollutant sources found in the interviewed states; and
- Recommendations and feedback on issues, challenges, and needs identified by the states.

The main body of this report provides a summary of information provided by the states; however, all of the information gathered from each state is provided in Appendix C, including case studies of documented

improvement and/or attainment of water quality standards due to actual restoration work; many of the case studies include examples of watersheds that had sufficient data to demonstrate significant improvements. However, it should be noted that the watersheds featured in the case studies are not necessarily eligible for SP-12.

Section 7 of this report provides recommendations for improving the ability to measure and demonstrate water quality improvements. Recommendations for states include:

- Utilize all potential sources of funding to support efforts to monitor water quality improvements.
- Target monitoring resources more effectively.
- Develop and implement effectiveness monitoring programs.
- Establish biological assessment approaches and include biological and physical monitoring data in efforts to evaluate for and demonstrate water quality improvements.
- Improve communication, coordination, and collaboration within the state and at the local level.
- Establish state databases to track improvement monitoring data and information.
- Update Consolidated Assessment and Listing Methodology (CALM) and include delisting criteria.

In a study conducted to assess the success of restoration projects in the Pacific Northwest (i.e., Oregon, Washington, Montana, and Idaho), Rumps et. al. (2007) found that 34% of the projects surveyed did not conduct *sufficient* monitoring to evaluate effectiveness. Of the 81% of respondents that did report collecting monitoring data, 18% of the respondents reported collecting only a single sample

Monitoring data are absolutely necessary in order to be able to demonstrate water quality improvements (including incremental improvements) and attainment of water quality standards. A key issue revealed during this project is the lack of adequate data and appropriate monitoring programs to support efforts to report on water quality improvements and meet Measure SP-12 reporting needs. Only one of the nine states interviewed (**Washington**) has a formal "effectiveness monitoring" program in place to measure and track watershed improvements. The other eight states currently do not have programs specifically designed to measure or track water quality improvements at a scale relevant or fine enough to capture impacts of individual watershed improvement projects or practices.

Most of the states indicated that the primary source of data for use in measuring and tracking water quality improvements is the state ambient monitoring program. Statewide ambient water quality monitoring networks are generally not set up to provide a significant amount of data on targeted water bodies; rather, ambient monitoring networks provide basic data for many different uses, including supporting the development of water quality criteria, reporting on the condition of the state's waters, and identifying impaired waters. As a result, ambient monitoring networks are typically designed to characterize water quality conditions at a broad scale. This approach is not consistent with the data needs of a watershed improvement or effectiveness monitoring program, which requires targeted, more rigorous sample collection of specific parameters on a smaller (i.e., subwatershed) scale.

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1.0 INTRODUCTION

1.1. Background

The Government Performance and Results Act (GPRA) requires that EPA develop a 5-year strategic plan every three years. The current plan calls for the full restoration of 2,250 impaired water bodies nationwide; removal of at least 5,600 specific causes of impairment; and the improvement of water quality in 250 watersheds (12-digit HUC). The strategic plan refers to these three targets as National Water Program Guidance Measures SP-10, SP-11, and SP-12 (a copy of EPA's guidance on Measure SP-12 reporting is provided in Appendix A). Measure SP-12[1] is a "demonstration" measure, used to document water quality successes that result from application of the watershed approach; the intent is not to inventory all instances where success has occurred or is underway in a state. Under Measure SP-12, improvement is defined as the removal of one or more of the causes of impairment (as identified in the 2002 303(d) list) for at least 40% of the streams or stream miles in the candidate watershed (Option 1 under SP-12). Improvement can also be documented by a significant watershed-wide improvement in one or more water quality parameters (Option 2 under SP-12); however, the improvement must be a scientifically documented improvement, and not an administrative change (e.g., change in water quality criteria). The goal of Measure SP-12 is to report on improved water quality conditions in 250 impaired (12-digit HUC) watersheds nationwide by 2012.

States have made significant progress in efforts to restore and protect the nation's waters. However, without the ability to detect and measure improvements in water quality, states will not be able to demonstrate progress toward attainment of water quality standards. In a study conducted to assess the success of restoration projects in the Pacific Northwest (i.e., Oregon, Washington, Montana, and Idaho), Rumps et. al. (2007[2]) found that 34% of the projects surveyed did not conduct *sufficient* monitoring to evaluate effectiveness. Of the 81% of respondents that did report collecting monitoring data, 18% of the respondents reported collecting only a single sample. Another interesting finding from the study has to do with respondent's responses on whether they considered the restoration project a success. 71% of respondents indicated that the project was a complete success, 23% said a partial success, 4% said it was too soon to tell, and 2% indicated that the project was not at all successful. "However, only 12% of respondents based their answers on actual measurements" (Rumps et. al. (2007[3]).

In 2008, the U.S. Environmental Protection Agency (EPA) funded a project to collect information on how each of nine states are measuring and demonstrating water quality improvements and attainment with water quality standards for impaired watersheds, including Measure SP-12 Watersheds. Nine states participated in the project, including: Alaska, Iowa, North Carolina, Oregon, Texas, Virginia, Washington, Wisconsin, and Wyoming. Using questionnaires and telephone interviews, information on the following topics was obtained from each of the nine states:

- Overview of current state programs for supporting monitoring, tracking, and assessment efforts to measure and demonstrate water quality improvements and/or attainment of water quality standards for impaired watersheds, including Measure SP-12 Watersheds;
- Types of data used to measure and assess for water quality improvements and/or attainment of water quality standards;
- Approaches to evaluate for improvements in water quality;
- Measures used to demonstrate improvements in water quality;

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[1] http://www.epa.gov/water/waterplan/pamsfy08/def_wq08.html#sp12 & http://www.epa.gov/water/waterplan/documents/SP-12_Guidance_1-31-08.pdf

[2] Stream Restoration in the Pacific Northwest: Analysis of Interviews with Project Managers by: Rumps, M. Jeanne, Katz, L. Stephen, Barnas, Katie, Morehead, D. Mark, Jenkinson, Robin, Clayton, R. Stephen, Goodwin, Peter. *Restoration Ecology*, Vol. 15, No. 3. (September 2007), pp. 506-515.

- Communication of improvements in water quality;
- Case studies of documented improvements in water quality[3]; and
- State's future assistance needs for effectiveness monitoring, tracking, and assessment.

The information gathered was summarized for each state and is provided in Appendix C. This report synthesizes key technical, programmatic, and resource information provided by the states, as well as provides strategic planning recommendations for supporting effectiveness monitoring, tracking, and assessment.

Note that the term "effectiveness" is used in this report to describe improvements in water quality in the water body itself; it is not meant to describe the success or effectiveness of best management practices (BMPs) or other measures taken to improve water quality. The term effectiveness monitoring may be best captured by **Washington** Department of Ecology (WA DOE): "It measures to what extent the water body has improved and whether it has been brought into compliance with the state water quality standards."[4] WA DOE breaks this down further into three key specific benefits or gains from effectiveness monitoring:

1. Provides a measure of progress toward implementation of recommendations (i.e., how much watershed restoration has been achieved, how much more effort is required);
2. Supports the decision-making process on more efficient allocation of funding and optimization in planning (i.e., identifying recommendations or restoration activities that worked, which restoration activity achieved the most success for the resources); and
3. Provides technical feedback that is useful for refinements of initial modeling analysis (e.g., for a TMDL) or refinements in the planning of BMPs, permits, and other pollutant reduction and watershed restoration strategies.

1.2. Purpose of this Report

Achieving Measure SP-12 goals will require a collaborative effort on the part of EPA, state agencies, and local partners. The goal of this report is to provide EPA and states with information on current approaches, state needs, and recommendations for measuring and demonstrating water quality improvements and attainment with water quality standards for SP-12 Watersheds, and all watersheds in general. Specifically, this report includes the following:

- Summary of how each of nine states is measuring and demonstrating water quality improvements and attainment of water quality standards for SP-12 Watersheds (as well as other watersheds).
- Overview of the type of data being used by states to satisfy reporting requirements for Measure SP-12 and other performance measures.
- Discussion of protocols, approaches, and viable options for effectiveness monitoring while considering the diverse geographic, land use, and pollutant sources found in the interviewed states.
- Recommendations based on issues, challenges, and needs identified by the states.

The main body of this report provides a summary of information provided by the states; however, all of the information gathered from each state is provided in Appendix C, including case studies of documented improvement and/or attainment of water quality standards due to actual restoration work; many of the case studies include examples of watersheds that had sufficient data to demonstrate significant improvements. However, it should be noted that the watersheds featured in the case studies are not necessarily eligible for SP-12.

[3] It should be noted that the watersheds featured in the case studies are not necessarily eligible for SP-12.
[4] http://www.ecy.wa.gov/programs/eap/tem/index.html

1.3. Methodology

EPA identified nine states that were interested in participating in this project, including: Alaska, Iowa, North Carolina, Oregon, Texas, Virginia, Washington, Wisconsin, and Wyoming. States were chosen from multiple EPA regions in order to capture diversity in various characteristics (e.g., size, geography, climate, hydrology, land use, etc.). Information was obtained from each of the states through the use of written questionnaires and telephone interviews. Questionnaires were distributed to each of the states via email. Several days following distribution of the questionnaires, each state was contacted to schedule a date and time for interviews; all interviews were conducted via telephone. States were instructed to return completed questionnaires prior to the interview.

Upon receipt of the completed questionnaires, the contractor reviewed the responses and prepared a list of follow-up questions for the interviews. In addition to asking follow-up questions during the interviews, the states were also given the opportunity to elaborate on any points they made in the questionnaires. The information gathered using the questionnaires and through the interviews was used to prepare individual state summaries. Each state's summary was sent to the state for review of accuracy and to allow for additional input to better clarify information. The final state summaries are provided in Appendix C.

Some of the potential constraints or limitations to the use of the information gathered from the states include:

- The level of information provided in the written questionnaires varied significantly from brief answers to in-depth explanations. Effort was made to obtain additional information during the interviews where answers were not specific or detailed.
- Although state staff from all applicable programs (e.g., TMDL, monitoring, NPS, etc.) were encouraged to assist with the completion of the written questionnaire and to participate in the interviews, a different number and mix of staff participated in each call, ranging from just one person for some states to as many as eight people for other states, including water program directors. As a result, the information reported, while accurate, may not be 100% complete as it's simply not possible for any one person to understand the details of every aspect of his/her state's water program.
- Each state interview lasted from between one to two hours and was conducted via telephone. The level of detail and depth of familiarity that one can obtain from a 2-hour telephone interview may differ from that which might be obtained in person at the state agency, meeting and talking with various program staff.

2.0 OVERVIEW OF CURRENT STATE PROGRAMS FOR SUPPORTING EFFECTIVENESS MONITORING, TRACKING, AND ASSESSMENT

2.1. State Programs and Sources of Data to Measure and Track Water Quality Improvements

Only one of the nine states interviewed (**Washington**) has a formal "effectiveness" monitoring program in place to measure and track watershed improvements. The other eight states currently do not have programs specifically designed to measure or track water quality improvements at a scale relevant or fine enough to capture impacts of individual watershed improvement projects or practices. These states indicated that the primary source of data for use in measuring and tracking water quality improvements is the state ambient monitoring program. Statewide ambient water quality monitoring networks are generally not set up to provide a significant amount of data on targeted water bodies; rather, ambient monitoring networks provide basic data for many different uses, including supporting the development of water quality criteria, reporting on the condition of the state's waters, and identifying impaired waters. As a result, ambient monitoring networks are

typically designed to characterize water quality conditions at a broad scale. This approach is not consistent with the data needs of a watershed improvement or effectiveness monitoring program, which requires targeted, more rigorous sample collection of specific parameters on a smaller (i.e., subwatershed) scale. The selection of sites, frequency, and timing of ambient monitoring could differ significantly from that needed to evaluate for specific improvements in water quality.

Many of the states indicated that water quality improvement monitoring and assessment is sometimes conducted as a component of implementation projects funded by grants from the Section 319 Program. While this approach may help to generate some of the data needed to evaluate immediate improvements in water quality, unfortunately, any monitoring conducted as part of 319 projects ends following completion of the project (typically 1 to 2 years). As a result, an insufficient amount of data may hinder the states' ability to assess whether improvements are continuing to occur.

For states that do have limited data on water quality improvements, the process for tracking these data is unstructured; for example, the information may be in paper files or reside at multiple agencies, no central database exists for tracking these data, no single staff person is responsible for compiling, organizing, and evaluating improvement or effectiveness data. Also, most of the interviewed states mentioned that the lack of data and information about both the impacts of nonpoint source (NPS) controls (e.g., BMPs) on water quality, and the extent of BMP implementation itself is a major limiting factor in their ability to measure and report on any potential improvements in water quality.

2.2. Unique State Programs and Approaches

Washington, Iowa, Virginia, and Wisconsin have unique programs (or unique aspects to traditional programs) that have potential to provide sufficient data and information to report on Measure SP-12.

Washington was among one of the first states to implement a rigorous effectiveness monitoring program, starting with a pilot project in Totten and Eld Inlets (in Puget Sound, **Washington)** that employed statistics-based cause and effect analyses. Totten and Eld Inlets are highly productive shellfish growing areas. Two major concerns drove pollution-control efforts in their watersheds – restrictions on shellfish harvest from Eld Inlet, and population increases in both watersheds, which will likely increase bacterial contamination and lead it to further restriction or prohibition of shellfish harvest. State grants with partial matching local funds, totaling roughly $1.9 million, paid for targeted pollution-control efforts for these inlets. **Washington** completed ten years (1992-2002) of water quality monitoring and analysis for fecal coliform bacteria loading in six sub-basins discharging to Totten and Eld Inlets. The goal of the ten-year EPA-funded monitoring program was to determine the effectiveness of watershed-scale, nonpoint source pollution management programs for improving water quality (the final report is available at www.ecy.wa.gov/pubs/0303010.pdf). **Washington** State has since put in place a dedicated effectiveness monitoring program, which works in conjunction with other agencies (e.g., counties) to measure and track watershed improvements. At least ten effectiveness monitoring reports have been developed (see www.ecy.wa.gov/programs/eap/tem/index.html) and additional effectiveness monitoring efforts are currently underway in the Snoqualmie and Skokomish Basins, the Union River Basin, and the Lower Dungeness Basin.

Iowa recently initiated a new strategy for the use of its Section 319 funding. **Iowa** Department of Natural Resources (IDNR) is focusing the implementation of 319 projects in watersheds that are 30,000 acres or less. Further, a portion of 319 funding is being set aside specifically to support monitoring during the implementation phase of watershed projects in order to assess and track watershed improvements and effectiveness of watershed improvement projects; these data include instream water quality monitoring data used to measure progress toward meeting water quality standards. This program is just getting underway, so results are not yet available. However, the anticipation is that this new strategy for targeting the use of Section 319 funding for projects in smaller watersheds and using some of the funding to support water quality monitoring will result in more improvements in water quality and data that documents those improvements.

While not included in this project, the **Ohio** Environmental Protection Agency gave a presentation at a 2009 EPA Region 5 meeting, in which they shared their plans to conduct all of the environmental monitoring for 319-funded projects.[5] **Ohio** EPA's 319 program monitoring activities include habitat, macroinvertebrate, and fish assessments, as well as water and sediment sampling as needed. Any given 319 project will have 3-5 monitoring sites, and between 15 and 20 projects are monitored each year. In total, approximately 75 sites are sampled on an annual basis. The total annual cost to run **Ohio** EPA's 319 monitoring program is $225,000 ($10,000 - $15,000 per project); this cost includes all field and analytical work. **Ohio** EPA identified the following benefits to having a fully dedicated monitoring team for 319 projects: cost savings; only one QAPP needed; all data are credible; all data are STORET compatible; and monitoring can be targeted to specific projects and watersheds.

Virginia is somewhat unique in that they are required by state law to implement TMDLs, which includes developing Implementation Plans (IP) that, among other things, identify the date of expected achievement of water quality objectives. The development of the IP involves coordination with multiple state agencies and major stakeholders (e.g., agricultural and urban representatives, mining/manufacturing associations, etc.). **Virginia** Department of Environmental Quality (VA DEQ) works closely with all of the agencies and stakeholder groups to determine the management practices that will address the impairments identified through the TMDL development process. VA DEQ also works with the stakeholders to identify sources of funding to support the practices. VA DEQ uses a staged approach to implement TMDLs, which provides opportunities for periodic evaluation of the effectiveness of the implementation actions and adjustment of efforts to achieve water quality objectives in a timely and cost-effective manner. Each TMDL IP is required to have a monitoring and evaluation schedule that is specific to the stressor-impairment relationship, as well as an implementation timeline and projected end date. This monitoring includes the collection of data that allows for the evaluation of progress toward attainment of water quality standards; in some cases, these data may be helpful for use in Measure SP-12 reporting.

Washington and **Oregon** are also required to develop TMDL IPs. **Oregon's** IPs include plans for post-TMDL monitoring and evaluation. **Washington's** IPs include monitoring strategies for measuring implementation activities and water quality improvement, as well as progress in achieving interim targets and attainment of water quality standards. Further, their IPs also include schedules that outline when the state will monitor to evaluate TMDL implementation effectiveness. While not included in this project, **Idaho** is also required to develop TMDL IPs, which include a monitoring strategy to measure implementation activities and achievement of water quality standards.

Some of the states interviewed (e.g. **Texas** and **Alaska**) talked about challenges associated with the extensive number of surface water resources that need to be monitored and how it's difficult enough (given available funding) to adequately monitor all of the state's waters in the ambient program, let alone go back to conduct more focused improvement or effectiveness monitoring. **Wisconsin** has developed an approach to attempt to address this issue. The **Wisconsin** Department of Natural Resources (WDNR) designed a monitoring program that includes three tiers of monitoring. Tier 1 employs standardized sampling protocols to collect statewide data. This approach ensures broad spatial coverage of the state's aquatic resources, and is designed to identify broad trends and water quality issues. As part of the Tier 1 process, core indicators are identified and sampled at every site (or a subset of sites) in order to develop a baseline picture of water quality. Where water quality issues are flagged, more intensive sampling occurs under Tier 2 to determine the cause and extent (WDNR is currently developing specific numeric criteria that will trigger Tier 2 monitoring). This site-specific monitoring of targeted areas can be used to develop management plans for corrective action. Tier 3 employs follow-up studies on targeted waters to determine the success of management actions. Effectiveness of water body-specific management actions is determined using core indicators from the more intensive sampling designs under Tier 2 that are specific to the problem being addressed. The chosen indicators are compared before and after management actions are implemented. Tier 3 monitoring is also used to evaluate

[5] http://www.epa.gov/region5/water/wqb/presentations/DeShon_ppt.pdf

permit compliance and the effectiveness of permit conditions for regulated point source facilities. WDNR's Water Resource Monitoring Strategy is available at dnr.wi.gov/org/water/monitoring/strategy.htm. Unfortunately, WDNR has been dealing with a dwindling resource base - both funding and staff - over the last 10 years. As a result, the limited resources allocated for funding are primarily directed to Tier 1 and Tier 2 monitoring, leaving very little funding for Tier 3 monitoring.

2.3. Funding Availability

All states identified a lack of funding as the primary obstacle to being able to adequately measure and track water quality improvements. Further, very few states have funding set-aside specifically to support effectiveness monitoring efforts. As a result, conclusions about water quality improvements are based primarily on data collected through the ambient monitoring program or as part of 319 projects. Unfortunately, these programs are not always designed to collect data sufficient to detect changes in water quality over time, or to determine whether an impaired water body is meeting water quality standards. Monitoring to evaluate for improvements typically requires years of data from strategically placed collection sites in order to recognize improvements.

A gap analysis was completed for the State of **Wisconsin's** monitoring program in 2001. The analysis projections indicated that an estimated $4.6 million, including 38.7 FTE positions, was needed to implement a robust monitoring program. Approximately $1 million would be needed for Tier 3 (effectiveness) monitoring alone. The State of **Washington** recently assessed the workload to conduct effectiveness monitoring for all of their completed TMDLs, as well as all of the remaining impaired waters on the state's 2004 303(d) list. The state estimated that it would take 10 staff people plus $230,000 in funds (for laboratory analyses) per year to accomplish the work by 2014; the state presently has just three staff people and $80,000 per year to support effectiveness monitoring. This translates into an annual shortfall for effectiveness monitoring of 7 FTEs and $150,000 for laboratory analyses.

2.4. Key Challenges

Each state was asked to identify key challenges to implementing watershed improvement or effectiveness monitoring programs. Each state's complete list of challenges is provided in Appendix C. The following list provides an overview of the common challenges identified by the nine states.

- Inadequate funding to support targeted, long-term monitoring to detect changes in water quality, including monitoring to fully and adequately address SP-12.
- Lack of consistent source of funding to hire staff to analyze effectiveness data, as well as staff needed to compile and organize effectiveness data (e.g., into a database).
- Lack of a central database to store monitoring data collected by various agencies, which might be useful for measuring water quality improvements. 319 data, for example, are generally summarized by grant recipients in annual reports on a project-specific basis; this approach does not allow for watershed-scale improvement analyses.
- Lack of ability to track all of the activities that occur in a watershed that might impact water quality; this includes state implemented activities and activities being carried out by other entities.
- Program fragmentation and lack of interagency coordination on monitoring and other efforts to collect information to measure and report on water quality improvements. This includes lack of effective strategy for sharing and communicating results to support planning for future efforts.
- Inadequate regulatory and political commitment to monitoring.
- Impatience (both on a state and local level) with the long-term monitoring needed to detect improvements in water quality; a general desire for quick fixes and immediate improvements.

3.0 AVAILABLE DATA TO MEASURE AND ASSESS EFFECTIVENESS

3.1. Available Data

Each state has well-established programs in place to routinely monitor chemical and physical water quality constituents. In most cases, water quality improvements are measured through assessment techniques that are single parameter specific. All nine of the states conduct some biological monitoring to supplement chemical and physical data. Over the past six years, the **Wyoming** Department of Environmental Quality – Water Quality Division (WDEQ/WQD) has invested considerable effort in the development of indicators for assessing the biological condition of **Wyoming** streams.[6] Much of the focus has been on developing and refining a statewide multi-metric index (MMI) named the **Wyoming** Stream Integrity Index (WSII). Originally developed in 2000 and later revised in 2002, the WSII is based on macroinvertebrate community-level attributes or metrics designed to assess the degree to which biological communities are different from that expected to occur under reference or baseline conditions. The WSII is one of several tools the WDEQ uses to understand and quantify both biological impacts on stream ecosystems and the degree to which management practices are effective at rehabilitating them.

Several states, including **Virginia** and **Alaska**, have programs to monitor specific constituents related to industries like shellfish and salmon harvesting. One unique measure of assessment was mentioned by **Wyoming**, where photo points provide an inexpensive qualitative means to evaluate changes by comparing photographs of a restoration project over time (e.g., photographs taken at designated photo points to document stream channel condition and riparian recovery).[7]

3.2. Additional Data Needs

Several states would like to increase the use of biological data to assess effectiveness and compliance with water quality standards, not just to show interim progress. Biological indexing and trend analysis is becoming a very popular measure of long-term quality of habitat and water quality. In order to integrate biological data into the listing/delisting process, states will need to adopt biological criteria, as well as establish a process for identifying impairments if the biological criteria are not numeric.

In order to better measure and track watershed improvements, several of the states expressed an interest in collecting additional BMP effectiveness data. **Washington** would like EPA to publish more data on BMP effectiveness, especially for NPS issues in the arid West. **Alaska** has unique challenges because many of their pollutant sources are less common as compared to other states; examples include petroleum, log bark, seafood waste, and residues (e.g., debris and trash that accumulate within snow and ice and are released during spring melt). **Iowa**, **Virginia**, and **Wisconsin** have started to collect data to track water quality improvements where BMPs have been installed. As **Iowa** notes, however, more funding is needed to conduct long-term post-implementation monitoring to better report on progress toward meeting EPA targets.

Oregon would like to use more remote-sensing monitoring techniques with watershed-scale characteristics such as Light Detection and Ranging (LiDAR) and Forward Looking Infrared (FLIR) techniques, but funding and data assessment expertise are extremely limited. **Oregon** feels that the collection of geospatial data would generate more useful data for less money and provide useful information for targeting the placement of BMPs.

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[6] http://deq.state.wy.us/wqd/watershed/Downloads/Monitoring/The%20Wyoming%20Stream%20Integrity%20Index_2006.pdf
[7] http://www.oregon.gov/OWEB/docs/pubs/PhotoPoint_Monitoring_Doc_July2007.pdf

3.3. Databases

Most states use or are developing databases to store monitoring data. Many of the databases are accessible by project partners and the public, such as **Wisconsin's** Surface Water Integrated Monitoring System (SWIMS) database.[8] Several of the states, including **Virginia**, **North Carolina**, **Alaska**, and **Wisconsin**, currently or will soon use one or more databases to track watershed effectiveness data. For example, the **North Carolina** Watershed Restoration Assessment and Protection Super Structure (WRAPS) is an integration of several previously used tools for tracking information and data on water quality assessments, implementation planning, TMDL accounting, permitting, and other protection efforts. The **Alaska** Clean Water Action database is currently being enhanced to include the ability to track basic water body information and actions taken to protect or restore waters. In addition, the database will be used to prioritize waters for improvement measures. In **Oregon**, several watershed councils are in the process of developing databases to track water quality improvements and project effectiveness, but consistency among databases and long-term funding for data entry and maintenance are limiting factors.

3.4. Key Challenges

The states noted several key challenges in collecting data that will show progress toward meeting water quality standards for impaired watersheds. First, all of the states highlighted the lack of available funding and staffing to conduct the long-term data collection and analysis necessary to demonstrate improvements. In most cases, long-term data collection is provided through ambient monitoring programs. Therefore, tracking long-term effectiveness for an impairment that is not at an ambient monitoring station is relatively rare. In addition, several states noted that where long-term data exists, it is not necessarily at a scale that can detect localized improvements resulting from BMP implementation.

States want to utilize as much available data as possible, so they often try to integrate data from various sources within their agency, as well as from third parties. Several states noted that it is often difficult to integrate data from different sources due to inconsistencies in format. Many states have developed or are in the process of developing databases that require third party data to be entered in a format consistent with state data; however, oftentimes the state cannot require the use of this database and does not have the resources to convert the third party data to the correct format themselves. Coordination with third parties regarding the planning, prioritization, enforcement, and monitoring of implementation activities has also been a challenge for many of the states.

Although existing monitoring and assessment efforts could be modified to address the needs of an effectiveness monitoring program, this would require a fundamental reprioritization of long-standing monitoring programs at the state level. Challenges to reprioritizing current monitoring programs include:

- Relaxing current monitoring efforts may cause current program commitments to be missed;
- More focused or intensive monitoring in select locations, without relaxing existing ambient monitoring efforts, will take additional resources beyond what is currently dedicated; and
- Potential restrictions on the use of monitoring funds. Some funding sources have specific guidelines for using monitoring funds that are inconsistent with other program or reporting measure goals.

[8] http://dnr.wi.gov/org/water/swims/

4.0 STATE APPROACHES TO EVALUATING WATERSHED IMPROVEMENTS

4.1. Approaches for Evaluating Improvements

Many of the states look for long-term trends in data to evaluate improvements. In general, the states gage improvement of impaired water bodies by monitoring pollutants, rather than by evaluating the designated beneficial uses of the segment. **Alaska** conducts detailed follow-up monitoring on selected waters as individual projects. The follow-up determination may be based on numeric criteria or beneficial use support, depending on the specific impairment. The 303(d) listing and delisting process in **Iowa** focuses on segment/parameter-specific and segment/beneficial use evaluations.

In addition to reviewing water quality monitoring data, **Wyoming** evaluates effectiveness by examining changes in physical channel attributes, observable changes at permanent photo points, output from load reduction models for completed projects, and operation and maintenance information from project sponsors. **Wisconsin** is currently developing an assessment methodology to evaluate how biological and chemical parameters will be used to assess for watershed improvements.

4.2. Documenting Incremental Improvements

Several states document incremental improvements in water quality through progress reports; for example, **Alaska's** Integrated Report and **Virginia's** Annual TMDL Progress Report. **Iowa** presents interim progress through modeling, watershed improvement phase completion, public relations efforts, biennial Section 303(d) and 305(b) assessments, and their lake annual report. **Iowa** noted that reporting on incremental improvements is rare and it is difficult to document improvements without water quality data at a project scale. **Wisconsin** is exploring the use of biological responses and social/behavioral aspects to measure incremental improvements.

Other states, like **Oregon** and **North Carolina**, have not traditionally focused on documenting incremental improvements. Rather, the focus has been on whether or not water bodies are attaining water quality standards. **North Carolina** uses the same measures to determine both impairment and restoration (e.g., attainment of water quality standards); however, the state has found it difficult to determine how to measure "in between" and does not believe instream water quality chemical data are necessarily the best measure of incremental improvements. Historically, **Virginia** DEQ reported on interim progress due to the lack of full restoration examples to report. However, **Virginia** DEQ stopped reporting incremental success stories in response to EPA's uncertainty of the usefulness of reporting interim restoration information.

4.3. Determining When and How Strategies Should be Re-Evaluated

A few of the surveyed states have processes in place to re-evaluate TMDLs and other watershed restoration strategies. **North Carolina** re-evaluates a TMDL or restoration plan if the state determines that it has been fully implemented but water quality standards have not been attained. **Washington** uses a five-year rotating basin schedule to re-evaluate implementation measures and/or TMDL targets. Where full implementation has been accomplished (e.g., permit limit changes, all feasible BMPs, etc.) but does not seem to be adequate to meet standards, the TMDL may be revised. TMDLs and Watershed Protection Plans in **Texas** are evaluated periodically through on-going stakeholder-led and regulatory procedures. Decisions regarding "when and how" to revise Watershed Protection Plans are dependent upon circumstances in individual watersheds. Most of the plans in **Texas** are still in their early stages and have not yet been evaluated or re-evaluated to the degree that generalizations can be made.

Other states do not currently have a systematic approach to determine when and how restoration strategies should be re-evaluated. Because **Alaska** has limited resources and relatively few waters identified as impaired, impaired water bodies that do not have TMDLs or other water body recovery plans receive higher priority for

available resources. **Iowa** has typically not re-evaluated TMDLs due to limited staff and resources compared to the extensive list of TMDLs that have not yet been addressed. **Iowa's** diagnostic feasibility studies for lakes are sometimes re-evaluated. The need to re-evaluate is determined by examining if study information matches current conditions in the lake and/or watershed. If information from a given diagnostic study is not current enough to provide useful restoration alternatives or if data gaps exist, then the need for updating the study will be considered. For **Iowa**, local interest is also a strong driver of re-evaluating restoration strategies.

4.4. Key Challenges

Several key challenges to evaluating data for watershed improvements were noted by the states, including:

- Staffing limitations (number of staff and staff with appropriate expertise) is a challenge most states face in being able to sufficiently evaluate for watershed improvements.
- The challenge of coordinating with other agencies and third parties was also mentioned again.
- **Alaska** added the unique challenge of finding local laboratories near remote sampling locations to analyze collected samples.
- **Washington** noted that there is not enough systematic planning and documentation of implementation activities or restoration projects to determine progress.
- One of **Wisconsin's** key challenges is finalizing a definitive assessment methodology process.
- **Iowa** noted the difficulty of improving water quality given the influence of climatic factors and political externalities (e.g., changes in Farm Bill policy) that can negate water quality improvements gained from watershed improvement strategies.
- **Iowa** also listed the lack of adequate pre-project monitoring data and the time requirements to evaluate improvements as key challenges.

5.0 MEASURES USED BY THE STATES TO DEMONSTRATE EFFECTIVENESS

5.1. Strategic Planning Measures

Most of the interviewed states use a combination of national and state strategic planning measures to measure, track, and report on water quality improvements; many states attempt to correlate national measures with state measures where possible. For example, the State of **Wyoming's** strategic planning measures take into account national measures so that only one set of measures needs to be collected and reported. Their strategic planning process looks at pollutant/segment combinations on the state's Section 303(d) list of impaired waters as the universal population. Individual measures include approved watershed plans, watershed plans substantially implemented, removal from Category 5 [303(d) list], and watershed restoration (watershed restoration is the final measure).

Most of the interviewed states have state-specific planning and reporting measures. States reported that it isn't always feasible to correlate their own planning measures with national measures due to the different uses of the reported information (i.e., states have specific needs for their reporting measures). For example, the State of **Iowa** is required to report on the Water Quality Index[9] (WQI), which is directly reported to the Governor. **Iowa's** WQI is calculated using nine common water quality parameters (dissolved oxygen, *E. coli* bacteria, 5-day biological oxygen demand, total phosphorus, nitrate + nitrite as N, total detected pesticides, pH, total dissolved solids, and total suspended solids). Values range from 0 – 100 and streams are classified as very

[9] http://wqm.igsb.uiowa.edu/wqi/wqi.asp

poor (0-25), poor (25-50), fair (50-70), good (70-90), or excellent (90-100). WQIs are calculated on those streams monitored monthly as part of **Iowa's** Ambient Water Monitoring Program. Additionally, **Iowa** DNR evaluates the percentage of lakes that qualify as "good" based on watershed condition and water quality.[10]

The State of **Wisconsin** is beginning to use strategic planning measures developed by the **Wisconsin** DNR Impaired Waters Team to measure water quality improvements following implementation of TMDLs. **Wisconsin** DNR reported that EPA Region 5 and the Region 5 states have worked closely to develop a set of five shared environmental goals to enhance joint efforts to protect and restore valuable water resources and to measure accomplishments. The enumeration of measurable goals is a significant step in collectively defining the long-term vision for clean and safe water. The goals will be used to more comprehensively report on the progress in, and status of, improving water quality in the Great Lakes Region. The agreed upon shared environmental goals are:

- Goal 1: All waters in Region 5 will support healthy aquatic biological communities.
- Goal 2: All waters in Region 5 will support fish populations with safe levels of contaminants.
- Goal 3: Designated swimming waters in Region 5 will be swimmable.
- Goal 4: All people in Region 5 served by public water supplies will have water that is consistently safe to drink.
- Goal 5: The quantity and quality of critical aquatic habitat in Region 5, including wetlands, will be maintained or improved.

Several states reported using state strategic planning measures directed from the Governor's office to track progress in achieving water quality improvements. The State of **Texas** specifically measures surface water quality improvements to report on TCEQ's Strategic Plan Measures 01-01.05 ("Percent of **Texas** surface waters meeting or exceeding water quality standards") and 01–01–02.01 ("Number of surface water assessments").[11] The State of **Virginia** operates under a water quality strategic plan (the Chesapeake Bay and **Virginia** Waters Cleanup Plan[12]). As part of this plan, a consistent set of "measureable environmental outcomes" are reported on from year to year (i.e., updates in meeting the various measures are reported).

5.2. Selecting Watersheds for Effectiveness Reporting

Among the nine interviewed states, there is no common approach used to select candidate watersheds for measuring and reporting on water quality improvements. For example, **Virginia** does not use preset criteria for selecting specific watersheds; rather they report on all watersheds that have sufficient data to illustrate improving trends or attainment with water quality standards. **Wisconsin** selects candidate watersheds for reporting effectiveness measures where BMPs have been implemented and the potential exists for meeting water quality standards in the near future. **Oregon** uses Endangered Species Act listed salmon waters to identify target areas for reporting effectiveness measures. Candidate watersheds for reporting water quality improvement are chosen in **Wyoming** based on WDEQ staff familiarity with the watershed through nonpoint source water quality improvement project management, site tours, and departmental monitoring efforts. Other drivers for candidate watershed selection in **Wyoming** include input from project sponsors and stakeholders to confirm and recognize that their watershed has been restored. **Alaska** reported that public interest in a watershed may influence the resources dedicated to measuring for water quality improvements. **Alaska** also indicated that watersheds with the most complete information to answer questions on effectiveness and improvements are typically selected for reporting.

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[10] See Larscheid, J., M. Hawkins, J. Downing, D. Bonneau, and G. Antoniou. 2008. Iowa's Lake Program. Lakeline. Volume 28 (1), 24-29.

[11] TCEQ's Strategic Plan: http://www.tceq.state.tx.us/assets/public/comm_exec/pubs/sfr/035_05.pdf

[12] http://www.naturalresources.virginia.gov/Initiatives/WaterCleanupPlan/docs/ChesBayVaWatersCleanupPlan0107.pdf

Washington is the only state (of those interviewed) that appears to have a formal and structured process for selecting candidate watersheds in which TMDL effectiveness monitoring and reporting will occur. The 2-phase selection process includes WA DOE's scoping process and the Environmental Assessment Program's (EAP) annual project planning process. This scoping process involves the original TMDL developers, project managers, agency planners, TMDL/Watershed leaders, and local partnerships working together to determine which watersheds are ready for effectiveness monitoring. In the second phase, the EAP undertakes an annual project planning process to prioritize monitoring project requests from regional and headquarters staff, and watershed leaders statewide. The annual process leads to staff and laboratory funding allocation decisions and determines to a large degree which specific TMDLs, intensive studies, annual monitoring locations, etc. will be implemented the following year. As the projects are scoped, WA DOE includes monitoring that will inform as many decisions as possible regarding various performance measures from EPA and at the state level. The water bodies selected for reporting performance measures to EPA come from a variety of monitoring data sources, not just the effectiveness monitoring projects. When reporting for EPA performance measures, WA DOE starts with an investigation of all data sources that are associated with improvements in water quality that lead to a category upgrade. It is likely that most of the SP-12 measures will be from data derived from effectiveness monitoring projects; however, other sources of data may augment the watershed characterizations.

In **Texas**, impaired watersheds that have targeted water quality management programs developed under TMDLs and NPS programs are used for reporting effectiveness measures. **Texas** acknowledges that monitoring programs could be improved to make them more effective in supporting national performance measures, such as SP-12. The TCEQ will consider national performance measures in future planning for the statewide ambient monitoring program. **Texas** is also using an approach of giving funding priority to project proposals under a NPS program solicitation that will demonstrate water quality improvement or help facilitate restoration of water quality.

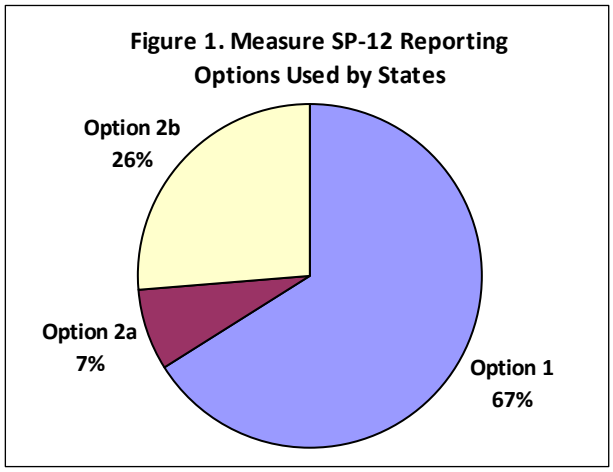
5.3. State Approaches to Monitoring and Other Measurement Methods for SP-12 Reporting

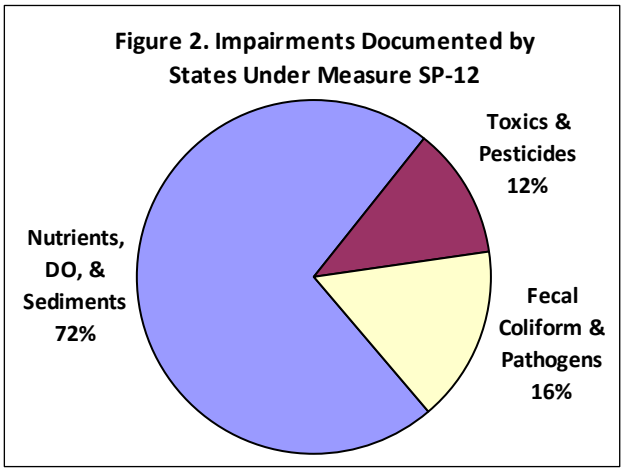
For a watershed to be counted under SP-12, states can use one of three options for demonstrating water quality improvement. Under Option 1, states must demonstrate improvement as the removal of one or more of the impairment causes identified in 2002 for at least 40 percent of the impaired water bodies or impaired miles/acres. Under Option 2a, states must use valid scientific information and statistical procedures to demonstrate that significant improvement has occurred with a 90 percent or greater level of confidence, where improvement is defined as a significant watershed-wide improvement in one or more water quality parameters associated with the impairments. Under Option 2b, states can use a multiple lines of evidence approach to demonstrate watershed improvement. A "multiple lines of evidence approach" means that the cumulative weight of several lines of evidence is used to assess whether a watershed-wide improvement has occurred. When asked which option they would be using for SP-12 reporting, the response from states was mixed, though more seem to be leaning toward the use of Option 1 because of its straightforwardness. Several states also identified Option 2b as favorable, as the multiple lines of evidence approach is perhaps the most flexible of the 3 options for demonstrating water quality improvement.

During this project, several of the states expressed concern about the lack of flexibility to report on interim progress under SP-12. Due to EPA's early definition of "restoration progress," many states do not realize that SP-12 actually does allow for showing interim progress even if segments are not delisted. This flexibility to report on interim progress for Measure SP-12 exists under Option 2. States are urged to discuss this in detail with their EPA Regional SP-12 Coordinators, as well as review the guidance on Measure SP-12.[13]

[13] http://www.epa.gov/water/waterplan/pamsfy08/def_wq08.html#sp12 & http://www.epa.gov/water/waterplan/documents/SP-12_Guidance_1-31-08.pdf

EPA Region 10 recently completed a survey of 68 SP-12 demonstrations submitted to EPA by 24 different states.[14] The majority of the SP-12 demonstrations were conducted using Option 1, followed by Option 2b, then 2a (Figure 1). For Option 2b, states often used biological and/or habitat data to document improving trends (e.g., Indices of Biological Integrity, Qualitative Habitat Evaluation Index, etc.). Of the 68 demonstrations submitted to EPA at the time of the survey, 72% of the demonstrations were for impairments related to nutrients, dissolved oxygen (DO), and sedimentation; 16 % for fecal coliform and pathogens; and 12% for toxics and pesticides (Figure 2).





Many of the interviewed states indicated that their current monitoring programs are not set-up to capture the data needed to fully address the reporting requirements of all national performance measures, including SP-12. For example, many of the target measures include a benchmark date of 2002, but the water bodies listed in 2002 may not be the state's highest priority to address. Most states need to use data collected primarily through their ambient monitoring programs or under 319 Program grant projects for SP-12 reporting. States are concerned that ambient monitoring data are not sufficient or appropriate to support SP-12 reporting, as the sample locations tend to be sites that do not necessarily indicate what is happening in the watershed. Historically, **Wisconsin** has used subjective data analysis in the spirit of a "weight of evidence" comparison to show that watershed conditions have improved. For example, if fish populations have returned to a water body after BMPs have been implemented, the water body may be considered to be restored. **Wisconsin** is working on a more objective, data-driven approach to evaluating post-implementation conditions and demonstrating improvements on both a water body segment and watershed scale.

A few states indicated that their current monitoring program will be sufficient in providing the data needed to report on EPA's various national performance measures, including SP-12. The State of **Wyoming** is hoping to develop a tracking tool for all 12-digit HUC basins in the state, which will identify all impaired reaches and pollutants within the HUC. As specific pollutants are mitigated or reaches are restored, that information will be included in SP-12 reporting.

Alaska has started to direct funding specifically to monitoring to support SP-12 reporting; however, the exact funding amount is difficult to quantify. One of the projects they are currently conducting has been expanded because it is an SP-12 watershed, though much of this monitoring would likely have occurred anyway on account of this being an impaired water body.

For the past two years, **Iowa** has directed EPA 319 funding to monitoring on new 319 watershed projects. The goal of this monitoring is to demonstrate load reductions in pollutants, but also to document the removal of impairments. Since the reporting of SP-12 is aimed at documenting the removal of impairments at the

[14] J. Carlin, personal communication, July 1, 2009

watershed level, this could be considered an act of directing funds at monitoring for SP-12 purposes. **Iowa** has not altered their ambient monitoring program to meet SP-12 reporting needs. Since most impairments were identified through routine ambient monitoring, they feel as though their existing monitoring program will be sufficient for SP-12 reporting, assuming they see changes in impairment status. However, as just noted, **Iowa** has added a new 319 monitoring component to their overall monitoring program specifically to capture improvements in 319-funded watersheds.

Neither **North Carolina** nor **Oregon** are directing funds specifically to monitoring for SP-12 reporting purposes, nor have they made modifications to their monitoring programs to gather information specifically for SP-12 reporting. Data used as part of SP-12 determinations in **North Carolina** comes from the same ambient monitoring network used to make the impairment determination in the first place. There may be situations in which additional sampling is conducted in a few locations; however, that additional sampling is performed using funds earmarked for special studies.

Texas' Surface Water Quality Monitoring Program currently includes routine quarterly monitoring to evaluate for attainment of water quality standards. The Monitoring Program is also responsible for coordinating monitoring resources and efforts to address SP-12 needs throughout the State. This is facilitated through river basin specific meetings with local, state and federal agencies convened prior to the start of each fiscal year. Special projects to collect water quality data to evaluate the success of management activities are planned by regional water quality entities when possible. **Texas** is beginning to make changes to their monitoring program to gather information specifically for SP-12 reporting. Starting with the next round of river basin specific meetings, SP-12 water bodies will be prioritized. To plan for monitoring in SP- 12 watersheds, Texas has developed implementation plans that include a monitoring component to evaluate for success.

Virginia is directing some funding toward monitoring to evaluate for improvements in general, as well as for SP-12 watersheds specifically. All monitoring, assessment, and TMDL development is implemented in **Virginia** with SP-12 (and other performance measures) in mind.

Washington is not directing funds specifically to monitoring for SP-12 reporting purposes; however, activities that provide information for SP-12 reporting among other objectives are funded. **Washington** is beginning to modify their approach to effectiveness monitoring to include sampling and data analysis to address SP-12 (HUC 12 watershed scale) metrics that are likely additional, different locations than the original TMDL segments.

Wisconsin does direct some funding to the evaluation of SP-12 waters; however, the exact funding amount is difficult to quantify. The following watersheds are currently being monitored or have been monitored in recent years specifically for SP-12 reporting: Adams Creek - LaCrosse County; Bass Lake - Marinette County; German Valley Creek - SW Dane County; Lake Superior - Allouez Bay; Little Hay River - Chippewa County; Otter Creek - Sheboygan County; Silver Lake - Manitowoc County; and Upper Sugar River - Dane County.

Wisconsin has not altered or expanded their monitoring programs to gather information specifically for SP-12 reporting; however, their current monitoring program includes a component to allow for "management evaluation" monitoring and the state directs a limited amount of funding to that component annually. The sampling design is case-specific and is intended to show whether or not on the ground management has resulted in environmental success.

Wyoming occasionally conducts monitoring specifically to addresses SP-12 reporting needs; however, monitoring is typically conducted through conservation districts, with some funding from Section 319 grants. **Wyoming** has not, however, made modifications to their monitoring programs to gather information specifically for SP-12 reporting.

6.0 FUTURE ASSISTANCE NEEDS IDENTIFIED BY THE STATES

Each state was asked to identify specific areas in which they would like future assistance in order to enhance their programs and processes for measuring, tracking, and reporting on watershed improvements. Each state's complete response is provided in Appendix C. The following list provides an overview of the common needs identified by the nine states.

- Secure, consistent source of funding to support the spatial and temporal intensity of water quality monitoring needed to measure for improvements; this includes funding to support laboratory analyses, monitoring staff, and staff needed to track, assess, and report the results of these efforts. Often, TMDL implementation and monitoring are funded with whatever funding remains after TMDL development. Monitoring is perceived as less productive in terms of restoring waters, but it is vital to assessing watershed improvement.
- Guidance or recommendations on which specific water quality indicators to use for measuring and assessing water quality improvements or effectiveness, including recommendations on ways to better utilize biological indicators for measuring improvements.
- Guidance, prepared in cooperation with states, on the development of protocols for measuring and quantifying interim progress for water quality improvements.
- Funding to support the development and maintenance of state-specific databases for tracking water quality effectiveness data. The databases should complement existing state databases and programs.
- Support in the development of state-specific centralized web-based self-reporting tools (or databases) to collect information on all water quality improvement activities statewide, regardless of funding source. Various individuals and groups would then be able to report on their restoration activities and efforts. Such a system could help State Water Programs to identify areas to conduct monitoring, as well as help to establish links between water quality improvements and restoration activities.
- Clarification on the specific target levels for making confident conclusions on attainment of water quality standards for reporting on SP-12. If comparability and consistency are objectives in the reporting of performance measures across state lines, then this should be also addressed by EPA. If each state and region is left to its own metrics or approaches on how to report on performance measures, then the data and conclusions will not be comparable from one state to the next.
- Funding to implement more citizen-based monitoring programs. Trained citizen monitors could be a useful resource for collecting data to capture improvements in water quality after BMPs or other actions have been implemented. Training and guidance would lead to trusted, experienced citizens collecting and recording valuable monitoring data.
- Funding or other support to ensure continued collection of stream discharge data through fixed USGS (or other) stream gages.
- Tracking of BMPs and other restoration activities funded by non-EPA Federal programs (e.g., Environmental Quality Incentives Program [EQIP] and the Conservation Reserve Enhancement Program [CREP] as authorized in the Farm Bill). Awareness about watershed restoration activities carried out by other agencies would allow state water programs to consider conducting monitoring in areas where the BMPs have been installed to track for water quality improvements.
- Greater flexibility to use Section 319 funds to conduct more monitoring to better report on progress toward meeting EPA's national performance measures. *It should be noted, that 319 funds can be used to conduct monitoring (see discussion in Section 2.2 regarding Ohio's use of 319 funding to pay for state staff to conduct restoration monitoring). Also, states have the discretion to include post-restoration monitoring as a requirement for obtaining 319 funding.*

7.0 RECOMMENDATIONS

The following are recommendations for the states on actions they can take that may improve upon their ability to measure and demonstrate water quality improvements and/or attainment of water quality standards for impaired watersheds, including Measure SP-12.

1. Utilize all potential sources of funding to support efforts to monitor water quality improvements.

First, states should explore all potential sources of EPA funding to support efforts to monitor water quality improvements, including programs funded to implement Sections 106, 208, 319, and 604(b) of the Clean Water Act. Second, states should explore non-EPA sources of funding to support efforts to monitor water quality improvements. They should look for opportunities to leverage other agencies' monitoring activities to help support efforts to monitor water quality improvements. Examples of non-EPA agencies and programs that may be able to help support efforts to monitor water quality improvements include the U.S. Department of Agriculture (e.g., Farm Bill), U.S. Geological Survey, U.S. Forest Service, and the National Shellfish Sanitation Program. Numerous state and local agencies and groups may also be able to provide assistance in carrying out effectiveness monitoring activities; examples include Departments of Health, Tribes, watershed groups, universities, etc.

2. More effectively target monitoring resources

Neither the federal government nor the states can afford to comprehensively monitor each and every water body segment in the nation. Therefore, states need to target monitoring resources more effectively on the basis of programmatic goals. Further, opportunities for combining existing monitoring and assessment efforts to address reporting needs for multiple performance measures should be explored. Elements of longstanding ambient monitoring programs could be reprioritized to better serve reporting measures (like SP-12), TMDL implementation goals, or other state goals, such as for delisting water bodies.

Most state water quality monitoring networks were designed at a time when detection and control of chemical pollutants from point sources was the top priority. While this method of monitoring is still needed to evaluate for impacts resulting from point sources of pollution, nonpoint source pollution is now a major cause of water quality impairment in our nation. State monitoring programs must adapt in order to meet the need for water quality data that reflect impacts due primarily to nonpoint sources of pollution. Also, additional types of data, including biological and physical data, are also needed to adequately evaluate existing water quality conditions, as well as future changes (e.g., improvements) in conditions.

Finally, states should also consider the appropriate timeframe for conducting water quality improvement monitoring. For example, water quality and biological monitoring data collected immediately following a channel restoration project for sediment impairments in McCoy Creek, Oregon showed higher sediment levels and lower macroinvertebrate scores (i.e., higher pollutant tolerant species). If the monitoring had been conducted several years after the restoration, data likely would have shown more favorable results. Even when the best designed watershed restoration projects are fully implemented, monitoring may not detect measurable improvements in water quality if sufficient time has not passed to account for the lag between watershed restoration and water body response.

State programs should review their programmatic goals and objectives and revise their current monitoring frameworks to meet those goals and objectives. Monitoring resources must be effectively targeted to efforts that will achieve key goals; for example, monitoring to evaluate for improvements in watersheds where restoration is well underway and sufficient time allowed for the water body to show a response. Better targeted monitoring will lead to better decision-making for environmental protection.

Better targeting of resources for monitoring can help states better identify priority problems and more quickly evaluate the effectiveness of implementation efforts and make adjustments. This could result in cost savings to the states.

3. Develop and implement effectiveness monitoring programs.

The goal of SP-12 reporting is to document improvements in water quality conditions in impaired watersheds; states have flexibility in how that documentation can be made (see Section 5.3). However, the majority of interviewed states indicated that current monitoring frameworks will not likely provide sufficient data needed to make determinations on improvements in water quality and progress toward water quality standards attainment. Therefore it is recommended that state monitoring programs be modified to not only better position themselves to report on Measure SP-12, but to be able to measure, track, and evaluate water quality improvements.

Most states developed ambient water quality monitoring programs primarily to capture data on water quality conditions at a very broad scale and to evaluate impacts from permitted point source discharges; very few states set up ambient monitoring networks to capture more localized water quality conditions. Further, with nonpoint source pollution considered a major cause of water quality impairment, states also need data that better reflect the effects of nonpoint source runoff on water quality. Currently, the majority of state ambient monitoring stations are located in large mainstem segments; however, a majority of nonpoint source impairments originate in smaller streams and subwatersheds. Finally, monitoring to assess for improvements in water quality is best conducted on a smaller scale. State monitoring programs need to be implemented at relevant geographic scales to better support a range of water quality management objectives and decision making, including the need to evaluate for improvements and make decisions on water body delistings.

In order to better equip themselves to report on Measure SP-12 and evaluate progress in restoring water quality in all impaired waters, it is recommended that states develop ***effectiveness monitoring programs*** designed specifically to: 1) adequately detect nonpoint source impairments, and 2) measure water quality improvements resulting from the implementation of BMPs and other restoration measures. This can be accomplished by expanding upon existing monitoring networks to include monitoring stations on targeted smaller streams. EPA's 1997 *Monitoring Guidance for Determining the Effectiveness of Nonpoint Source Controls* includes useful information on the development of effectiveness monitoring programs. The following is a brief summary of key principles for designing monitoring programs specifically to detect water quality improvements. States can refer to the guidance for more detailed information on specific monitoring approaches.

a) Monitoring Objectives. The goal of effectiveness monitoring is to document improvements in the water body that are a direct consequence of specific BMPs or other restoration and management activities. It is important to establish specific objectives for effectiveness monitoring. For example, if a water body is impaired for aquatic life use support due to sediment loading from bank erosion, the primary objective may be to measure restoration of the designated use; therefore, monitoring would include assessments of the benthic macroinvertebrate community. In cases where improvements in water quality are expected to occur over a longer period of time, it may be appropriate to include secondary effectiveness monitoring objectives in order to measure incremental improvements in water quality, such as changes in physical habitat or stream flow variability.

b) Monitoring Design. The design of an adequate effectiveness monitoring and assessment framework must take into consideration the spatial and temporal variability of nonpoint source loading. The following are key items to consider when designing an effectiveness monitoring program:

- Variability. The level of monitoring needed to assess the effectiveness of a BMP on improving water quality in a stream will be largely determined by the scale of the impairment sources. Streams impacted by multiple sources of pollution will require more samples, as well as greater effort to capture variability, as compared to streams impacted by a single, isolated impact that can be easily measured.

- Parameters. The monitoring objectives will drive the selection of parameters; chemical, physical, and biological indicators should all be considered. Primary measurements should provide data to determine whether or not BMP implementation has restored the designated use or improved water quality in the impaired water body. Secondary measures should provide data for assessing load reductions. Also, qualitative measures that document or describe improvements, such as before and after photographs, could be valuable, more subjective indicators of success. It is important to keep in mind that factors not related to BMP implementation could be the cause for change in water quality; therefore, in addition to measuring water quality, it is important to also monitor and record changes in the watershed's land use, precipitation patterns, and any other factors that may have an impact on water quality.

- Sampling Sites. Monitoring stations are typically selected using probabilistic, systematic sampling, or targeted designs. Targeted designs with selected sampling sites are most effective for evaluating the impact of BMPs on water quality in the water body (not to be confused with edge-of-field loading to the water body). Further, the use of "before and after" and "paired/nested" monitoring designs are common for effectiveness monitoring.

    - *Before and after study designs* are useful for assessing the effectiveness of BMPs to improve water quality in a water body or small basin. Monitoring is conducted in the water body for several years prior to the implementation of BMPs and for several years following the implementation of BMPs. Pre-BMP monitoring in the water body is required to establish the baseline data, which will then be used for statistical comparisons with post-BMP monitoring data collected in the water body. The success of before and after studies is dependent on the ability to control temporal variability (e.g., annual or seasonal variation in weather, flow variability, land use, etc.).

    - *Paired/nested study designs* are very useful for assessing the effectiveness of BMPs to improve water quality in a water body in a short period of time. In a paired watershed sampling design, at least two subwatersheds are monitored; one is a control or reference subwatershed and the other is the treatment subwatershed (i.e., where BMPs are implemented). It is essential that the two subwatersheds be as similar as possible (other than the presence of the BMP in the treatment watershed) in terms of geology, hydrology, rainfall patterns, vegetation types, land use, and other factors that may contribute uncertainty to the comparison.

- Frequency. Time should be spent determining the appropriate number of samples and the appropriate design for collecting samples needed to detect trends or differences in water quality. For example, studies intended to measure changes in sediment loading rates from streams with variable flows should employ flow-weighted sampling designs so that most of the sediment samples are collected during high flow periods when the magnitude of the loads and load variability are highest.

In addition to being able to better establish baseline water quality conditions and detect improvements in water quality, another key benefit to monitoring for effectiveness on a small scale is that it allows for assessments and evaluations to be completed more rapidly, as opposed to monitoring efforts at larger scales. Reducing the time associated with data assessments, in turn, fosters the use of a phased or adaptive management approach to implementing BMPs, which helps to ensure that money is spent wisely.

4. ***Establish biological assessment approaches and include biological and physical monitoring data in efforts to evaluate for and demonstrate water quality improvements.***

Most state monitoring networks were designed at a time when focus was on the detection and control of chemical pollutants in our waters. However, there is a growing recognition of the need for data on both biological and physical conditions in aquatic systems. State monitoring programs should aim to gather data and information that capture the varied and complex nature of the entire water body system; these include chemical, physical, *and* biological data. Water quality impairments are not just reflected in the chemistry of a water body. Water quality impairments are typically reflected in the biology and habitat of an aquatic ecosystem (e.g., population of organisms, species composition and diversity, physiological condition of the natural aquatic communities, etc.). This makes biological and physical monitoring data very effective for evaluating water quality improvements resulting from BMPs and restoration activities. Option 2 under Measure SP-12 allows states to demonstrate improvements as positive trends or changes in key parameters or indicators (of the impairment). This provides the states with flexibility to use biological or physical monitoring data to demonstrate improvements even in cases where the specific numeric water quality target/criterion has not yet been attained. Finally, the public generally understands biological indicators far more than chemical indicators, so the ability to present on the biological integrity of a water body may help to communicate updates on impairments and progress in restoring waters.

Most of the interviewed states collect some biological and physical data, such as fish habitat and vegetation indices; and spoke to the high value of these data. Though these data cannot be used to demonstrate compliance with numeric water quality standards, they can be used as part of a weight of evidence approach to show that narrative standards are being met (e.g., for aquatic life use); they can also serve as indicators of water quality and be used to measure and track incremental improvements in water quality. Traditional chemical data help identify the presence and sources of various contaminants, while biological and physical monitoring data provide a more direct reflection of the multiple stressors that may be adversely impacting an aquatic ecosystem. In addition, chemical monitoring provides a measurement that is valid only for the instance in time when the sample was collected, whereas biological monitoring data reflect the effects of the physical and chemical conditions to which the organisms were exposed over a period of time. It is recommended that states: 1) incorporate biological and physical monitoring into their monitoring frameworks, and 2) develop indices of biological integrity (IBIs) or other biological data analysis methods (e.g., RIVPAC models being used by states in Region 10) to support the interpretation of biological data and allow the data to be translated into useful information for water quality assessments.

The multi-metric IBI is a scientifically validated tool that uses 8-12 biological attributes (or metrics) that are sensitive to changes in biological integrity caused by human activities. Examples of the metrics include: taxa richness, community composition, trophic structure, reproductive function, tolerance to human disturbance, abundance, and condition. The IBI approach involves the comparison of what is found at the monitored site to what is expected using a regional baseline that reflects minimally impacted conditions (i.e., a reference site of comparable size and type in the same geographic region). Each metric in an IBI represents a quantifiable attribute of the biological assemblage that changes in a predictable way with varying levels of human influence. Ratings are assigned to each metric and summed to obtain the index score, which characterizes the biological integrity of the measured site. A high IBI score indicates the biological assemblage is similar to the minimally impacted (reference) site. A low IBI score indicates the biological assemblage is significantly different or degraded as compared to the regional reference sites.

5. ***Improve communication, coordination, and collaboration within the state and at the local level.***

   A. ***Within state programs.*** State staff in the NPS, monitoring, TMDL, 305(b) assessment, and 303(d) impairment programs should work more closely to plan and implement effectiveness monitoring and assessment studies. For example, states can schedule annual internal "watershed

improvement monitoring meetings" to review results from the past year's effectiveness monitoring efforts and to plan for the upcoming year's effectiveness monitoring efforts. Improved communication and closer cooperation will result in better planning and more effective use of the limited resources available for monitoring.

B. With stakeholders and local partners. A number of states mentioned the need to better coordinate and communicate with other agencies and groups on both monitoring and restoration efforts. States should coordinate annual "watershed improvement" meetings in watersheds where efforts are underway to restore water quality. These meetings would bring together staff from all of the agencies and groups involved with the restoration of the watershed, as well as the monitoring of the watershed. It would enable these groups to report on activities underway, review and evaluate monitoring data, and coordinate/plan for next steps in terms of both additional restoration activities and additional monitoring to better capture improvements (or declines) in water quality.

6. Establish state databases to track improvement monitoring data and information.

While discussion of databases was minimal during the interviews, it was apparent that the lack of ability to adequately evaluate water quality improvements and report on Measure SP-12 is in part due to the lack of ready access to all of the potential data that may be useful for water quality improvement determinations. Much of the information is contained in multiple databases, in paper files, or resides with other agencies and groups. It is recommended that states create a database specifically designed to support efforts to track, measure, and report on water quality improvements. This could take the form of a new database or could be an enhancement of an existing database. Further, states should provide a mechanism to also obtain data collected by other agencies and groups, perhaps via a web-based self-reporting tool as **North Carolina** suggested. Of course, any such tool would also need to include metadata standards such that the state can evaluate whether the self-reported data meet certain criteria, requirements, or needs.

While there are a number of national databases (e.g., STORET/WQX[15]) that could potentially be modified to support tracking needs for reporting on improvements in water quality, after interviewing each of the nine states, it became apparent that no one tool could be developed to address every state's unique program elements or state-specific reporting needs; therefore, it is recommended that each state create their own database that not only addresses needs for Measure SP-12 reporting, but also meets state-specific needs for tracking, measuring, and reporting on water quality improvements. Alternatively, EPA can work with States to develop a national database that is compatible with existing state databases, and which can be adapted to meet state-specific needs.

7. Update Consolidated Assessment and Listing Methodology (CALM) and include delisting criteria.

In 2002, EPA issued guidance that each state document the decision making processes used to assess water quality standards attainment. This document (referred to as a state's Consolidated Assessment and Listing Methodology or CALM) summarizes the state's assessment and listing methodology, including the types of data needed to support water quality decision making and how the data are to be used to support different water quality determinations. During this project, several states identified the need for guidance or clarification from EPA on the level of confidence needed to make a conclusion on

[15] STORET (short for STOrage and RETrieval) is a repository for water quality, biological, and physical data and is used by state environmental agencies, EPA and other federal agencies, universities, private citizens, and many others. The Water Quality Exchange (WQX) is a new framework that makes it easier for States, Tribes, and others to submit and share water quality monitoring data over the Internet; WQX will eventually replace STORET.

improvements in water quality, including interim progress. It is recommended that states revisit their CALMs (or develop one if one does not already exist) and expand upon them to include assessment methodologies for supporting delisting decisions, and not just listing decisions. Further, states should include discussion on the use of interim measures of progress for documenting incremental improvements in water quality. States should also include (in their CALMs) discussion about the type, quantity, and frequency of monitoring needed to support adequate assessments of waters for both listing and delisting (and for the range of different types of impairments). The states must clearly define uniform protocols for assessing waters for both impairment and water quality standards attainment; discrepancies in assessment approaches not only results in problems with listing decisions, but can also make it difficult to justify the delisting of waters once a state believes they are restored. Revitalizing their CALMs in these and other ways will significantly help the states with the assessment needed to report on Measure SP-12.

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8.0 APPENDIX A. EPA GUIDANCE FOR REPORTING WATERSHED IMPROVEMENT UNDER MEASURE SP-12 – FY 2009

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Guidance for Reporting Watershed Improvement under Measure SP-12 – FY 2009

Measure Text

By 2012, improve water quality conditions in 250 impaired watersheds nationwide using the watershed approach (cumulative). (2002 baseline: 0 watersheds improved of an estimated 4,767 impaired watersheds of focus having one or more water bodies impaired. The watershed boundaries for this measure are those established at the "12-digit" scale by the U.S. Geological Survey [USGS]. Watersheds at this scale average 22 square miles in size. "Improved" means that one or more of the impairment causes identified in 2002 are removed for at least 40 percent of the impaired water bodies or impaired miles/acres, or there is significant watershed-wide improvement, as demonstrated by valid scientific information, in one or more water quality parameters associated with the impairments.)

Type

Targeted Measure
Cumulative Measure

Who Reports in ACS

Regions

Introduction

This measure will establish and demonstrate a capacity for watershed-scale restoration and protection throughout the country using the "watershed approach." It is not designed to be a measure of what portion of the 12-digit watersheds in the country have improved or meet water quality standards. See below for a description of how the program will focus its attention on these watersheds.

Definitions

Watershed means (a) a watershed or hydrologic unit at the scale of 12-digit hydrologic unit codes, or HUC-12, as determined by the draft or final Watershed Boundary Dataset (WBD), or (b) a regionally defined hydrologic unit of appropriate scale. Option (b) is provided since some waters, such as coastal and estuary waters, fall outside the WBD, and may or may not be hydrologically definable at a scale comparable to inland HUC-12s. Although watersheds or hydrologic units at the 12-digit scale are technically termed "sub-watersheds" by USGS, the Strategic Plan will use the term "watershed" for simplicity.

An *impaired watershed* is a watershed containing one or more impaired water bodies.

Impaired water bodies are those identified by states and EPA in the 2002 universe (fixed base) for measure SP-10.

Watershed approach is a coordinating process for focusing on priority water resource problems that:

- Is focused on hydrologically defined areas,
- Involves key stakeholders,
- Uses an iterative planning or adaptive management process to address priority water resource goals, and
- Uses an integrated set of tools and programs.

Functionally, the watershed approach is a problem-solving tool for protecting water quality and aquatic resources. It recognizes that factors affecting the health of our nation's waters should be understood within their watershed context. It includes assessment of relevant watershed processes and socioeconomic factors, identification of priority issues and most promising corrective actions, involvement by affected parties throughout the process, and implementation at the required scale. See EPA's Web site at http://www.epa.gov/owow/watershed/approach.html for more information. Also, see Demonstrating Use of the Watershed Approach below.

The watershed approach can be applied at any appropriate scale, including scales smaller or larger than the HUC-12 watersheds described above. Thus, for this measure, one watershed effort could result in improvements in one or in many HUC-12 watersheds, depending on its scale. For consistency, however, all successes under this measure will be reported as numbers of HUC-12 watersheds.

Improved means either that:

- One or more of the waterbody/impairment causes identified in 2002 are removed, as reflected in EPA-approved state assessments, for at least 40% of the impaired water bodies or impaired stream miles/lake acres in the watershed (see Option 1 below); OR

- There is significant watershed-wide improvement, as demonstrated by valid scientific information, in one or more water quality parameters or related indicators associated with the impairments (see Options 2a and 2b below).

Watersheds of focus are watersheds in which Regions and states will be focusing application of the watershed approach to attain this measure. Regions and states have identified an estimated 4,767 watersheds of focus. Regions and states will maintain lists of the watersheds of focus. The watersheds of focus include watersheds that may be amenable to water quality improvement in the near term (five years), as well as watersheds where improvement may take much longer. In many cases, the time frame cannot be predicted without more information gathered for watershed planning. EPA envisions flexibility in identifying the watersheds of focus over time. EPA and the

states may add, change, or remove watersheds they are focusing on as new information becomes available or as resources are reallocated. The measure thus envisions "living" lists of watersheds.

Overview of Implementation

This guidance provides information needed for states and EPA to implement the measure. For a watershed to be counted under SP-12, the state and Region must demonstrate that the watershed approach was applied, and that water quality improved. Either Option 1, Option 2a, or Option 2b described below may be used for demonstrating water quality improvement.

Supporting information should be provided using the appropriate attached template. A separate template is available for each reporting option below (1, 2a, or 2b).

An individual watershed may be counted only once under this measure. That is, a watershed may be counted only when it initially meets the definition. Subsequent actions, such as having additional impairment causes removed or additional water quality parameters showing watershed-wide improvement, would not enable the watershed to be counted again in a subsequent reporting period.

Under some circumstances, water quality improvements may result in the same watershed being eligible for reporting under both measure SP-12 and measure WQ-10 (nonpoint source waters restored). Consult the detailed definitions for both measures to determine whether a particular watershed is eligible. See additional discussion under Optional Narratives below.

Demonstrating Use of the Watershed Approach

This measure requires a demonstration that the watershed approach was utilized and helped lead to the water quality improvement being recognized. One of the primary objectives of this measure is to demonstrate and model the watershed approach by linking the activities of key partners in a manner that results in sustainable watershed management and improved water quality at the watershed scale.

For the purposes of this measure, Regions will provide the following information to demonstrate that the watershed approach, as defined in the Definitions section above, was used to help achieve the water quality improvement reported:

- Information identifying the HUC-12 or regionally defined watershed(s) in which the watershed approach was applied.
- Information identifying key stakeholders involved. The number of key stakeholders is not important as long as they are connected to the watershed approach. Participation can be voluntary or as a result of regulatory efforts, and need not be limited to the watershed's geographic area.

- Information about the role of each key stakeholder in applying the watershed approach to achieve the water quality improvements reported. If this information is available in a detailed work plan, that portion of the work plan may be incorporated by reference.
- Information describing the watershed plan that was developed and how it was implemented to achieve the water quality improvements reported. Note that the watershed plan may be a comprehensive plan, for example, one that contains the nine elements of a NPS program watershed plan. It may also be a less rigorous planning or adaptive management approach that is scaled to address the problem(s) affecting waters within the watershed. This could include different planning approaches, ranging from formal agreements to informal meeting minutes. Whether comprehensive or limited, or formal or informal, the approach should clearly demonstrate problem identification and prioritization, stakeholder involvement, integrated application of the voluntary and regulatory tools and programs available to correct the problem, outcome objectives, and monitoring and assessment to gauge improvement and identify appropriate adjustments.
- Information about the restoration work – BMPs or other actions – that resulted in the watershed's improvement. The restoration work can take place within the improved watershed(s), or in a nearby watershed(s) affecting the water quality of the improved watershed(s). If no restoration activities occurred within the boundaries of the improved watershed, the Region must supply information in the template describing how restoration activities in nearby watersheds had an impact on the reported water quality improvement.

The above information need not be lengthy, but should provide the minimum detail needed for understanding by a general audience.

Guidance for Option 1 – Reporting Watershed Improvement Based on Impairment Removal

> *"Improved" means that one or more of the impairment causes identified in 2002 are removed for at least 40 percent of the impaired water bodies or impaired miles/acres*

Option 1, corresponding to the first definition of improvement under this measure, in italics above, is designed to track watershed improvements based on removal of waterbody/impairment causes in subsequent EPA-approved 303(d) lists and Integrated Reports. It is based on existing state reporting to EPA. It is perhaps the most rigorous of the three options.

Removal of an impairment cause for a waterbody in the 2002 baseline must be demonstrated in a post-2002 EPA-approved 303(d) list or Integrated Report. Further , the removal must be as a result of restoration activities. The following table shows how this relates to "Delisting Reasons" reported in the Assessment, TMDL Tracking, and Implementation System (ATTAINS).

Delisting Reason in ATTAINS	Can Removal of Impairment Cause Be Used in Reporting Under SP-12?
8. Applicable WQS attained; due to restoration activities	**YES**
9. Applicable WQS attained; due to change in WQS	No
10. Applicable WQS attained; according to new assessment method.	No
11. Applicable WQS attained; threatened water no longer threatened.	**POSSIBLY,** if Region has reason to believe restoration and/or protection activities played a significant role
12. Applicable WQS attained; reason for recovery unspecified.	**POSSIBLY**, if Region has reason to believe restoration activities played a significant role
13. Applicable WQS attained; original basis for listing was incorrect.	No
14. Data and/or information lacking to determine water quality status; original basis for listing was incorrect.	No

The Region must demonstrate that the removal of impairment causes meets the 40% threshold. That is, one or more of the waterbody impairment causes identified in 2002 are removed, as reflected in EPA-approved state assessments, <u>for at least 40% of the impaired water bodies or impaired stream miles/lake acres in the watershed</u>. A Region may report on the basis of either the <u>number</u> of waters or the <u>miles/acres</u> that those waters represent. The Region must provide the following information from EPA-approved state 303(d) lists or Integrated Reports:

- The baseline condition, i.e., the number (or miles/acres) of waters in the watershed listed in 2002; and

- The improved condition, i.e., the number (or miles/acres) of waters in the watershed for which one or more impairment causes are removed.

The following examples illustrate how a watershed could meet the 40% threshold under Option 1:

- A watershed has 5 segments listed as impaired for impairment cause A, none listed for impairment cause B. In 2008, 2 of the 5 are restored for A and removed from the 303(d) list. Thus, 2 out of 5 segments (40%) have an impairment cause removed.
- A watershed has 5 segments listed as impaired, 2 for A only, 1 for B only, and 2 for both A and B. In 2008, the B impairment was removed for the 2 segments listed for both A and B; all other segments remain on the list. Thus, 2 out of 5 segments (40%) have any cause removed.

The following example illustrates a watershed that would not meet the 40% threshold in Option 1:

- A watershed has 5 segments listed as impaired, 2 for A and 3 for B, no segments listed for both A and B. In 2008, 1 of the 2 segments listed for A is restored and removed from the 303(d) list; all other segments remain on the list. Thus, only 1 of 5 segments (20%) has any cause removed, so the watershed cannot be listed even though half of the A impairments have been removed.

Note that for the purposes of this measure we track changes against only the 2002 baseline condition. For example, if a waterbody impairment that was 303(d)-listed in 2002 is removed in a subsequent listing cycle for either of the two reasons above as a result of the watershed approach, it may be counted for this measure. In contrast, if an impairment that was originally 303(d)-listed after 2002 is removed in a subsequent listing cycle, it may not be counted for this measure. For example, if an impairment cause is initially identified in a particular waterbody in 2004 and subsequently restored in 2010, it cannot be counted for this measure. Similarly, a waterbody impairment initially listed for an impairment cause after 2002 does not count in the baseline when determining if the 40% threshold is achieved for improvement for that impairment cause in the watershed.

A watershed can be counted in ACS under Option 1 if the Region has approved the appropriate delisting actions for that watershed and agrees that the needed number of impairments have been removed. The impairment removals should also be counted in ACS under SP-11 (and SP-10 where applicable).

Guidance for Option 2 – Reporting Watershed-wide Improvement

> *Improved means there is significant watershed-wide improvement, as demonstrated by valid scientific information, in one or more water quality parameters associated with the impairments.*

Option 2, corresponding to the second definition of improvement under this measure, in italics above, provides an alternative reporting mechanism for demonstrating progress at the watershed scale. It is designed to use water quality monitoring data to track improvements occurring across the watershed that have not yet resulted in an impairment cause being removed. If multiple watersheds are reported as improving, monitoring data must be provided for each.

Watershed-wide means that the monitoring design is representative of spatial variability within each watershed appropriate to the water quality listing(s) within the watershed and the selected parameter(s), loadings or indices. Examples of monitoring designs that might be appropriate depending on the issue being addressed include statistically valid, watershed-scale results (e.g. census or probability-design), watershed outlet (pour point) monitoring to capture cumulative impacts, or spatially distributed sampling considered to be representative of the watershed by the State and Regional office. Documentation for the improvement would need to explain how the monitoring design is representative.

Valid scientific information means that information supporting watershed-wide improvements is based on objective, accepted monitoring and assessment approaches. The monitoring/assessment process includes adequate documentation of data, observations, and method of investigation sufficient to allow for independently reproducible results (such as information covered in quality assurance management plans). Data used in assessment are available either in an appropriate EPA database or other accessible formats (e.g., websites, published documents, technical memos, etc.)

To meet this second (Option 2) definition of improved, a watershed assessment must demonstrate evidence of a positive trend/change that accounts for a significant portion of the nonattainment gap for the key parameter(s)/indicator(s).

Parameters or related indicators refer to either:

- The specific parameters listed as causes of impairment on the 2002 303(d) list or Integrated Report. They are associated with waters that qualify under Categories 5, 4a, 4b, or 4c in the Integrated Report Guidance; or
- Parameters, loadings, and/or indices directly related to the designated use impairment (e.g., phosphorus loadings might be reduced to address a low dissolved oxygen listing).

One of the two following sub-options must be used to demonstrate watershed-wide improvement: using accepted statistical procedures, or evaluating and documenting multiple lines of evidence. The baseline for the trend or change may start as far back as 1992. The evidence must be supported by an analytical plan, and may be peer-reviewed within EPA.

Option 2a –Using statistical procedures to demonstrate that significant improvement has occurred with a 90 percent or greater level of confidence. For purposes of this measure, **"**statistical procedures" are those procedures capable of showing statistically significant change in the water quality parameters or related indicators (e.g., seasonal Kendall trend test, Wilcoxon sign rank). Supporting documentation should describe the environmental significance of any reported changes in water quality.

Option 2b – Using a multiple lines of evidence approach to demonstrate watershed improvement. A "multiple lines of evidence approach" means that the cumulative weight of several lines of evidence is used to assess whether a watershed-wide improvement has occurred. If, taken together, the amount and consistency of evidence are judged sufficient to indicate improvement, we will count this toward the measure. Evidence for Option 2b must include the following:

A. Evidence of an improving trend in a water quality parameter (physical or chemical) based on empirical data which may or may not be statistically significant (e.g., descriptive statistics) but nevertheless supports improvement[1].

AND at least one of the following three lines of evidence

B1. Evidence of an improving trend in a related biological indicator/index.
B2. Evidence of an improving trend in water quality based on predictive/ modeled data, with field level ground truthing.
B3. Evidence of widespread, significant load reductions.

AND

C. Evidence of widespread nonpoint source or point source implementation, or other evidence of watershed implementation actions.

AND

D. No evidence of significant deteriorating trends in related parameters as called for in the analytical plan. A lack of evidence (data) for other parameters identified in the analytical plan is not adequate to support this line of evidence.

To document watershed-wide improvement using the watershed approach, information must be made available to demonstrate how either Option 2a or 2b is met. If an improvement occurs in a parameter/indicator which the Region and State believe should be counted toward the measure but which differs somewhat from this guidance, an explanation must be provided in the documentation and agreed to by Headquarters.

Supporting documentation must also be provided to demonstrate that the improvement is watershed-wide, uses valid scientific information, and includes parameters or other indicators associated with the impairment (see definitions for these terms below). In addition, information provided must specifically identify:

- A clear written rationale that describes how a determination of improved water quality is supported – including the type, quality, and amount of

[1] For those impairments where a chemical or physical parameter is not relevant, such as invasive species, this line of evidence can be met by showing an improvement in the biological indicator. Information must accompany the documentation explaining why chemical/physical parameter(s) are not relevant and why the specific biological indicator was chosen.

environmental data, and decision criteria. The rationale must identify the specific parameters used to assess improvements, and must also describe the efforts made to locate and analyze any evidence of deteriorating trends in these or related parameters. Sufficient information must be provided to give readers an understanding of the approach used to assess data, but the level of detail may vary. Relevant information may be found in state-wide quality plans, standard operating procedures, project-specific quality assurance project plan, or other analogous forms. Other information may be written to describe how data were used or to document the analyses performed that demonstrate improved water quality.

- A description of the problem and the link to the impairment causes identified in 2002,
- Data used in the assessment, and
- The results which demonstrate improvement.

Results and documentation must be reviewed and accepted by the Regional office. The results and documentation for at least one submission from each Region will be reviewed by an EPA SP-12 Review Panel. The Panel will consist of at least two reviewers from Regions other than the reporting Region, and at least one reviewer from EPA Headquarters. The Panel will give particular attention to reports that use options 2a and 2b. Response to the review must accompany the documentation. The Review Panel will recommend whether to accept the watershed(s) to be counted, and may develop recommendations for improving the measure definition to ensure consistency. Regional consistency in reporting on the measure may also be ensured by periodic Headquarters audits of other submissions.

Templates

Supporting information for results reported under measure SP-12 must be provided using the appropriate template on the following pages. A separate template is available for each reporting option described above (1, 2a, or 2b).

Regions can count a watershed whenever they have made a clear determination that the watershed fully meets the measure definition under this guidance. When reporting results to ACS, the Region must provide the appropriate template as soon as possible, preferably by the time results are reported to ACS, but in no case any later than 45 days after entering results in ACS.

Headquarters will provide an electronic storage location for the templates. Currently this location is the EPA Portal at http://portal.epa.gov, using the Watershed Managers Forum project in the Environmental Science Connector (ESC). This location may change in the future. Headquarters prefers that the Region post the template (and optional narrative – see below) to the ESC site, and simultaneously notify Christopher Zabawa at Zabawa.Christopher@epa.gov by email.

Optional Narratives ("Success Stories")

Regional Offices may choose to develop narrative descriptions of the watershed improvements. Regions may choose any format for these narratives. For improvements that also satisfy the requirements for Measure WQ-10 (nonpoint source waters restored), the Region may choose to use the format required for WQ-10 success stories.

Information in the narrative does not need to be repeated in the template. That is, the template may refer to elements of the narrative and incorporate them by reference.

If a narrative is used, it must be provided with the template to the electronic storage location as described above.

Reporting of Water Quality Data (supporting Options 2a and 2b)

Any water quality data developed to support Options 2a or 2b should be provided in a timely fashion into EPA's STORET warehouse, using the WQX data transfer protocol, or otherwise be made available in a STORET-compatible format. Data used to support the measure for which WQX-templates are still under development should be provided in a timely fashion once the WQX templates are completed.

Supporting water quality data are not needed if results are reported under Option 1.

EPA's intention would be to make the evidence for Options 2a and 2b available publicly in some form. In the future, EPA anticipates that the Watershed Assessment, Tracking & Environmental ResultS (WATERS) system will provide access for much of the information/data needed to support this demonstration of watershed-wide improvement.

Future Measure Improvements

EPA intends to further improve this measure in succeeding strategic plans to refine and expand incremental measures of water quality "improvement" in watersheds, and possibly to reflect maintenance of water quality.

Contact for More Information

- Christopher Zabawa, EPA's Office of Wetlands, Oceans, and Watersheds, (202) 566-1222, Zabawa.christopher@epa.gov.

- Fred Leutner, EPA's Office of Science and Technology, (202) 566-0378, Leutner.fred@epa.gov.

TEMPLATE 1 October 2008

REPORTING WATERSHED IMPROVEMENT

Based on Impairment Removal (Option 1)

Watershed Identification

a	Organization	*Name and type of organization reporting for the watershed*
b	Point of Contact	*Name, title, address, telephone number and e-mail address of individual responsible for this report*
c	Project Title	*Short descriptive title, e.g., "Reducing bacterial contamination in the Long Creek watershed, Indiana"*
d	No.Watersheds Improved	*Number of watersheds achieving improvement, and associated HUC-12 codes*

Description of 2002 Baseline Condition

e	Watershed(s)	*Enter list of one or more 12-digit HUC watersheds. Note: if 12 digit HUCs are not delineated, describe the regionally-defined watershed(s) of appropriate scale.*
f	2002 Impairments	*Enter HUC, waterbody ID, and impairment cause*
		Enter HUC, waterbody ID, and impairment cause
		Enter HUC, waterbody ID, and impairment cause
		Additional lines as needed
g	Map (optional)	*Attach map(s) showing watershed(s) and impaired waterbodies*

Evidence of Watershed Approach

h	Area of Effort	*Describe geographic area - may be larger than the watershed(s) with documented improvement*
i	Key Stake-holders Involved and Their Roles	*Identify key partners responsible for planning and implementation. Describe each kay partner's role, or cite detailed work plan having this information..*
j	Watershed Plan	*Description of, or reference to, a watershed plan that identifies problems and proposes solutions to implement*
k	Restoration Work	*Describe BMPs or other actions taken to improve watershed condition. Should provide a clear, succinct summary in plain language understandable to the general public. Avoid technical terms without a plain language description or definition (or photo) that demonstrates the meaning.*

Evidence of Impairment Removal

l	Impairments Removed	*List waterbody IDs sufficient to demonstrate that one or more impairment causes identified in 2002 (see "e" above) have been removed from at least 40% of the impaired waterbodies or impaired miles/acres in the watershed. Include the date of the state WQ assessment that reported the impairment removal. Include the date of the IR or approved 303(d) list that reflects the removed waterbodies.*
m	Photos/Graphics (optional)	*Attach available photos or graphics, with captions, illustrating the local problem or project, and results.*

Refer to "Guidance on Reporting Watershed Improvement under Measure SP-12" for more complete descriptions of information requested in this template.

TEMPLATE 2a October 2008

REPORTING WATERSHED IMPROVEMENT

Based on Statistical Evidence of Watershed-wide Improvement (Option 2a)

Watershed Identification

a	Organization	*Name and type of organization reporting for the watershed*
b	Point of Contact	*Name, title, address, telephone number and e-mail address of individual responsible for this report*
c	Project Title	*Short descriptive title, e.g. "Reducing bacterial contamination in the Long Creek watershed, Indiana"*
d	No.Watersheds Improved	*Number of watersheds achieving improvement, and associated HUC-12 codes*

Description of 2002 Baseline Condition

e	Watershed(s)	*Enter list of one or more 12-digit HUC watersheds. Note: if 12 digit HUCs are not delineated, describe regionally-defined watershed(s) of appropriate scale.*
f	2002 Impairments	*Enter HUC, waterbody ID and impairment cause*
		Enter HUC, waterbody ID and impairment cause
		Enter HUC, waterbody ID and impairment cause
		Additional lines as needed
g	Map (optional)	*Attach map(s) showing watershed(s) and impaired waterbodies*

Evidence of Watershed Approach

h	Area of Effort	*Describe geographic area - may be larger than the watershed(s) with documented improvement*
i	Key Stake-holders Involved and Their Roles	*Identify key partners responsible for planning and implementation. Describe each key partner's role, or cite detailed work plan having this information..*
j	Watershed Plan	*Description of, or reference to, a watershed plan that identifies problems and proposes solutions to implement*
k	Restoration Work	*Describe BMPs or other actions taken to improve watershed condition. Should provide a clear, succinct summary in plain language understandable to the general public. Avoid technical terms without a plain language description or definition (or photo) that demonstrates the meaning.*

Evidence of Watershed-wide Improvement

l	Impairments Removed (if applicable)	*List waterbody IDs where one or more impairment causes identified in 2002 have been removed, if any. Include the date of the IR or approved 303(d) list that reflects the removed waterbodies.*
m	Statistical Results	*Summarize statistical analysis demonstrating that significant improvement has occurred in each improved watershed with a 90 percent or greater level of confidence. See guidance.*
n	Environmental Significance	*Relate statistical results to goals of the watershed plan*
o	Photos/Graphics (optional)	*Attach available photos or graphics, with captions, illustrating the local problem or project, and results.*

Refer to "Guidance on Reporting Watershed Improvement under Measure SP-12" for more complete descriptions of information requested in this template.

REPORTING WATERSHED IMPROVEMENT

Based on Multiple Evidence of Watershed-wide Improvement (Option 2b)

Watershed Identification

a	Organization	*Name and type of organization reporting for the watershed*
b	Point of Contact	*Name, title, address, telephone number and e-mail address of individual responsible for this report*
c	Project Title	*Short descriptive title, e.g. "Reducing bacterial contamination in the Long Creek watershed, Indiana"*
d	No.Watersheds Improved	*Number of watersheds achieving improvement, and associated HUC-12 codes*

Description of 2002 Baseline Condition

e	Watershed(s)	*Enter list of one or more 12-digit HUC watersheds. Note: if 12 digit HUCs are not delineated, describe regionally-defined watershed(s) of appropriate scale.*
f	2002 Impairments	*Enter HUC, waterbody ID and impairment cause*
		Enter HUC, waterbody ID and impairment cause
		Enter HUC, waterbody ID and impairment cause
		Additional lines as needed
g	Map (optional)	*Attach map(s) showing watershed(s) and impaired waterbodies*

Evidence of Watershed Approach

h	Area of Effort	*Describe geographic area - may be larger than the watershed(s) with documented improvement*
i	Kay Stake-holders Involved and Their Roles	*Identify key partners responsible for planning and implementation. Describe each key partner's role, or cite detailed work plan having this information..*
j	Watershed Plan	*Description of, or reference to, a watershed plan that identifies problems and proposes solutions to implement*
k	Restoration Work	*Describe BMPs or other actions taken to improve watershed condition. Should provide a clear, succinct summary in plain language understandable to the general public. Avoid technical terms without a plain language description or definition (or photo) that demonstrates the meaning.*

Evidence of Watershed-wide Improvement

l	Impairments Removed (If applicable)	*List waterbody IDs where one or more impairment causes identified in 2002 have been removed. Include the date of the IR or approved 303(d) list that reflects the removed waterbodies..*
m	Improving Trend in Water Quality	*Describe the physical or chemical trend in each improved watershed, based on empirical data which may or may not be statistically significant (e.g., descriptive statistics) but nevertheless supports improvement.*
n	Supporting Trends (one or more)	*1. Evidence of improving trend in related biological indicator/index* *2. Evidence of improving trend in water quality based on predictive/modeled data, with field level ground thruthing* *3. Evidence of widespread significant load reductions*
o	Evidence of implementation	*Evidence of widespread nonpoint source, point source, or other implementation actions*

p	No deteriorating trends	*No evidence of significant deteriorating trends in related parameters as called for in the analytical plan. A lack of evidence (data) for other parameters identified in the analytical plan is not adequate to support this line of evidence.*
q	Photos/Graphics (optional)	*Attach available photos or graphics, with captions, illustrating the local problem or project, and results.*

Refer to "Guidance on Reporting Watershed Improvement under Measure SP-12" for more complete descriptions of information requested in this template.

9.0 APPENDIX B. OVERVIEW OF INDIVIDUAL STATE ASSESSMENTS

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	OVERVIEW OF PROGRAMS			
	Key Programs to Measure/Track Watershed Effectiveness	**Funding/Staff Dedicated to Effectiveness Monitoring**	**Process for Tracking Watershed Effectiveness**	**Obstacles**
Alaska	Alaska Monitoring and Assessment Program (AKMAP) conducts surveys using probabilistic sampling in accordance with to EMAP protocols. Nonpoint Source Water Pollution Control Program collects data using both contract and grant funded external resources. Alaska's Environmental and Natural Resources Institute (ENRI) also collects biological data through a 319 grant.	Five FTEs manage the 319 program plus one more to report the data in the state's integrated report. Two to three FTEs collect data for AKMAP and additional staffing is provided by other agencies. Funding from 319 grants and contract resources is approx. $1.1 million for FY 2009.	Tracking is done on a site-specific basis in limited areas. Revising its tracking system (ACWA) to document the actions needed on a limited number of water bodies.	The amount of surface water in Alaska compared to the resources available. Monitoring programs must prioritize data collection efforts where human impacts and development activities are most likely.
Iowa	Ambient Water Quality Monitoring Network designed to characterize water quality conditions in watersheds, and identify differences in water quality upstream versus downstream of larger cities. Also performs TMDL monitoring, participates in Section 319 Nonpoint Source Program, ambient lake monitoring, and Lakes Restoration Programs. Some locally-led efforts.	Well staffed and well-funded. 25 FTEs work on IDNR projects, although they might not work on them full time. $2.9 million comes from state funds, and another $1 million available from other programs and funds.	Currently no ongoing programs specifically designed to track watershed effectiveness at a scale large enough to capture impacts of watershed improvement projects. Only waters that are routinely monitored have tracking data available for review.	Overall lack of funding, staffing, interagency cooperation and a strategy for sharing and communicating results, along with insufficient political commitment to watershed improvement are obstacles for IDNR. Lack of community interest and authority in controlling NPS pollution. Inability to implement TMDLs.
North Carolina	Ambient monitoring system, biological assessment unit, intensive surveys, selected Section 319 projects, NPDES Discharge Monitoring Coalition Program, and Ecosystem Enhancement Program.	Combination of federal grants, state appropriations, and NPDES permit fees, mitigation fees from highway and private development. Two DWQ FTEs oversee NPDES program and 5 FTEs support analysis and data evaluation.	Has a database to track assessment, restoration, and protection by assessment units and watersheds.	NC DWQ receives conflicting messages from EPA on monitoring priorities and has trouble prioritizing monitoring programs. NC DWQ is not the only agency carrying out efforts to measure and track water quality improvements, and there is no process or system to support communication.
Oregon	Ambient Monitoring Program monitors 151 sites regularly. The 319 Nonpoint Source and Oregon Watershed Enhancement Board grants provide program monitoring. The Environmental Monitoring and Assessment Program (EMAP) can provide statewide conditions of limited use to watershed monitoring.	3 to 3.5 FTEs responsible for collecting, analyzing, and evaluating data (to be reduced to 2 to 3 in 2009). Generally $1.5 million in funding received through grants for project work of which a portion goes to watershed monitoring, and other funds come from state lottery monies.	No program currently in place to track effectiveness monitoring data and information.	Lack of directed, long-term funding for monitoring (monitoring requires years of data to recognize improvements and change). Poor economy has led to significant declines in staffing. Lack of funding specifically for data analysis and lack of consistency in data entry, storage, archiving, and retrieval.
Texas	Surface Water Quality Monitoring (SWQM) Program conducts ambient assessments. Texas Clean Rivers Program (CRP) and partner agencies provide funding for statewide sampling programs. Nonpoint Source Program and TMDL Program conduct specific project monitoring to assess effectiveness of 319 and TMDL projects.	~$6.8M per year. ~190 FTEs.	Water quality conditions and trends in individual river basins are described every 5 years through Clean Rivers Basin Highlights and Reports and Basin Summary Reports.	Size of the state and abundance of water resources. Large population and rapid urbanization. Large commitment of resources needed to adequately monitor all of the water resources in the state.
Virginia	Virginia has many different agencies (VADEQ, VA DCR, VDH, and VA DMME) and thus, many different programs are tracking watershed effectiveness. Local agencies also receive grants and other funding sources to support effectiveness monitoring.	No personnel working solely on watershed effectiveness. Many agencies perform this function to some degree. Thus, VADEQ is not able to calculate how much of their resources goes into monitoring, analyzing, and evaluating data to measure and track watershed improvement.	Issues several annual reports that are used to report on TMDL progress.	Coordination efforts between multiple agencies that each have their own goals - "program fragmentation." Availability of financial resources.
Washington	Ambient Monitoring Program; Status and Trends Monitoring for watersheds; Environmental Monitoring and Assessment Program (EMAP); Water Quality Assessment; Wastewater Discharge; Nonpoint Source Pollution Planning; Water Cleanup (TMDL Program); TMDL Effectiveness Monitoring; Intensive Monitored Watershed for Salmon Recovery; Puget Sound Water Quality Management Planning; Ground Water Management Planning, Underground Injection Control Program; Family Forest Fish Passage program.	Majority of monitoring resources housed in Environmental Assessment Program (EAP) - 3 staff and $80K/year. Also has State General Funds (i.e., water quality permit fees) and Section 319 and 106 grants. Partnering with Counties and County Conservation Districts to share workload.	EAP Study Tracker database tracks studies that investigate effectiveness monitoring. EIM database for comparing numerical outputs to TMDL targets. WATS contains limited information on implementation activities and monitoring projects open to the public.	Large number of ongoing programs involve measurement and tracking of watershed effectiveness, but information is not managed within a single, integrated tracking tool. Current inadequate funding for effectiveness monitoring (shortfall of 7 FTEs and $150K).
Wisconsin	3 Tier Monitoring Program developed by WDNR: Tier 1 - Statewide Baseline Monitoring; Tier 2 - Targeted Evaluation Monitoring to determine cause/extent and develop management and restoration plans; Tier 3 - Management Effectiveness and Compliance.	Currently conducting a work planning analysis, but majority of staff and resources are used for Tier 1 sampling. Large Gap between monitoring goals for all three Tiers and available funding.	Watershed planning, impaired waters listings and delistings, Region 5 watershed assessment measures, and WATERS and SWIMS databases.	Funding has been stretched thin focusing on Tiers 1 & 2 with little funding available for Tier 3.
Wyoming	Section 319 program. Regular surface water monitoring at select locations through Section 106 funding. Section 604b planning and assistance projects. Wyoming Dept of Agriculture grants for monitoring.	Currently 7 FTEs and 3 seasonal interns collect surface water quality data and 4 FTEs are involved in project management. Funding primarily comes from Section 319, 106, and 604B funds. Other funding comes from the Wyoming Dept of Agriculture.	Tracking process is limited, unstructured, and relies on third party submittals. Database was created by the WDEQ for Section 319 for project sponsors to input data but data entry is inconsistent and difficult to direct into more meaningful spatial and temporal data.	Section 319 lacks follow-up assessment to determine effectiveness of BMP implementation. Staffing deficiencies. Third party monitoring data are questionable and not in a standardized format. Reluctance to utilize models to better understand data trends and predictors.

	DATA		
	Types of Data Used to Track Watershed Improvement	**Database Tools**	**Data/Information Collection Challenges**
Alaska	Generally, chemical data and physical/habitat data are collected. Occasionally biological data are used in support of chemical and physical data.	Requires collected data to be entered into the national STORET data warehouse. Currently revising a state-wide database known as the Alaska Clean Water Actions (ACWA) that tracks basic water body information and actions and to prioritize water for improvement measures to track watershed improvement information. ACWA is currently open only to Alaska state agencies.	Logistics and expense of monitoring in remote locations over large distances. Less common pollutant sources also provide challenges in determining effective BMPs for addressing impairments.
Iowa	Data for chemical, physical and biological parameters are collected through routine monitoring programs. Data collected include flow, biological, fish and macroinvertebrate data, ambient chemical, bacterial, and physical monitoring data, fish kill data, and fish tissue monitoring data.	Water quality monitoring data stored in the Iowa STORET database. Fish kill data in the Iowa fish kill database. Biological monitoring data in Iowa's biocriteria database. Collects volunteer monitoring data in the IOWATER database. Data in IDNR's 305(b)/303(d) assessment database and ADBNet. Additional data collected through the RASCAL stream assessment tool.	For some types of impairments, determination of water quality improvements needs additional or major refinements because no effective monitoring protocols or designs exist to measure effectiveness. Also, lack of citizens involvement, funding, staff, and interagency cooperation.
North Carolina	Chemical, physical, and biological data; and specifically focuses on macroinvertebrate and fish health data.	Access database - NC Watershed Restoration Assessment and Protection Super Structure (WRAPS) - to tracks water quality assessments, implementation, TMDL accounting, permitting and other protection efforts spatially by both assessment unit and watershed.	Satisfied with ability to track own activities and projects, but wants ability to collect and track information conducted by other entities.
Oregon	Parameter-specific chemical data and some limited biological data to assess watershed improvement (biomonitoring is seen as a direct measurement of beneficial use support and a key component in effectiveness monitoring). EMAP collects chemical, physical, and biological data on selected watersheds.	Water quality data stored in the Laboratory Analytical Storage and Retrieval (LASAR) database as data points only. Currently developing an online database that project partners can use to ensure consistency with LASAR.	Some watershed councils are in the process of developing databases to track effectiveness, but there is no consistency between them. Lack of funding and maintenance for long-term projects. Identifying staff time, appropriate collection methodologies and indicators, and coordinating efforts with other stakeholders.
Texas	Water chemistry, biological, sediment chemistry, fish tissue, toxicity, bacteria, flow, land use, and spatial data are some of the data used to assess water bodies.	Data input to the Surface Water Quality Management Information System (SWQM-IS). A publically available database, TXBad, is then used to created 305(b) reports for submittal to EPA.	Collecting long-term data to evaluate trends for certain water bodies. Lack of available staff to analyze data. Lack of programs to identify local improvements.
Virginia	Site-specific and state-wide level data along with probabilistic monitoring techniques, point sources, and BMP tracking and effectiveness. Works with the VDH to determine health of shellfish water and fisheries.	Several online databases used to track watershed effectiveness, TMDLs, monitoring, and assessment. Some also include mapping functions.	Lack of sufficient funding (short-term funding to meet long-term improvement goals). Lack of one single standardized system (e.g., database) for tracking/evaluation historic and new impaired segments.
Washington	Routine monitoring of physical and chemical indicators at 62 locations. Biological data are increasingly collected (would like to substitute biological monitoring for water quality parameters that are costly to measure). Would like to collect info on BMP implementation, cost, and success.	Process for tracking effectiveness monitoring data - EAP Study Tracker database, which includes logging the data into another database; EIM, whose outputs are available for comparing with TMDL targets and water quality criteria. Another database, WATS, contains limited information on implementation activities and monitoring projects.	Assessing whether water quality conditions are being met as a direct result of TMDL implementation activities. Need more information on BMP effectiveness and application to NPS, especially for the arid West states.
Wisconsin	Varies by site and includes water chemistry data, biological indicators, and qualitative data (e.g., observations, habitat, etc.). Collecting land use data and recording where BMPs have been installed to track and link management actions with water quality improvements.	Uses SWIMS database to manage chemical, biological and physical data. Uses WATERS database to track assessment and planning, watershed effectiveness monitoring data, SP-12 indicators and performance measures. Would like to expand tracking efforts into additional flow data, BMP actions, training, standardize sampling protocols/methods.	Competition for funding, reduced resources, lack of understanding of the cause of impairment, reticence of program managers to concentrate efforts on a particular watershed - broad ranging/general monitoring reduces funds for tracking improvements. Unrealistic expectations of public and legislature - who desire to see quick returns from funds spent on BMP implementation.
Wyoming	Biological, physical, and chemical indicators, along with permanent photo points.	Sediment, total nitrogen, and total phosphorus load reduction data are placed in EPA Grants Report and Tracking System (GRTS). Does not presently use a database tool to track watershed effectiveness monitoring data.	Collecting a sufficient amount of Post 319 project data to demonstrate an improvement in water quality and relying on data from third parties.

	EVALUATING WATERSHED IMPROVEMENT			EFFECTIVENESS MEASURES	
	Process for Evaluating Watershed Improvement	**Determining Effectiveness, Improvement, and Re-evaluating TMDLs and Other Watershed Improvement Plans**	**Key Challenges in Evaluating Improvement**	**State Measures Used for Watershed Effectiveness/WQ improvement**	**Application to Federal Measure SP-12**
Alaska	Focus is for improvement is on the specific cause of impairment for a water body segment. Detailed follow-up and evaluation is conducted on selected waters. Improvement may be determined by numeric criteria or beneficial use support.	Does not have a systematic approach to re-evaluating restoration strategies, but in general gives priority to water bodies that do not have TMDLs or recovery plans in place. TMDLs may be re-visited if significant new information becomes available that would change the loading analysis.	Communicating results with other state programs that collect water quality data, along with coordinating and communicating data collection efforts with federal agencies. Finding local laboratories with the capabilities to analyze samples.		Does not feel that current monitoring priorities fully address the requirement of Federal target measures such as SP-12 and WQ-10.
Iowa	Uses routine, ambient fixed monitoring and 319 data to evaluate for water quality improvements.	Uses social values to qualitatively evaluate watershed improvement. For monitored waters, the ambient monitoring network provides IDNR with sufficient data to determine water quality trends. Presents incremental improvements through modeling, watershed improvement completion, public relations efforts, and lake annual report.	Difficulty in improving water quality; time required to evaluate improvements; lack of adequate pre-project monitoring data; lack of funding; insufficient staffing, lack of interagency cooperation; lack of numeric water quality criteria for certain pollutants.	IDNR required to report on the Water Quality Index. Also, reports on water bodies that come off of 303(d) list, and evaluates percentages of lakes that are 'good'.	Believes existing state strategies are effective at meeting SP-12. Would like authority to use Section 319 funds to conduct more monitoring to better report on progress towards meeting EPA targets.
North Carolina	Water quality improvement and impairment are assessed by attainment of WQS performed on an assessment unit/pollutant basis. Has not traditionally focused effort on documenting improvements detected in water quality but hopes to begin identifying incremental improvements.	Re-evaluates a TMDL or other restoration plan if determined it has been implemented but WQS are not attained.	Lack of ability to measure and document incremental improvements since measures used to determine impairment and restoration are the same. Does not believe chemical data are the best measure of incremental improvements.		Will likely use Option 1 for SP-12 reporting due to its straightforward approach.
Oregon	Uses parameter-specific monitoring. Ambient monitoring program provides one set of data collected within their basin; and local watershed councils track certain information but there is no formal process.	No consistent determination for effectiveness relative to resource benefits.	Identifying funding and staff; identifying appropriate evaluation mechanisms; and coordinating with other agencies and stakeholders.		Some of the data collected by ODEQ could be used to support option 2A or 2B under SP-12, but ambient monitoring program sampling location data are from integrator sites that do not necessarily reflect what happens in the watershed.
Texas	Uses a segment-based assessment unit and parameter-specific approach to evaluating water quality conditions. Positive trends in water quality, improved instream and watershed conditions, and reduced constituent loadings are used where possible.	Specific water quality analyses programs identify positive trend in water quality improvements and watershed project effectiveness. TMDLs and watershed protection plans are evaluated periodically through on-going stakeholder-led and regulatory procedures.		Surface water quality improvements are based on output measures 01-01.05 and 01-01-02.01 in TCEQ's Strategic Plan.	Current monitoring programs do not effectively support federal performance measures. Will consider federal performance measures in the future when planning the statewide ambient monitoring program.
Virginia	Evaluates improvements through follow-up monitoring to collect data for trend analysis (data comparisons are made to water quality criteria). Works with local stakeholders to confirm recommended practices (from the IP) are occurring, including number of BMPs installed.	Documents incremental improvements in annual progress reports and on the TMDL web page. Currently looking for new ways to show effectiveness of actions on improving water quality (e.g., permits, BMPs, etc.).	Lack of funding to support adequate water quality monitoring to evaluate changes. EPA support of incremental progress/success stories rather than focusing on delisting success only.	Makes efforts to be consistent with EPA and state strategic planning measures for water quality improvements. Report on all watersheds that have sufficient data to illustrate improving trends or attainment of WQS.	Governor requires VADEQ to report on measures that fulfill the Federal targets. Intends to use Option 2b, because of its objective approach using multiple lines of evidence to demonstrate watershed improvement.
Washington	Effectiveness and improvement focuses on parameter/stream segment combinations. Looks at long-term trends in data from monitoring projects compiled in the EIM; also conducts follow up monitoring.	Five-year rotating basin schedule is used to re-evaluate implementation measures and/or TMDL targets.	Not enough systematic planning and documentation of implementation activities or restoration projects to determine progress towards meeting WQS. Biological measures are also not routinely used and thus only partial water quality conditions are assessed.	Attempts to correlate state measures with federal ones are made wherever possible.	Two watersheds may potentially meet the 40% threshold under Option 1 under SP-12.
Wisconsin	Based on qualitative assessment of water quality and an effort to install BMPs in one area to monitor a water body for physical and chemical parameters. Is developing an assessment strategy to evaluate how biological and chemical parameters will be used on an individual basis.	Using chemical, biological data, and professional judgment to determine if water bodies meet designated use. Developing guidance on how this is evaluated/determined in the Impaired Waters Program and Wisconsin's Assessment Methodology. Exploring use of biological responses and social/behavioral aspects to measure incremental improvements.	Lack of a definitive Assessment Methodology; EPA's policy on independent application of water quality assessment approaches; and the amount of monitoring required for water bodies to characterize the central tendency of measurements amidst strong natural variations in water quality in many water bodies.	EPA Region 5 states share 5 environmental goals: support healthy aquatic biological communities, support fish populations with safe contaminant levels, swimmable waters, served by safe public drinking water, critical habitat will be maintained or improved.	Currently uses subjective "weight of evidence" comparisons to show watershed improvement, which may be useful for meeting federal target measures such as SP-12 (Option 2). Completion of the State's Assessment Methodology will provide a more objective (data supported) approach that will match SP-12 options 1 and 2b to evaluate post-implementation.
Wyoming	Tracking changes in bioassessment metrics, changes in the physical survey data, changes in physical attributes of the channel, changes in overall pollutant loads, and observable changes at permanent photo point locations.	Evaluates effectiveness by reviewing water quality improvement monitoring data and follow-up data from long-term monitoring projects for select watersheds, output from load reduction models for completed projects, performing site visits, and O&M information from project sponsors.	Staff time limitations; inability to obtain all data quickly in a consistent format; and need for training in modeling and model development to demonstrate the value of such tools.	State measures same as national measures so that only one set of data to be collected and reported. Individual measures include watershed plans, substantially implemented, 303d delisting and watershed restoration.	Program protocols, staff training, and staff experience are sufficient to address SP-12; however, staff resources are insufficient to fully address target measures. State wants to develop a tracking tool for all 12-digit HUCs to ID reaches and pollutants listed in the HUC. WQEQ has not decided on using Option 1, or 2 for reporting SP-12.

	COMMUNICATION		FUTURE ASSISTANCE REQUESTED
	How is Improvement Reported	Impacts of Reporting to Public	
Alaska	Improvement reported to the public through the biennial Integrated Report. Separate fact sheets or press releases may be developed for highly visible water bodies.	The effects have largely depended on the water body and restrictions imposed on it.	Assistance with data management and analysis in order to compile and analyze data from multiple projects and assess waters on a regional basis. TMDL implementation tracking tools. More flexibility to focus on issues that cause impairments in Alaska.
Iowa	Required to report to EPA, Iowa legislature, and governor. Communicates through Lake Restoration Annual Report, Annual Success Story Publication, 305(b) Report, Annual Water Monitoring Conference, Fact Sheets, News Releases, Website, public events, "Iowa Outdoors" magazine, State Fair, Farm Progress Show, and presentation booths.	Increased awareness, recreational use, and amount of funding made available for certain projects. Currently developing a formal plan to publicize successes locally and state-wide and track effectiveness of outreach efforts.	To track, measure and report on watershed effectiveness and water quality improvements, IDNR would like additional funding, improvement of EPA databases, guidance on trend analysis and protocol development, and a Farm Bill policy that considers water quality effects.
North Carolina	Improvements in water quality communicated to the public through the state's Integrated Report, basin plans, and 319 Program annual reports.	Growing local interest and an increase in number and quality of 319 Program grant applications. Demand for 319 grants has exceeded funding; DWQ selects proposed projects that are most likely to result in WQ improvements.	A way to collect additional data and information, such as a contractor-developed web-based self-supporting tool to collect information on all water quality improvement activities, along with aerial photos and imagery.
Oregon	Water quality improvement results reported in technical reports posted to the ODEQ website. ODEQ is required to provide information to OWEB and EPA as a part of the 319 nonpoint source program and to the NOAA Fisheries services for making decisions about management of threatened and endangered fish stocks.	Increased awareness of water quality issues and increased interest in participation.	Assistance from EPA to better utilize biological indicators for measuring improvement, to develop basin-scale monitoring by land use, to secure consistent, long-term funding, and to provide the ability to report interim effectiveness.
Texas	Improvements reported through web sites and print media. 305(b) and 303(d) reports published on the TCEQ web site and the CRP publishes print and web Basin Highlights Reports. TMDL program publishes a biennial report on the status of TMDLs in the state.		Additional resources needed to enhance existing efforts in program planning and development. Stormwater monitoring and data analysis protocols are needed in order to standardize the procedures and facilitate statistical analysis. Additional flexibility in the use of federal grant funds and standardization of approaches to managing and analyzing data across state programs are also wanted.
Virginia	Improvements reported to the public through press releases, 305(b)/303(d) Integrated Report, TMDL progress reports, NPS Program Reports, and via VADEQ's TMDL web page.	Helped to increase stakeholder interest and involvement; as a result many organizations have taken ownership of their watersheds without regulatory intervention.	To improve coordination among agencies and focus on NPS issues. EPA should focus more on TMDL implementation, provide a TMDL implementation tool for NPS pollutant sources, and provide greater flexibility to address certain impairments.
Washington	Well-developed public website used to communicate monitoring program and effectiveness data to the general public, academia, scientists, and consulting firms. Studies, reports, and specific data can be found on this site. WA DOE also sends data and studies to specific groups.	Noted increased awareness; over 10,000 web site visits in 2008.	More information on BMP implementation, cost, and effectiveness. Federal target measures lack specific target levels for the confidence that is ascribed to concluding attainment of water quality standards.
Wisconsin	WDNR web site includes success stories and provides tools for the public to review information on water bodies (e.g., Surface Water Data Viewer). Press releases, WDNR Natural Resources Magazine, and fact sheets are also available to the public.	Does not have an effective tool to gauge the impact reporting watershed improvement has had on the public.	Funding for water quality planners, biologists, technical support, GIS map development, pilot programs, support for the nonpoint source program, the WI Buffer Initiative, the stormwater program, a Citizen Based Monitoring Program, tracking of federal programs, and outreach.
Wyoming	Improvements reported to the public through Wyoming Association of Conservation District annual water quality improvement report. Current staff resources are not sufficient to report 'success stories'. Hopes to use SP-12 documents as the basis for poster and newsletter presentations to the public.	Unknown - no noticeable increase in demand for Section 319 funds or increase in volunteers or public contact. Notable public comments show impatience for seeing restoration effects - less enthusiasm for additional monitoring.	Better technical support with databases (e.g., NHD and EPA assessment database) to allow better characterization of 12-digit HUCs/mapping reach links and make assessment and reporting easier.

10.0 APPENDIX C. INDIVIDUAL STATE ASSESSMENTS

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10.1. Alaska

10.1.1. *Overview of Current Programs*

The Water Division of the Alaska Department of Environmental Conservation (ADEC) has two programs that collect data and information used to track water quality improvements: the Alaska Monitoring and Assessment Program (AKMAP) and the Nonpoint Source Water Pollution Control Program. AKMAP conducts regional freshwater and coastal surveys using probabilistic sampling in accordance with national Environmental Monitoring and Assessment Program (EMAP) protocols. The Nonpoint Source Water Pollution Control Program collects data from selected water bodies or watersheds using both contract and grant funded external resources. Other programs within ADEC (e.g., the Contaminated Sites and BEACH Grant Programs) also collect some data that relate to water quality improvements. In addition, the University of Alaska's Environmental and Natural Resources Institute (ENRI) collects biological data through a 319 grant, primarily on salmon habitat streams. ADEC has been working with ENRI to develop standardized protocols and regional indices. This information will be crucial if Alaska pursues biological criteria as part of its water quality standards in the future.

Five full time staff equivalents (FTEs) manage the state 319 program with data collection and analysis included in their responsibilities. An additional FTE assists in the reporting of data in the State's Integrated Report.[16] Two to three FTEs collect data for AKMAP and additional staffing is provided by other agencies, including University of Alaska, EPA, NOAA, and USGS. Some volunteer monitoring is occurring, however with little oversight and coordination with ADEC.

FY09 funding for 319 grants and contract resources, which include data collection as a component of the work, is approximately $1.1 million. The AKMAP monitoring budget is between $600K and $1.8 million per year, depending on the number of regional survey projects in progress. Alaska Department of Fish and Game (ADF&G) has been providing $50K toward these grant programs. For FY09, Alaska Department of Natural Resources (ADNR) is providing approximately $100K. The US Fish and Wildlife Service conduct some water quality projects in the state and also conduct stream restoration activities. For FY09, Minerals Management Service provided between $1.4 and $1.6 million to AKMAP for a 2-year Chukchi Sea survey.

Tracking effectiveness monitoring data and information on water quality improvements is largely done on a site-specific basis in limited areas. ADEC is developing a water management tool to document the actions needed on a limited number of water bodies (largely those that have impairments). This tool is currently in use by ADEC, ADF&G, and ADNR. ADEC hopes to make some of the data available to the general public over the next year.

Alaska contains half of the nation's surface water. The state has over 365,000 miles of rivers and streams, 3 million lakes larger than 20 acres, and 44,226 miles of coastal shoreline (more than the entire continental United States). Of the state's 3,000-plus rivers, less than one percent are listed on the Alaska 303(d) list of impaired waters, largely because so many of the state's water bodies have not been assessed due to lack of data (and resources to collect the necessary data). The sheer magnitude of the task to monitor the quality of all these water resources, compounded by the fact that many areas are inaccessible, is probably the largest obstacle to the state's watershed improvement monitoring program. The funding available for water quality monitoring in Alaska always falls far short of the amount that is necessary to match the density of information collected in other states. The monitoring programs in Alaska must prioritize data collection efforts in waters or regions where human impacts and development activities are most likely to occur in the present and near future.

[16] Available at: http://www.dec.state.ak.us/water/wqsar/water body/integratedreport.htm

10.1.2. *Available Data*

Monitoring is conducted to detect both improvements toward and full attainment of water quality standards. Due to its stretched resources, ADEC currently focuses greater efforts on watershed protection and less on restoration and improvement monitoring. However, ADEC will collect data and track restoration and improvement in watersheds where acute impacts are being seen. The type of monitoring largely depends on the specific issues at a given location. Generally, chemical data are collected and physical/habitat data are also frequently obtained. Biological data are collected only for specific projects in regions where biological indicators have been developed. For example, biological monitoring is conducted to assess habitat issues in areas with large salmon populations. Currently, biological data are used as an assessment tool to supplement chemical and physical data assessments, but not enough data have been collected to develop biological criteria. ADEC generally uses professional contractors to conduct sampling and analysis. Partnerships with non-profit and volunteer monitoring groups are used to conduct screening level monitoring and then the state follows up with more detailed monitoring and/or other actions.

ADEC does not have an independent state-wide database to track data and information. ADEC is considering abandoning their "local" STORET database and requiring collected data to be entered directly into the national STORET data warehouse; however, they also recognize the need for some sort of state database or tool for data storage to track data and information. In addition, ADEC is also in the process of modifying its state-wide database, known as the Alaska Clean Water Actions (ACWA) database, to track basic water body information and actions taken to protect or restore waters. ACWA is also used to prioritize waters for improvement measures and funding. This database is currently open only to Alaska state agencies. ADEC would eventually like to have a comprehensive GIS-based system that can incorporate data (quality/quantity/habitat) from a range of sources and include both the activities occurring and specific sampling data.

According to ADEC, the greatest challenges they face related to collecting data to show progress toward meeting water quality standards are the logistics and expense of monitoring in remote locations over large distances. Another related challenge is obtaining a reasonable level of funding. Because of the limitations on data collection, Alaska does not have long records of data, which makes evaluating trends and improvements difficult. Finally, Alaska's predominant watershed impairments are less common in the contiguous 48 states. For example, a common historical impairment for Alaska has been residues, which include debris and trash that accumulates within the snow and ice and becomes a loading issue in some developed and populated areas during the spring melt. Other impairment issues, also less common to the contiguous states, include petroleum, log bark, and seafood waste. Because these pollutant sources are less common to the other states, there is far less empirical data and information to pull from for establishing effective restoration strategies and BMPs for these impairments. In the case of petroleum, Alaska's water quality standard is much different than the standards in other states.

10.1.3. *Evaluating Watershed Improvement*

Generally, Alaska focuses on the specific cause of impairment for a segment to evaluate improvement of impaired water bodies. Detailed follow-up monitoring is conducted on selected waters as individual projects. These projects have an evaluation component that includes the analysis of data for water quality improvements and making recommendations for future sampling efforts or other work within the watershed to improve water quality. The follow-up determination of whether water quality has improved may be based on numeric criteria or beneficial use support, depending on the specific impairment.

Alaska documents incremental improvement in impaired watersheds in their Integrated Report, which provides detailed documentation on the status of water body restoration progress (for all impaired water bodies – Categories 4 & 5). ADEC believes that these reports contain more water body specific detail about the status of actions than other similar state reports.

Because Alaska has limited resources and relatively few waters identified as impaired, the state does not have a systematic approach to re-evaluating restoration strategies. In general, impaired water bodies that do not have TMDLs or other water body recovery plans receive higher priority for available resources. For waters that have a TMDL in place, that TMDL may be re-visited if significant new information becomes available that would change the loading analysis. The burden of proof falls to a permittee to demonstrate that a TMDL needs to be re-opened. To-date, ADEC has not re-opened any completed TMDLs.

ADEC feels that one of the biggest challenges they face in evaluating data to show water quality improvement is sharing and communicating results with other state programs that collect water quality data. The same challenge exists with coordinating and communicating data collection and evaluation with Federal agencies. Another challenge has been finding local laboratories with the capabilities and expertise to analyze the samples to the detection limits needed for certain parameters. Alaska often sends samples out of state for analysis and holding times have been an issue for sample analysis, particularly for bacteria analysis, which has a 6-hour maximum holding time. Laboratories may be several hundred miles away from the sampling site, making it difficult to meet holding time requirements.

10.1.4. *Effectiveness Measures*

ADEC works closely with EPA Region 10 for assistance in keeping up to date on tools, resources, and ideas for measuring water quality improvements. ADEC prioritizes watersheds on an annual basis for actions needed to address water quality, water quantity, and habitat concerns. Public interest in a watershed may also influence the resources dedicated to monitoring for water quality improvements. Watersheds with the most complete information to answer questions on effectiveness and improvements are selected for reporting.

ADEC does not feel that Alaska's monitoring strategies fully address the requirements of national performance measures such as SP-12. For example, many of the target measures include a benchmark date of 2002, but the water bodies listed in 2002 may not be the state's highest priority to address. ADEC feels that some of the waters that the state has recently listed, such as the Kenai River, would be more appropriate for SP-12 reporting except for the fact that they were listed after 2002. ADEC is currently working with EPA Region 10 to identify which water bodies to report under SP-12.

Alaska has started to direct funding specifically to monitoring to support SP-12 reporting; however, the exact funding amount is difficult to quantify. One of the projects they are currently conducting has been expanded because it is an SP-12 watershed, though much of this monitoring work likely would have occurred anyway because it is an impaired water body.

10.1.5. *Communication*

ADEC communicates the status of Alaska's waters to the public in the biennial Integrated Report. For high visibility water bodies, separate fact sheets or press releases may be developed. ADEC staff also participate in, report to, and sometimes fund local or regional stakeholder groups. The effect of reporting watershed improvements to the public has largely depended on the water body and what restrictions were imposed to accomplish the improvement.

ADEC is required to report to the State Legislature on performance measures regarding impaired waters. Performance measures include the total number of polluted waters, the number of newly restored waters and new polluted waters (based on the Integrated Report), and the percentage of polluted waters for which ADEC has active restoration projects in place. Though not required, ADEC, ADF&G, and ADNR discuss progress and share information and actions needed on water bodies.

10.1.6. *Case Study*

Swan Lake, a widely-used recreational area, is located on the west coast of Baranof Island in southeast Alaska's Alexander Archipelago. Swan Lake and its main tributary, Wrinkleneck Creek, were placed on Alaska's impaired water body list due to impairment from debris, solid waste, metals, and plastics.

In 2000, ADEC developed an EPA-approved TMDL and implemented the Swan Lake Watershed Recovery Strategy. Through the use of 319 grants, ADEC funded community trash pickups, harvest of noxious aquatic plants, lake dredging, water quality monitoring, educational efforts, stormwater mapping, and operations and maintenance schedules. These activities resulted in the de-listing of both Swan Lake and Wrinkleneck Creek for debris and solid waste in 2004. Several of the restoration activities continue to be performed, including annual trash cleanup events.

10.1.7. *Future Assistance*

ADEC is interested in receiving assistance with data management and analysis in order to compile and analyze data from multiple projects in order to assess the status of waters on a regional basis and allow for trend analysis and tracking.

Assistance with developing practical and flexible TMDL implementation tracking tools that include information on implementation activities would also be useful.

ADEC would like more flexibility to focus on issues that cause impairments in Alaska (e.g., impairments related logging). For example, nutrient pollution from agricultural areas is not a major source of impairment in the state like it is in other parts of the country. Fecal coliform impairments in Alaska are due in large part to wildlife, not only human sources. The impact of climate change is predicted to be a larger problem in Alaska than in other states. In addition, Alaska has not had a lot of the historical problems that other parts of the country have had. The state is rapidly developing and would like to learn from what the rest of the country has done and work toward preventing similar problems from happening.

10.2. Iowa

10.2.1. *Overview of Current Programs*

Water quality data and information are collected through Iowa's ambient water quality monitoring programs sponsored by the Iowa Department of Natural Resources (IDNR), U.S. Army Corps of Engineers (USACE), and U.S. Geological Survey (USGS). Chemical, physical, and biological data are collected.

There are currently no ongoing programs specifically designed to track water quality improvements at a scale relevant or fine enough to capture impacts of individual watershed improvement projects or practices in Iowa. IDNR's ambient water quality monitoring network is designed to: (1) characterize water quality conditions in watersheds draining approximately 500 square miles; and (2) identify differences in water quality upstream versus downstream of the state's larger cities.

IDNR's monitoring to support TMDL development is focused primarily in smaller watersheds. Due to a limited ability to implement TMDLs, IDNR usually does not conduct special post-implementation monitoring to determine whether an impairment has been eliminated. Post-TMDL monitoring is largely restricted to stream/river segments and lakes where the impairment is based on results of ongoing routine ambient water quality monitoring.

The Section 319 Nonpoint Source Program focuses on implementation of projects within watersheds that are 30,000 acres or less. IDNR recently adopted a strategy to use this program to support monitoring during the implementation phase of watershed projects to try to assess and track watershed improvements and effectiveness of watershed improvement projects. This program is just getting underway.

The IDNR ambient lake monitoring program is designed to assess the water quality in Iowa's significant publicly owned lakes. In Iowa, significant publicly-owned lakes are those (1) maintained principally for public use, (2) capable of supporting fish stocks of at least 200 pounds per acre, (3) having a surface water area of at least 10 acres, (4) having a watershed to lake surface area ratio of less than 200:1, and (5) are not shallow marsh-like lakes, Federal flood control impoundments, or used solely as water supply reservoirs.

The IDNR Lakes Restoration Program receives funding from the state legislature, which requires that a lake and watershed assessment and restoration plan be submitted. A diagnostic/feasibility (D/F) study is also required and includes the collection of data and information in order to both identify restoration alternatives and tracking post-implementation effectiveness of BMPs and other management practices. In addition, on-going research performed by Iowa State University is focused on lakes and their economic impacts to the state.

There are several locally-led and targeted efforts in the state, including:

- The Rathbun Lake Watershed project has a comprehensive watershed management plan and collects data and information to measure and assess progress in implementing the watershed plan;
- Agriculture's Clean Water Alliance (ACWA) and Des Moines Water Works have partnered to monitor water quality in the Raccoon River Basin;
- The Iowa Soybean Association has collaborated with The Nature Conservancy and Iowa State University to monitor in the Boone River Watershed; and
- The University of Iowa Institute for Hydroscience and Engineering (IIHR) has been monitoring Clear Creek.

IDNR has the following approximate resources available for collecting, analyzing, and evaluating data to measure and track watershed improvements:

- $2.9 million in state ambient monitoring funds;
- $400K in EPA Section 106 funds for assessment ;
- $350K for TMDL program work;
- $250K-300K in Section 319 funds;
- 25 FTE (12 IDNR FTE staff plus University of Iowa Hygienic Lab [UHL] staff of 13 FTE); however, not all the UHL staff work on IDNR monitoring projects in a full-time capacity; and
- Fisheries/Lakes - 25% of Fisheries Management biologists' efforts directed to water quality improvement projects. D/F Studies: ~ $400K.

In addition, funding dedicated to monitoring is available from the following organizations: ACWA, IIHR, Iowa Soybean Association, and USACE. Budgets are unknown at this time. USGS dedicates approximately $300-400K plus 6 FTEs for monitoring approximately 12 sites and gauging at approximately 60 sites.

There is a lack of programs designed to track watershed improvement monitoring data. For the most part, only waters that are routinely monitored through long-term monitoring networks track data that are readily available for review. Ambient water quality monitoring data for chemical/physical parameters are entered into Iowa's STORET database; biological data are entered into IDNR's biocriteria database.

As part of Section 305(b) assessments and Section 303(d) listings, monitoring data are summarized and compared to Iowa's water quality standards to determine the degree to which monitored waters support their designated beneficial uses. This information is placed into IDNR's assessment database, ADBNet[17], which is patterned after EPA's assessment database (ADB). Iowa's ADBNet database provides a means of tracking the use support status of Iowa water bodies over time.

Waterweb[18] is a new web-based search engine that links to pertinent information relative to a particular water body or watershed. The linked information would continue to be maintained by the data generator and could include TMDLs, Section 319 studies, fishery studies, university theses, or even just a contact for further information. Waterweb is currently functional for lake watersheds and is being developed for stream watersheds. IDNR would like to use Waterweb as a multi-agency tool for identifying successful water quality improvement projects and to improve efficiency toward implementing watershed improvements activities.

IDNR identified the following obstacles to the state's water quality improvement monitoring program:

- An overall lack of funding, staff, interagency cooperation, and strategy for sharing and communicating results. An integrated tracking system could improve monitoring effectiveness;
- Inadequate financial, regulatory, and political commitment to pursue improvement of 303(d) impaired waters in HUC 12 watersheds;
- Insufficient political commitment to watershed improvement;
- Lack of strong community interest in stream monitoring and restoration. Community involvement is much stronger for lakes;

[17] http://programs.iowadnr.gov/adbnet/index.aspx
[18] http://www.iowadnr.gov/mapping/maps/waterweb.html

- The challenge of implementing controls for pollutants where the state has no authority for enforcing the implementation of such controls;
- Lack of ability and/or authority to implement TMDLs for nonpoint sources of bacteria, nitrate (as it affects drinking water uses), nutrients, and siltation;
- Impatience (both on a state and local level) with long-term monitoring. People (both politicians and the general public) are too quick to move on to the next issue before improvements have been shown in other watersheds.

10.2.2. *Available Data*

Data for chemical, physical, and biological parameters are primarily collected through routine ambient monitoring programs on Iowa's streams, rivers, and lakes. The only long-term data that may be available to measure water quality improvements are the data collected for an impairment that happens to occur at an ambient monitoring station. Collected information may include flow, biological data, fish and macroinvertebrate data, ambient chemical and physical monitoring data, bacteria monitoring data, fish kill data, and fish tissue monitoring data. Biological data have proven to be very useful for determining whether a water body should be placed on the state's impaired waters list. For biological assessments, an additional stressor identification effort is typically needed to determine the cause of impairment. Only after the specific cause of impairment is identified can the water body be evaluated for improvements. IDNR operates under EPA's policy on independent application of water quality assessment approaches; IDNR does not favor one type of data for evaluating water quality.

Additional data are collected through RASCAL (Rapid Assessment of Stream Conditions Along Length) stream assessments. The RASCAL tool is, essentially, the Natural Resources Conservation Service Stream Visual Assessment Protocol put into a handheld GPS device that allows for the capture of current stream conditions while walking the stream. Parameters assessed include: canopy cover, adjacent land use, riparian zone width and cover, bank stability and cover, livestock access, in-stream habitat, pool frequency, embeddedness, and substrate.

Various surface water utilities also collect data (e.g., Cedar Rapids Water Department and the Des Moines Water Works). Syngenta (a large agribusiness that markets seeds and pesticides) has a voluntary monitoring program where raw and finished water from participating municipal water utilities is analyzed weekly for atrazine.

There are a variety of project level monitoring programs that could and do provide long-term information on water quality in watersheds (Yellow River, Dry Run Creek, Walnut/Squaw Creek, Iowa River, etc.). Some of these watersheds are and will be the focus of improvement efforts and will likely yield information on the effectiveness of IDNR's improvement programs.

Iowa uses the following databases to track water quality data and information:

- Results of water quality monitoring conducted by IDNR and other agencies (e.g., USACE) are entered into the Iowa STORET database;[19]
- The impairment status of water bodies assessed as part of 305(b) reporting and 303(d) listing is tracked through IDNR's 305(b)/303(d) assessment database, ADBNet;[20]
- Fish kills are tracked through the Iowa fish kill database;[21]

[19] http://wqm.igsb.uiowa.edu/iastoret/
[20] http://programs.iowadnr.gov/adbnet/index.aspx
[21] http://programs.iowadnr.gov/fishkill/404.aspx?aspxerrorpath=/fishkill/fkindex

- Results of biological (fish/aquatic and macroinvertebrate) monitoring are tracked though Iowa's biocriteria database;[22] and
- Volunteer water quality monitoring information is located in the IOWATER (volunteer monitoring program) database.

IDNR would like to continue to track water quality improvements where impairments were initially identified on the basis of data from special studies, but where water quality monitoring is no longer conducted. For example, although probably not a factor for Iowa's 2002 list of impaired waters and thus for SP-12, this scenario is increasingly common in Iowa due to: (1) the existence of presumptive primary contact recreation uses for all surface waters, (2) levels of indicator bacteria in small streams that routinely exceed primary contact recreation criteria, and (3) the ease with which one season's monitoring can identify a bacteria-related impairment. Once such a study concludes, a water body will be considered to have a bacteria impairment with no resources available for the two to three seasons of monitoring needed to remove the impairment. Post-TMDL monitoring would ideally follow implementation of some type of watershed controls designed to reduce delivery of bacteria to the affected water body. IDNR, however, has limited ability to implement such controls.

For some types of impairments, primarily those attributed to siltation, determination of water quality improvements needs additional or major refinements. States are asked by EPA to conduct monitoring at Section 319 projects designed to control sediment delivery; however, no effective monitoring protocols or designs exist to measure such "effectiveness," with hydrology potentially being the controlling factor. IDNR would like to collect more flow data and detailed sediment data, investigate better ways of measuring sediment, and increase the intensity of both spatial and temporal data collection. In particular, compiling flow data is a challenge because the interpolation/extrapolation necessary to apply large-scale USGS streamflow data for certain models introduces a lot of uncertainty. IDNR is currently field testing a Doppler-based flow measurement technology to collect flow data directly and cost-effectively.

IDNR feels that it would be helpful to conduct surveys to determine the public's knowledge of relevant issues and their willingness to participate in programs. IDNR feels it would also be helpful to conduct similar surveys after project completion. In addition, IDNR would like to measure BMP adoption rates and compare them with how effective the practices are once they are in place.

IDNR feels that its greatest challenges related to collecting data to show progress toward meeting water quality standards are the following:

- An overall lack of funding, staff, and interagency cooperation;
- The availability of resources (dollars and staff) to collect sufficient data to accurately characterize water quality;
- Getting local citizens involved and organized; and
- Monitoring and modeling at a smaller scale.

10.2.3. *Evaluating Watershed Improvement*

In general, IDNR uses its routine, ambient fixed monitoring program to evaluate the improvement of impaired water bodies. The data from this and similar programs are used to both list and de-list water bodies. While IDNR does conduct impairment-specific monitoring to support TMDL development, there have been relatively few targeted efforts to monitor impaired waters. The 303(d) listing and delisting processes in Iowa focus on both segment/parameter specific and segment/beneficial use evaluations.

[22] This database is currently not available on-line.

For Section 319 watershed projects, modeling has historically been used to estimate reductions in nutrient/sediment loads from implementation of agricultural BMPs. Recently, however, EPA has pushed states to conduct water quality monitoring to determine project effectiveness, which is tied to 303(d) listing. Climate-controlled parameters plus insufficient funds for the frequency and duration of both pre- and post-project monitoring to determine the effectiveness of the installed BMPs point to a difficult, if not impossible, task with current parameters and resources.

IDNR also qualitatively evaluates water quality improvement based on surrogate measures such as the percent of landowner participation; improved attitudes and changes in behavior and policy; changes in use or improved water use; and a growing value of a water body to a community (i.e., quality of life, return on economic investment, tourism, partnership development, and sustained success).

The state's ambient monitoring network provides IDNR with the data needed for determining water quality trends on water bodies. Data are reviewed to determine general directions of key parameters (e.g., levels of lake chlorophyll *a* in summer increasing or decreasing over time). Where data are of sufficient quantity and quality, trend analyses are conducted to assess changes in water quality through time. In addition, IDNR uses water quality indices based on data, trout reproduction numbers, and fish surveys for purposes of Section 305(b) assessments and Section 303(d) listings. IDNR also uses park use numbers and economic day use value data (fisheries) to evaluate whether water quality is improving for purposes of public policy discussion. IDNR would like to link economic return with improvements in surface water quality to help garner political interest and funding support.

IDNR may present incremental improvements in impaired watersheds through modeling; watershed improvement phase completion; public relations efforts; and the lake annual report. IDNR also uses its biennial Section 305(b) assessments to document incremental improvements. This information is most readily used for lakes where some type of in-lake or watershed restoration work has been conducted. The identification of incremental improvements, however, is relatively rare and IDNR believes it is difficult to document any improvements (including incremental improvements) without water quality data collected at a project scale (vs. data collected via the state-wide ambient monitoring program).

As far as re-evaluating watershed restoration strategies, IDNR has typically not re-evaluated TMDLs due to limited staff and resource dollars working on the extensive list of TMDLs that have not yet been addressed. To date, IDNR has only completed one Watershed-Based Plan (WBP) (Lake Rathbun) and took part in a joint effort with Nebraska Department of Environmental Quality on a second WBP (Carter Lake). WBPs are currently not a part of IDNR's standard operating procedures; however, a more concerted effort toward developing such documents is currently in development in the form of a watershed management plan template and emphasis on planning criteria for Section 319 awards. The need to re-evaluate a diagnostic feasibility study for a given lake is determined by examining if study information matches current conditions in the lake and/or watershed. If information from a given diagnostic study is not current enough to provide useful restoration alternatives or if data gaps exist, then the need for updating the study will be considered. Local interest is also a strong driver of re-evaluating restoration strategies. Iowa is trying to realign Section 319 programs to allow funds to be used to assist with preparing watershed plans.

IDNR believes that its greatest challenges in evaluating data to show progress toward meeting water quality standards include:

- The difficulty of improving water quality given the influence of climatic factors and political externalities (e.g., changes in the Farm Bill) that can negate water quality improvements gained from watershed improvement strategies;
- An overall lack of funding, staff, and interagency cooperation;

- The time requirements to evaluate improvements, especially if they are made incrementally over a number of years;
- The lack of adequate pre-project monitoring data (relying only on post-project data to demonstrate water quality improvements is a difficult, and usually impossible, task); and
- Lack of numeric water quality criteria for certain pollutants (e.g., nutrient, sediments). As an agricultural state, 80 to 90 percent of Iowa's pollutant load comes from nonpoint sources.

10.2.4. *Effectiveness Measures*

IDNR uses a combination of the national and state strategic planning measures to measure water quality improvements. On a national level, IDNR utilizes EPA success stories (Iowa contributed 3 of the 146 success stories). On a state level, IDNR is required to report on the Water Quality Index[23], which is directly reported to the Governor, and IDNR reports on a number of water bodies that have been removed from the 303(d) list. Additionally, IDNR evaluates the percentage of lakes that qualify as "good" in terms of a matrix of watershed condition and in-lake water quality.[24]

IDNR does not believe that existing state monitoring strategies are effective at addressing the needs of national performance measures such as SP-12. The state would like authority to use Section 319 funds to conduct more monitoring to better report on progress toward meeting EPA targets. The state needs this funding to continue monitoring for long-term improvement, including up to five years of monitoring after the last BMP was implemented. With an average of eight Section 319 projects funded each year, a large amount of resources would be necessary to conduct enough monitoring to meet the requirements of SP-12.

For the past two years, Iowa has directed EPA 319 funding to monitoring on new 319 watershed projects. The goal of this monitoring is to demonstrate load reductions in pollutants, but also to document the removal of impairments. Since the reporting of SP-12 is aimed at documenting the removal of impairments at the watershed level, this could be considered an act of directing funds at monitoring for SP-12 purposes. Iowa has not altered their ambient monitoring program to meet SP-12 reporting needs. Since most impairments were identified through routine ambient monitoring, they feel as though their existing monitoring program could potentially be sufficient for SP-12 reporting, assuming they see changes in *impairment status*. However, as just noted, Iowa has added a new 319 monitoring component to their overall monitoring program specifically to capture improvements in 319-funded watersheds.

10.2.5. *Communication*

IDNR uses the following outlets to communicate water quality improvement results to the public:

- Lake restoration annual report;[25]
- Annual success story publication,[26] feature success stories, and EPA success stories;
- 305(b) report;[27]
- Annual water monitoring conference;
- Fact sheets;

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[23] http://wqm.igsb.uiowa.edu/wqi/wqi.asp
[24] See Larscheid, J., M. Hawkins, J. Downing, D. Bonneau, and G. Antoniou. 2008. Iowa's Lake Program. Lakeline. Volume 28 (1), 24-29.
[25] http://www.iowadnr.com/water/lakerestoration/
[26] http://www.iowadnr.gov/water/watershed/success.html
[27] http://wqm.igsb.uiowa.edu/wqa/305b.html

- News releases;
- Web sites;
- Public events;
- "Iowa Outdoors" magazine;
- State Fair, Farm Progress Show; and
- Booths and presentations at conferences and trade associations.

Where watershed improvements have been reported to the public, IDNR has noted increased awareness, recreational use, and the amount of funding made available for certain projects. IDNR communications staff are currently developing a formal plan to publicize successes locally and state-wide, as well as investigating better ways to track effectiveness of outreach efforts. Anecdotally, there may be increased buy-in from partners, positive economic impact on local communities, increased ownership by watershed landowners, possible changes in behaviors by landowners, etc., but there is currently no formal, organized effort to measure or track any of these changes.

IDNR is required to provide information regarding watershed and water quality improvements to EPA, the Iowa legislature, the Iowa Governor, and the media or concerned citizens via public information requests.

Though not required, IDNR also provides water quality information to the following entities to foster potential partnerships; provide transparent accountability; promote, educate, and solicit participation; and to garner political support and funding:

- Iowa Environmental Protection Commission (EPC);
- Iowa Department of Agriculture and Land Stewardship - Division of Soil Conservation (IDALS-DSC);
- Soil and Water Conservation Districts (SWCD) / Conservation Districts of Iowa (CDI);
- Iowa Natural Resource Commission (NRC);
- USDA Natural Resources & Conservation Service (NRCS);
- Iowa State University Extension;
- Iowa Water Resources Coordinating Council (WRCC);
- Local and statewide stakeholders (environmental, agricultural, and outdoor recreational groups);
- Public universities;
- Potential grant applicants;
- Iowa Watershed Improvement Review Board (WIRB);
- Statewide media list of more than 300 media outlets; and
- Statewide list of concerned citizens who have asked for environmental information.

10.2.6. *Case Studies*

Nine Eagles Lake

Nine Eagles Lake Watershed lies within Nine Eagles State Park in south-central Iowa. Erosion of colloidal clays led to the placement of the lake on Iowa's 303(d) list due to high turbidity. A detailed assessment indicated that improperly maintained trails and failing sediment ponds were two of the leading causes of erosion. A TMDL for turbidity established water clarity targets of 1.25 meters (as measured by Secchi disk depth) and a 50 percent reduction goal for sediment delivery. To meet these targets, IDNR prepared an implementation plan focused on reducing sediment delivery to the lake. Section 319 grant funds were used to construct 17 sediment basins. In addition, IDNR Parks Bureau rerouted and reworked several trails. Post-project monitoring indicated an average Secchi depth of 1.7 meters and an 85 percent reduction in sediment delivery to the lake. Because the TMDL targets were achieved, IDNR was able to remove Nine Eagles Lake from the state's 303(d) list of impaired waters.

Lake Icaria

Lake Icaria is located in southwest Iowa and serves as a popular recreation and fishing area. Sediment loads from agricultural areas began degrading water quality and the lake was placed on the state 303(d) list for sediment. A TMDL study determined that excess siltation caused the lake to not fully support its warm water aquatic life designated use. To reduce the amount of sediment delivery to the lake, state and Federal agencies worked with landowners to implement several BMPs. Practices included grade stabilization structures, terraces, filter strips, pasture and hay planting, grassed waterways, stream bank crossings, and prescribed grazing systems. A wetland was also constructed along the lake's largest tributary to trap sediment and nutrients. To fund BMP implementation, the project drew from a variety of funding sources, including Section 319 grants, the Natural Resources Conservation Service, Iowa's Publicly Owned Lakes Fund, Iowa's Water Protection and Watershed Protection Funds, and the Environmental Quality Incentives Program. The project was the first in Iowa to successfully use a geographical information system (GIS) to provide a platform for watershed assessment techniques, including mapping and placement of BMPs. GIS data for sheet/rill erosion indicate that the installed practices resulted in a 27 percent reduction of sheet/rill erosion and a 64 percent reduction in sediment delivery to the lake. Follow-up assessments indicate that the lake now supports its aquatic life designated use. In addition, IDNR Fisheries Bureau determined that the implemented practices successfully reduced sediment and nutrient loadings. As a result, IDNR has proposed removing Lake Icaria from the state's 2008 303(d) list of impaired waters.

10.2.7. *Future Assistance*

IDNR would like the following assistance from EPA for measuring, tracking, and reporting on water quality improvements:

- Funding to improve the spatial and temporal intensity of water quality monitoring, as well as funding to hire the staff needed to track, assess, and report the results of these efforts;
- Improvement of EPA databases (e.g., STORET, ATTAINS, and GRTS);
- Guidance, prepared in cooperation with the states, on development of a protocol for measuring and quantifying interim progress for water quality improvements;
- Guidance, prepared in cooperation with the states, on the addition of trend analysis to the water quality improvement assessment process; and
- Farm Bill policy that does not just focus on yield, but that also considers water quality effects. This item is perhaps where IDNR could use the greatest amount of assistance. All of the improvements resulting from watershed projects could be completely reversed by implementation of existing Farm Bill policy (e.g., adverse impacts resulting from the end of the CRP enrollment period).

10.3. North Carolina

10.3.1. *Overview of Current Programs*

The primary programs within the North Carolina Department of Environmental and Natural Resources (NC DENR) that collect data and information used to measure and track improvements in water quality include the ambient monitoring system, biological assessment unit, intensive surveys, selected Section 319 projects, the National Pollutant Discharge Elimination Systems (NPDES) Discharge Monitoring Coalition Program, and the Ecosystem Enhancement Program. All of these programs except the Ecosystem Enhancement Program are housed in the NC DENR's Division of Water Quality (DWQ).

The NPDES Discharge Monitoring Coalition Program[28] was developed by NC DWQ, in cooperation with NPDES permit holders, to utilize NPDES instream monitoring requirements to create an effective program for assessing water quality within a watershed context. Participating permit holders voluntarily work with DWQ to develop a monitoring program. Data are collected on both impaired and non-impaired waters with good spatial coverage. In order to better utilize the resources spent by NPDES permittees, the monitoring locations are coordinated with the DWQ's existing ambient and biological monitoring networks. This reduces duplication and provides a more complete picture of watershed conditions. The coalition program substantially increases the data resources available to DWQ for making basin-wide water quality management decisions. The NPDES Discharge Monitoring Coalition Program is paid for by NPDES dischargers and their consultants; however, two DWQ staff oversee this program on a full time basis.

North Carolina's Ecosystem Enhancement Program[29] is a partnership between NC DENR, the North Carolina Department of Transportation (NC DOT), and the USACE. The mission of the program is to "restore, enhance, preserve, and protect the functions associated with wetlands, streams, and riparian areas, including but not limited to those necessary for the restoration, maintenance and protection of water quality and riparian habitats throughout North Carolina." The Ecosystem Enhancement Program uses mitigation fees from highway and private development to support monitoring and water quality improvements activities.

NC DWQ considers their current financial resources for measuring, tracking, and reporting improvements in water quality to be inadequate. DWQ utilizes a combination of funding sources, including Federal grants, state appropriations, and NPDES permit fees to support its ambient, biological, intensive surveys, and Coalition monitoring programs, as well as at least five additional staff (part time) to support the analysis and evaluation of data collected to measure and track water quality improvements. In addition, the State Clean Water Management Trust Fund[30] can also be used to support monitoring as part of a larger overall project.

While NC DWQ believes that it is using its existing resources as efficiently and effectively as possible, they are not satisfied with their ability to track other entities' activities. NC DWQ is not the only agency carrying out efforts to measure and track water quality improvements, and there is no process or system to support the communication of these efforts to NC DWQ (or between the involved groups). NC DWQ would like to establish a web-based self-reporting system for various agencies to report on the activities they are carrying out, including where (spatially) they are doing this work.

NC DWQ has well-established programs for monitoring water quality improvement, but with limited resources. NC DWQ identified one major "obstacle" to monitoring water quality improvements: how best to prioritize monitoring programs given seemingly conflicting messages from EPA on monitoring priorities. These would include monitoring ALL waters of the state; monitoring to identify additional water quality problems; or monitoring to track improvements. NC DWQ places emphasis on trying to detect

[28] http://www.esb.enr.state.nc.us/coalitions.html
[29] http://www.nceep.net/index.html
[30] http://www.cwmtf.net/

improvements in water quality, so monitoring in water bodies that have TMDLs in place and implementation is ongoing. As a result, establishing new monitoring sites has not received as much attention; however, in recent years, NC DWQ has begun to collect data from many new sites through a random ambient monitoring system.[31]

10.3.2. *Available Data*

NC DWQ uses a Microsoft Access database, called NC Watershed Restoration Assessment and Protection Super Structure (WRAPS), to track assessment, restoration, and protection measures. NC WRAPS is an integration of several previously used NC DWQ tools for tracking information and data on water quality assessments, implementation planning, TMDL accounting, permitting, and other protection efforts. Data and information in WRAPS are tracked spatially by both assessment unit and watershed. NC DWQ believes this database will be useful to support reporting needs for SP-12 and other national performance measures.

NC DWQ is satisfied with their ability to track their own activities and projects, as well as those that other agencies carry out that are funded by NC DWQ (e.g., 319 Program projects). However, NC DWQ would like to be able to also collect information and data from other entities (e.g., local governments, watershed associations, etc.) including restoration and protection activities that are conducted without state or Federal funds. There are occasional instances when NC DWQ detects an improvement in water quality, but they don't know the cause for the improvement (i.e., restoration activity and responsible party). NC DWQ staff believe that a lot more groups are engaged in on-the-ground restoration efforts than they are currently aware of; they would like the ability to track those activities as well as their own.

NC DWQ collects chemical, physical, and biological data for use in assessing water quality improvements. NC DWQ is currently planning for a forum to bring together all of the state agencies working on restoration to learn about what information each collects. The forum is planned for fall 2008. Among other things, this will help promote additional collaboration and data sharing, as well as eliminate redundant efforts.

The predominant impairment in North Carolina is threatened macroinvertebrate and fish health, though this may be in part due to the fact that monitoring has traditionally focused on collecting these data. The cause of the biological impairment is not always known, in which case the state goes through its stressor identification process.

10.3.3. *Evaluating Watershed Improvement*

NC DWQ assesses water quality improvement by the same threshold in which impairment is determined (e.g., attainment of water quality standards). In most cases, this is performed on an assessment unit/pollutant (or cause) basis. Watershed projects are determined effective if data demonstrate reductions in instream pollutants (or improvements in biological integrity) and attainment of water quality standards.

NC DWQ has not traditionally focused much effort on documenting incremental improvements in water quality. Historically, the focus has been on whether or not water bodies are attaining water quality standards. However, NC DWQ hopes to be able to begin identifying incremental improvements through use of NC WRAPS. To date, NC DWQ has not had the need to report on incremental improvements.

NC DWQ evaluates the need to re-evaluate a TMDL or other watershed restoration plan if they determine that it has been fully implemented, yet water quality standards are still not being attained.

The greatest challenges NC DWQ faces in evaluating data to show progress toward meeting water quality standards is their lack of ability to document incremental improvements. As the measures used to determine

[31] http://h2o.enr.state.nc.us/esb/RAMS.html

impairment and restoration are the same measures (e.g., attainment of water quality standards), it is difficult to determine how to measure in between. NC DWQ does not believe instream water quality chemical data are necessarily the best measure of incremental improvements.

10.3.4. *Effectiveness Measures*

NC DWQ believes that their current monitoring programs will be sufficient in providing the data needed to report on EPA's various national performance measures, including SP-12. NC DWQ has not yet determined how they will select candidate watersheds for reporting effectiveness measures. Further, they are not yet sure whether or not they will use Option 1 or Option 2 for SP-12 reporting, though Option 1 is likely the one they will use because of its straightforwardness.

North Carolina is not directing funds specifically to monitoring for SP-12 reporting purposes, nor have they made modifications to their monitoring programs to gather information specifically for SP-12 reporting. Data used as part of SP-12 determinations in North Carolina comes from the same ambient monitoring network used to make the impairment determination in the first place. There may be situations in which additional sampling is conducted in a few locations; however, that additional sampling is performed using funds earmarked for special studies.

10.3.5. *Communication*

NC DWQ does not have a specific report or other means of communication solely for the purpose of reporting on water quality improvements in the state. Rather, improvements in water quality, along with other water quality information and activities, are communicated to the public through the state's Integrated Report, basin plans[32] and 319 Program annual reports.[33] The basin plans are water quality plans prepared by DWQ for each of the 17 major river basins in the state. Each basin plan is revised at five-year intervals.

As a result of this information sharing with the public and watershed stakeholders, NC DWQ has noticed a growing local interest and an increase in 319 Program grant applications, as more people learn what can be accomplished. In addition to the increased number of 319 Program grant applications, the quality of the proposed projects has also improved significantly. As the state learns more about activities that have a greater impact on water quality, they can demand more from 319 Program grant recipients. Lately, NC DWQ receives far more 319 Program grant proposals than they can fund; funding decisions are made based on those projects that are most likely to result in water quality improvements.

For some river basins, NC DWQ is required by state statute to report on their impairment status to the State Legislature and the State Environmental Management Commission. Aside from this required reporting, NC DWQ also informally shares data with various other state agencies, including the North Carolina Division of Public Health and North Carolina Division of Coastal Management.

10.3.6. *Case Study*

<u>Brasstown Creek</u>

Brasstown Creek is a small, well-defined project that demonstrated biological restoration. Brasstown Creek originates in Georgia and flows northwest into North Carolina. From the Georgia–North Carolina border, the creek travels 8.5 miles before reaching the Hiwassee River. The watershed has an 83 mi^2 drainage area and contains low-density residential development, pasture and hay lands, and a relatively large amount of forest cover.

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[32] http://h2o.enr.state.nc.us/basinwide/
[33] http://h2o.enr.state.nc.us/nps/Section_319_Grant_Program.htm

NC DWQ monitored macroinvertebrates in their state's portion of Brasstown Creek using two biological indices. The EPT index is a measure of pollution-sensitive aquatic insects inhabiting a water body. A stream showing high EPT richness is less likely to be polluted than one with low richness in the same geographic region. In addition, NC DWQ evaluated Brasstown Creek's biotic integrity (BI), which measures the presence of pollution-tolerant species. High BI values characterize streams that have poor water quality and are dominated by pollution-tolerant species. In 1994 the creek had an EPT index of 18. This low value caused the state to place an 8.5-mile segment of Brasstown Creek on its 303(d) list for only partially supporting state aquatic life use criteria. NC DWQ cited sediment from nonpoint sources, including streambank erosion and agricultural and highway runoff, as the causes of impairment.

In response to these problems, in 1995 the Hiwassee River Watershed Coalition (HRWC) formed a locally driven partnership to restore the watershed and implement numerous BMPs. The partners revegetated 160 acres of critically eroding bare areas (lands within 1,000 feet of streams); installed nearly 6.2 miles of livestock exclusion fencing; reconstructed stream channels; and created, enhanced, or protected 48 acres of forested riparian buffer from 1999 through 2004. In addition, project partners installed stock trails, stream crossings, wells, and spring developments in heavy-use areas, thereby improving more than 2,000 acres of pastureland. These practices kept an estimated 650 tons of soil, 162 pounds of nitrogen, and 45 pounds of phosphorus out of Brasstown Creek annually.

NC DWQ sampled Brasstown Creek again in 1999 and found that although instream habitat and sedimentation problems remained, the benthic macroinvertebrate community showed a marked improvement. Evaluating EPT and BI indices, NC DWQ assigned Brasstown Creek a "Good" bioclassification, indicating that the creek met its aquatic life support designation and allowing for its delisting in 2000. Subsequent monitoring in 2004 reaffirmed that the benthic community had recovered. Other signs of water quality improvement in Brasstown Creek have been noted. A pollutant loading model showed a nearly 25 percent reduction in total suspended solids (TSS) for the North Carolina portion of the Brasstown Creek watershed between 1997 and 2004. Up to greater 83% TSS reductions occurred in some subwatersheds where several BMPs were in close proximity.

Neuse River

The 6,000 mi^2 Neuse River Basin is an example of an impaired basin showing signs of incremental success in the form of reduced nitrogen concentrations in the river and reductions in permitted point source discharges of nitrogen, as well as reduced nitrogen loading from agricultural sources. High nitrogen levels from agricultural runoff in the Neuse River Basin have contributed to frequent algal blooms, hypoxic conditions, and fish kills in the estuary. In 1993 a NC DWQ management plan for the basin recommended an accelerated schedule to reduce nitrogen from point and nonpoint sources. The Neuse River Basin was listed as impaired by nitrogen on the state's 303(d) list.

In 1997, the North Carolina Environmental Management Commission (EMC) adopted the state's first mandatory plan to control both point and nonpoint source pollution in the basin. The plan, backed by the Neuse River TMDL, called for a mandatory 30% reduction in nitrogen from point, urban, and rural sources by 2003. The EMC worked with the appropriate nonpoint source agencies to target the implementation of BMPs to reduce sediment and nutrient runoff throughout the basin. Between 1996 and 2003, half of the croplands enrolled in the program implemented BMPs such as buffers, contour planting, no-till planting, and creek fencing.

Data for 2003 show that the Neuse agricultural community achieved a 42% nitrogen reduction, exceeding the 30% goal set by the EMC and Neuse River TMDL. A continuous monitoring system was established in the lower portion of the basin, near the Neuse estuary. Using flow-adjusted nitrogen concentrations, long-term nutrient data show a 27% instream nitrogen reduction in 2003 as compared to the average flow-adjusted concentrations from the 1991 to 1995 baseline. This decrease, along with point source reductions, was

accomplished by installing BMPs, implementing fertilizer management plans, and removing cropland from production. The new agricultural practices also led to lower phosphorus levels and slowed erosion, while farmers benefited from savings on fertilizer. The BMPs prevented more than 480,000 tons of soil from being washed away by erosion.

10.3.7. *Future Assistance*

NC DWQ has a well-established database for tracking data they collect. However, they need a way to capture additional data and information beyond what they are already aware of. NC DWQ knows that many more groups are engaged in on-the-ground restoration efforts than they are aware of. NC DWQ would like assistance in the development of a central web-based self-reporting tool to collect information on all water quality improvement activities statewide, regardless of funding source. Various individuals and groups would then be able to report on their restoration activities and efforts. Further, the system could have spatial reporting functions, where an individual could click on the stream they are working on and add information. The use of aerial photos and other imagery could make this tool even more useful. NC DWQ believes that a self-reporting system could help them to make even more links between water quality improvements and restoration activities. A university may be able to host and maintain the system.

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10.4. Oregon

10.4.1. *Overview of Current Programs*

Oregon Department of Environmental Quality (ODEQ) collects data and information that can be used to measure and track water quality improvements thorough the following programs:

- Ambient monitoring program, which includes 151 sites and approximately 40 years of data.
- Environmental Monitoring and Assessment Program (EMAP); ODEQ did point out that while EMAP studies are useful for understanding statewide conditions, they have limited utility at the watershed scale.
- 319 nonpoint source grant program monitoring.
- Oregon Watershed Enhancement Board (OWEB) grant program monitoring.
- Oregon Plan for Salmon and Watersheds (funds studies of threatened and endangered species); unfortunately, funding for this program is being cut from ODEQ's 2009-2011 budget, so this work will discontinue unless restored by legislature.
- Pesticide Stewardship Partnerships – Instream WQ (pesticide) monitoring to evaluate IPM effectiveness (http://www.deq.state.or.us/wq/pubs/factsheets/community/pesticide.pdf).
- Groundwater Monitoring – Groundwater monitoring to evaluate Groundwater Management Area Action Plan effectiveness (http://www.deq.state.or.us/lab/wqm/groundwater.htm).
- Volunteer Monitoring – Local partners monitor to evaluate their watershed restoration effectiveness (http://www.deq.state.or.us/lab/wqm/volmonitoring.htm).
- Willamette Toxics Monitoring Program – DEQ is collecting instream and fish toxics data to guide resources, implementation efforts, etc. Data from this program can potentially be used for effectiveness monitoring in the future (http://www.deq.state.or.us/lab/wqm/toxics.htm).

Potential water quality improvement data and information are also available to ODEQ from its partners, including USGS, municipalities (via MS4 Permit monitoring), watershed councils (approximately 100 in total), U.S. Forestry Service, and Bureau of Land Management.

Current available ODEQ laboratory staffing resources include approximately 3 to 3.5 FTEs that are responsible for collecting, analyzing, and evaluating data to measure and track water quality improvements. This will be reduced by 2 to 3 FTEs during 2009-2011 due to budget reductions.

Funding from the 319 nonpoint source grant program is generally around $1.5 million awarded annually for project work. A small portion of this (less than 25% on average) goes to implementation/effectiveness monitoring efforts. The ODEQ laboratory used to have 1 FTE dedicated to nonpoint source monitoring; however, that position is gone.

The OWEB grant program is funded by state lottery monies. Total monitoring funds awarded statewide were $1.5 million in 2007 and $1.0 million in 2006. These funds are not specific to effectiveness monitoring; however, the OWEB program is currently working on a strategy to implement a monitoring program that will focus on gauging the effectiveness of the projects funded by OWEB. This effectiveness evaluation will consist of at least two major elements: effectiveness of the project achieving its objectives and the contribution that a project makes to a larger cause (e.g., Oregon Plan, species recovery, watershed health, etc.).

Oregon Department of Agriculture and Oregon Department of Forestry conduct follow-up studies on Senate Bill 1010[34] agricultural water quality management plans and forestry plan requirements, but it is usually very general in nature.

ODEQ currently has no formal program in place for tracking watershed improvement monitoring data and information. ODEQ feels that the primary obstacle to the state's watershed improvement monitoring program is a lack of directed, long-term funding for monitoring. Monitoring for implementation effectiveness requires years of data in order to recognize true improvements versus changes due to natural variation and, in the case of temperature monitoring, climate change. Recent economic forces in Oregon have lead to significant declines in monitoring support and the loss of highly trained monitoring staff to other programs where they will not be available to help design and implement effectiveness monitoring strategies in the future. Grant programs, such as the OWEB grant program, are generally two years long, three years at the most. Monitoring for short periods following implementation, especially in the case of measurements specific to vegetation enhancement and channel restoration, may not yield data sets that are representative of the effects of the mature project.

Secondary obstacles include lack of funding for data analysis and lack of consistency in data entry, storage, archiving, and retrieval. Data are often summarized by OWEB grant recipients in annual reports on a project-specific basis. This approach does not allow coherent, watershed-scale improvement analysis as funding is not available for it—even at a 5-year or 10-year time scale. Additionally, few watershed councils have infrastructure or funding to adequately combine or aggregate monitoring data from a variety of sources to answer questions at different spatial scales. The lack of coordination among projects results in site/project-specific data storage with a myriad of formats, a wide range of accessibility, and uncertain archiving protocols. Long-term funding for data entry, archiving, and database maintenance is extremely limited. Hiring a database staff person with grant funding that has (generally) a two-year term results in frequent turnover and lack of consistency.

10.4.2. *Available Data*

Currently, water quality improvements are typically measured through direct techniques that are single parameter specific, for example, the use of thermistors for temperature measurement. The general trend in monitoring is moving toward more remote-sensing techniques with watershed-scale characteristics such as Light Detection and Ranging (LiDAR) and Forward Looking Infrared (FLIR) techniques, but consistent funding and data assessment expertise are still extremely limited.

ODEQ primarily collects parameter-specific chemical data and some limited biological data (fish and macroinvertebrates) to assess watershed improvement. EMAP collects chemical, physical, and biological data on selected watersheds and could show probabilistic time trending of watershed condition. ODEQ has also conducted biomonitoring using macroinvertebrate and aquatic vertebrate assemblages as part of the Oregon Plan, as part of national assessments for some mitigation monitoring, and for some TMDL projects. ODEQ sees biomonitoring as a direct measurement of beneficial use support and therefore believes it is a key component to effectiveness monitoring.

Water quality data are stored in the ODEQ Laboratory Analytical Storage and Retrieval (LASAR) database[35] but as data points only—the data are not linked to implementation actions. Improvements can be assessed in a limited fashion if data can be correlated with local implementation projects, but the LASAR database is not set up to track improvements at this time. Geospatial data currently collected on many agricultural and channel improvement projects cannot be input into the existing database and much of the linkage to

[34] Oregon Senate Bill 1010 requires the Oregon Department of Agriculture to work with farmers and ranchers to prepare agricultural water quality management plans for waters that are listed on the state's 303(d) list of impaired waters.

[35] http://deq12.deq.state.or.us/lasar2/

implementation is lost in the LASAR data. Some watershed councils are in the process of developing databases to track water quality improvements and project effectiveness, but there is no consistency between watershed councils at this time and funding for long-term data entry and maintenance is a primary limiting factor. ODEQ is currently developing an online database that project partners, such as watershed councils, can use to ensure consistency with the LASAR database. In addition, some reports summarize findings that indicate trends in water quality improvements such as ODEQ's ambient reports.

To better monitor effectiveness, ODEQ would ultimately like to collect more high-level indicator data such as biomonitoring, relative bed stability, and riparian condition. ODEQ also feels that it needs to establish a system of basin-scale sites with a consistent set of indicators. In addition, ODEQ would like to collect geospatial data on a watershed scale, including orthoimagery, digital elevation mapping (DEM), and data derived from techniques such as LiDAR, FLIR, green LiDAR (digital orthophoto quadrangle or vegetation density), and other emerging techniques. ODEQ feels that geospatial data collection generates more useful data for less money than is required for traditional monitoring and feels that it can be more proactive in placing BMPs through the use of geospatial data. ODEQ would also like to implement a consistent flow gauging program at all major tributary mouths. Finally, ODEQ would like to gather location data, location type, and BMPs implemented upstream and upland of each water quality monitoring site.

ODEQ feels that the greatest challenges that it faces in collecting data to show water quality improvements are identifying funding and staff time, identifying appropriate collection methodologies and indicators, and coordinating efforts with other agencies and stakeholders.

10.4.3. *Evaluating Watershed Improvement*

To evaluate improvement of impaired water bodies, ODEQ uses parameter-specific monitoring depending on the impairment of a given segment. The ambient monitoring program, which looks at conventional parameters, is one set of data used to determine whether water quality is improving. In addition, local basin coordinators review water quality data collected from within their basin, and local watershed councils often track information on certain parameters, but there is no formal determination of water quality trends. The data collected by the EMAP program could be used as a pseudo-effectiveness monitoring tool over time. A casual, outside observer would not be able to use EMAP data to measure water quality improvements, but an informed participant who was aware of watershed projects may be able to come to some conclusions based on the EMAP data. Likewise, the Oregon Plan information could be used in the same capacity.

ODEQ feels that there is no consistent determination of effectiveness relative to resource benefits. For example, if decreased fish populations started the TMDL process, the question that defines the project effectiveness should be "Did we get the fish back?" Instead, oftentimes the collected data can only answer questions like "Did we reduce TSS by some percent?" Ideally, ODEQ would like to take a "medical" approach to this type of issue. First, ODEQ would assess the beneficial use symptoms to select a suite of parameters that will suitably diagnose water quality and beneficial use support problems. They would then measure the extent of conditions and potential risk from those parameters to protected beneficial uses. Upon diagnosing the problems and measuring the extent of the problem, water quality management plans would be designed to comprehensively deal with the suite of issues that are adversely affecting beneficial use support. Finally ODEQ would periodically measure – at multiple spatial scales – parameters of concern and beneficial uses to see if the water quality management plans are effective.

The ambient monitoring program could be used to document incremental improvements in a limited way. The most common approach would be to identify the level of implementation and participation in a watershed. If a lot of projects are being implemented, an assumption could be made that water quality is improving.

ODEQ feels that the challenges it faces in collecting data are the same challenges it faces in evaluating data to show water quality improvements: identifying funding and staff time, identifying appropriate evaluation mechanisms (i.e., indicators, spatial scale, etc.), and coordinating efforts with other agencies and stakeholders.

10.4.4. *Effectiveness Measures*

While ODEQ has a monitoring strategy that outlines a rotating basin plan that could facilitate effectiveness monitoring at the basin scale, it has been difficult to get funding for this type of effort. ODEQ mainly uses the ambient monitoring program for tracking watershed changes. To select candidate watersheds for use in reporting effectiveness measures, Oregon Plan uses Endangered Species Act listed salmon waters to identify target areas. EMAP is strictly random in how it selects watersheds to report effectiveness.

Some of the data collected by ODEQ and others could be used to support reporting option 2a and 2b under SP-12. However, ODEQ is not certain that data from its ambient monitoring program could be used for delisting purposes because the sampling locations of the ambient program are integrator sites that do not necessarily indicate what is happening in the watershed.

Oregon is not directing funds specifically to monitoring for SP-12 reporting purposes, nor have they made modifications to their monitoring programs to gather information specifically for SP-12 reporting. Data used as part of SP-12 determinations in Oregon comes from the same ambient monitoring network used to make the impairment determination in the first place. There may be situations in which additional sampling is conducted in a few locations; however, that additional sampling is performed using funds earmarked for special studies.

10.4.5. *Communication*

ODEQ reports water quality improvement results in technical reports posted on the ODEQ website. Annual reports and specific technical reports are produced from EMAP and OWEB. This type of reporting is highly site-specific and generally the result of press releases or similar activities on the part of the local watershed councils. Also, these reporting efforts are specific to local projects rather than watershed-wide activities. ODEQ has found that reporting water quality improvements to the public has generally led to increased awareness of water quality issues and increased interest in participation.

ODEQ is required to provide information regarding water quality to OWEB and EPA as part of the 319 nonpoint source program and to NOAA Fisheries Service for making decisions about management of threatened and endangered fish stocks. Though not required, ODEQ provides information to cooperating agencies as part of coordinated project work (e.g., Tribal governments, local governments, etc.) and to the owners of land where sampling has been conducted.

10.4.6. *Case Study*

McCoy Creek flows through the McCoy Meadows area into Meadow Creek, a major tributary of the Grande Ronde River located in northeast Oregon. McCoy Meadows was historically a wetland meadow complex, but practices such as road construction, logging, and livestock grazing have altered the area. In addition, Lower McCoy Creek was relocated, straightened, and channelized to drain wetlands and maximize grazing land. As a result, habitat in the area was degraded and McCoy Creek became a wide, shallow channel with reduced connectivity with cool ground water leading to elevated water temperatures. McCoy Creek was subsequently listed on the state 303(d) list for sedimentation and temperature impairments.

An aggressive multi-agency watershed restoration project was initiated to restore water quality, fish and wildlife habitat, and wetland function. The restoration activities included channel restoration, bridge and culvert construction, and tree planting. Approximately 10 years of 319-funded monitoring of water chemistry,

temperature, habitat, macroinvertebrates, and fish has shown that in two to five years, the restoration activities improved habitat and benefited sensitive aquatic life in the McCoy Creek area.

10.4.7. *Future Assistance*

ODEQ would like assistance from EPA to:

- Better utilize biological indicators for measuring improvements – ODEQ feels that it is important to have a discussion on which indicators can be used to evaluate effectiveness;
- Develop basin-scale monitoring by land use – ODEQ believes that while this larger scale does not always align with the scale of TMDLs, it is still relevant to protecting beneficial uses. ODEQ feels that it is important to understand how small projects impact water quality on this larger scale;
- Secure consistent, long-term funding for monitoring, data assessment, and data storage and archiving – ODEQ believes that ensuring consistent long-term funding is necessary to obtain sufficient data to definitively monitor trends. ODEQ feels that the same level of funding that has gone into TMDL development and implementation should be made available for effectiveness monitoring;
- Provide the ability to report interim effectiveness to utilize all good efforts for reporting purposes; and
- ODEQ is having difficulty with characterizing and capturing sedimentation issues including source identification and TMDL development. ODEQ could use further technical and financial assistance from EPA to develop TMDL and source identification methodologies.

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10.5. Texas

10.5.1. *Overview of Current Programs*

The Texas Commission on Environmental Quality (TCEQ) maintains a number of programs that monitor surface water quality throughout the State of Texas. These include the Surface Water Quality Monitoring (SWQM) Program, the Texas Clean Rivers Program (CRP), the Nonpoint Source Program, and the TMDL Program. The SWQM program has the primary responsibility for conducting ambient assessments and writing the 305(b) reports, as well as providing training to monitoring groups throughout the state. As a means to collect the vast amount of data necessary for ambient assessments in the large state of Texas, both the CRP and the TCEQ SWQM programs receive funding from state and federal sources for the statewide sampling program. The SWQM program acquires data from federal, state, and local data providers such as USGS, Texas State Soil and Water Conservation Board, Texas Parks and Wildlife Department, universities, and municipalities. Over 60 percent of the data used by the TCEQ for ambient assessments is provided by the CRP's 15 partner agencies, which include river authorities, a water district, a council of governments, and an international water commission. The river authorities also contribute funding of their own and partner with local governments to obtain additional water quality data, providing additional capacity to statewide assessment efforts. Additionally, the Texas Department of State Health Services (DSHS) provides information for fish bans and advisories, while the Department of Parks and Wildlife provides data and analytical tools to assist TCEQ in its biological assessment efforts. The nonpoint source and TMDL programs, meanwhile, conduct project-specific monitoring to assess effectiveness of 319 projects and TMDLs. However, less post-TMDL monitoring is conducted due to the relatively small number of TMDL projects.

TCEQ's strategy for showing water quality improvements is through the ambient monitoring program. Ambient water quality data are compared to criteria established to define support or non-support of beneficial uses through the statewide ambient assessment and 305(b) report. Additionally, water quality conditions and trends are described every 5 years for individual river basins through Clean Rivers Basin Highlights Reports[36] and Basin Summary Reports.[37] In certain instances, water quality data are also compared to project-specific goals through NPS and TMDL projects and program reports.

Some of the challenges to monitoring for watershed improvement identified by Texas include: the size of the state, an abundance of surface water resources, a large population, and rapid urbanization. Addressing these challenges requires a very large commitment of resources, another challenge identified by Texas. The statewide ambient program is designed to evaluate individual water bodies in accordance with 305(b) assessment guidance. In many cases, this design is not consistent with the data needs of a watershed improvement monitoring program. One example of this is the non-random locations of ambient monitoring sites. This prevents the use of certain statistical techniques for evaluating watershed improvement. Also, sites are generally not selected to assess specific problems, but to provide information on the overall health of the water body. Data obtained from this sampling strategy may not be easily related back to improvement efforts in the local watersheds. One exception to the statewide ambient program is the Bosque River watershed project.[38] Site placements in that watershed were very specific to capture improvements in water quality, which may not have been easily seen if sites were randomly selected.

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[36] Guadalupe-Blanco Basin Highlights Report: http://www.gbra.org/Documents/CRP/BDA/2007BasinHighlightsReport.pdf

[37] Colorado Basin Summary Report: http://waterquality.lcra.org/text/crplcbs2007.pdf

[38] Bosque Report - report on water quality status and activities to address the impairment: http://www.tceq.state.tx.us/assets/public/implementation/water/tmdl/06bosque/bosque_rpt_jan2008.pdf

10.5.2. *Available Data*

Texas collects a variety of data to assess its water bodies, including: water chemistry, biological, sediment chemistry, fish tissue, toxicity, bacteria, flow, and land use and other spatial data. These data are input to a publically-available database called Surface Water Quality Management Information System (SWQMIS) where they are stored until accessed by a SAS interface, which allows for assessment of the data. An internal reporting Microsoft Access reporting database, TXBad, is then used to create 305(b) reports for submittal to EPA (which are publically available on the TCEQ website). It is hoped that, over time, watershed improvement will be shown through standards attainment as determined through the assessment of data from SWQMIS and reported in TxBAD as the 305(b) results.

Texas identified several additional data needs for water quality improvement monitoring. While sufficient long-term data are sometimes available for some water bodies, it is necessary to collect long-term data for more water bodies to perform trend analyses. Additionally, where long-term data do exist, there is not sufficient staff time to devote to this analysis. Texas also noted that monitoring programs are not set up to measure local improvements. For example, data are collected at too large a scale to show improvements from more localized BMP implementation. Texas is, however, at the beginning stages of collecting sufficient BMP effectiveness data, although it is very expensive to conduct both pre-and-post-implementation monitoring. Therefore, they are relying on modeling data in order to reserve funds for actual BMP implementation.

Texas considers biological information to be a good indicator of water quality in many cases. The state currently has a Virtual Biological Assessment Team that is composed of central and regional TCEQ office staff, TPWD, etc. This team collects between 25-30 samples per year for routine biomonitoring and an additional 10 samples for special studies. Texas would like to expand upon their biomonitoring data collection.

10.5.3. *Evaluating Watershed Improvement*

Texas' statewide ambient monitoring program uses a segment-based assessment unit and parameter-specific approach to evaluating water quality conditions. Compliance with state water quality standards is determined by the surface water quality monitoring program and can indicate whether watershed projects have been effective. Positive trends in water quality, improved instream and watershed conditions, and reduced constituent loadings are used where possible. For example, Basin Summary Reports from the river authorities provide some trends analyses. Certain high-profile watersheds, such as the Bosque River Watershed, have strategically-located index sites that allow for tracking changes in water quality over time. Other project-specific water quality analyses conducted through the Clean Rivers, NPS or TMDL programs may also identify a positive trend in water quality, improved in-stream conditions, or reduced constituent loadings. The TMDL Status Report[39] and Texas NPS Program Annual Report[40] also include watershed project effectiveness where available.

TMDLs and Watershed Protection Plans in Texas are evaluated periodically through on-going stakeholder-led and regulatory procedures. Decisions regarding "when and how" to revise water quality management plans are dependent upon circumstances in individual watersheds. However, most of these plans are still in their early stages and have not yet been evaluated or re-evaluated to the degree that generalizations can be made.

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[39] TMDL Status Report: http://www.tceq.state.tx.us/assets/public/implementation/water/tmdl/2006tmdlstatusreport.pdf

[40] Texas NPS Program Annual Report: http://www.tceq.state.tx.us/assets/public/comm_exec/pubs/sfr/066_07.pdf

10.5.4. *Effectiveness Measures*

Texas measures surface water quality improvements based on output measures 01-01.05 ("Percent of Texas surface waters meeting or exceeding water quality standards" and 01–01–02.01 ("Number of surface water assessments") in TCEQ's Strategic Plan,[41] as well as on national strategic planning measures. Impaired watersheds which have targeted water quality management programs developed under TMDLs and NPS programs are used for reporting effectiveness measures. However, Texas acknowledges that monitoring programs could be improved to make them more effective in supporting national performance measures, such as SP-12. The TCEQ will consider national performance measures in the future when planning the statewide ambient monitoring program. Texas is also using an approach of giving funding priority to project proposals under a NPS program solicitation that will demonstrate water quality improvement or help facilitate restoration of water quality.

Texas' Surface Water Quality Monitoring Program currently includes quarterly routine monitoring to evaluate for attainment of water quality standards. Specific to planning monitoring efforts to address SP-12 needs, the Monitoring Program is responsible for coordinating monitoring resources throughout the State. This is facilitated through river basin specific meetings with local, state and federal agencies convened prior to the start of each fiscal year. Special projects to collect water quality data to evaluate the success of management activities are planned by regional water quality entities when possible. Texas is beginning to make changes to their monitoring program to gather information specifically for SP-12 reporting. Starting with the next round of river basin specific meetings, SP-12 water bodies will be prioritized. To plan for monitoring in SP-12 watershed, Texas has developed implementation plans that include a monitoring component to evaluate for success.

10.5.5. *Communication*

Texas provides substantial information to the public through the use of websites and traditional print media. The 305(b) and 303(d) reports are published on the TCEQ website, while the Clean Rivers Program publishes print and web Basin Highlights Reports annually and Summary reports every 5 years. Additionally, the NPS program publishes web and print reports on the progress of NPS projects and programs in the state. The TMDL Program published a report on the status of TMDLs in the state in 2006. Texas also reports all of this information to the EPA, state legislature, and state legislative budget board, as well as watershed stakeholders.

10.5.6. *Case Study*

Lake Como is a 10-acre impoundment of an unnamed tributary to the Clear Fork Trinity River in Fort Worth. The lake drains a 743-acre watershed that is 65 percent residential. The Texas DSHS issued a ban on the possession of all fish species from Lake Como in 1995 because of elevated levels of several legacy pollutants including polychlorinated biphenyls (PCBs) and the pesticides chlordane, DDT and dieldrin. In 1996, TCEQ added the lake to the state's 303(d) list of impaired waters due to impairment of its designated fish consumption use.

Legacy pollutants are those pollutants that have been banned or had their uses restricted, yet remain in the environment. These materials were widely used in the past in products such as pesticides, coolants and lubricants. Area soils were contaminated through direct application, leaks and spills. Extensive urban development in the watershed caused contaminated soils to erode and accumulate in Lake Como. The pollutants then entered the food chain and became concentrated in fish tissue.

[41] TCEQ's Strategic Plan: http://www.tceq.state.tx.us/assets/public/comm_exec/pubs/sfr/035_05.pdf

In 2001 TCEQ and EPA approved a TMDL for Lake Como for legacy pollutants in fish tissue. The endpoint of the TMDL was to restore the fish consumption use by meeting the DSHS criteria for contaminant levels. The DSHS procedures specify that the additive risk of all contaminants cannot exceed either the cancer risk level or a non-carcinogenic hazard index.

Fort Worth's Environmental Management Department (FWEMD) operates the Environmental Collection Center (ECC), a permanent, year-round facility that accepts household hazardous waste from residents of Fort Worth and other areas. The ECC modified its record keeping to track the amounts of legacy pollutants collected. The city used the information as a measure for evaluating its pollution prevention program and targeting its educational efforts.

Fort Worth educates residents about local watersheds and the inherent problems associated with the use of pesticides. The city holds Lake Festivals and cleanup events. In 2004, the event included more than 30 information booths and educational activities. The city also installed a message board at the lake to provide water quality information. FWEMD produced a stormwater pollution prevention public service advertisement shown at local movie theaters. To reach a wider audience, FWEMD staff made presentations about water quality issues to numerous groups in the Fort Worth area.

The USGS conducted sediment and runoff sampling and analysis to evaluate loading of legacy pollutants, trends and sources of pollutants. The DSHS collected fish tissue samples for developing a quantitative risk characterization that was the basis of a revised health risk assessment that DSHS adopted in 2008.

Sampling of sediments in the reservoir detected all four legacy pollutants responsible for the fish consumption bans. However, concentrations of DDE, PCBs and chlordane have declined in Lake Como sediment since the 1960s. Results of core samples taken in the lake show a decrease over time in the pollutants of concern, with the exception of dieldrin. Sampling of residential stormwater outfalls showed that legacy pollutants were present and being transported in urban runoff.

Pollution prevention and source control practices helped reduce legacy pollutant levels. Fort Worth's educational program led to a 21 percent increase in the number of citizens using its permanent household hazardous waste facility. As of 2006, ECC collected and logged more than 8,000 pounds of materials containing legacy pollutants.

The combination of these investigations, management activities and the natural attenuation of the pollutants proved to be effective for Lake Como. Recent fish tissue monitoring shows that concentrations of legacy pollutants comply with the endpoint target in the TMDL. For example, chlordane fish tissue data collected in 1994 show a mean value of 1.78 milligrams per kilogram (mg/kg) and a range of values from 1.00 to 2.90 mg/kg. By 2008, data showed that chlordane concentrations in fish tissue had declined to mean of 0.036 mg/kg, with a range of values from 0.013 to 0.086 mg/kg.

The final risk assessment by DSHS found that "no single contaminant in fish from Lake Como increased the likelihood of systemic or carcinogenic health outcomes in people who eat fish from this lake." Additionally, DSHS risk assessors found no increase in the lifetime excess cancer risk with simultaneous exposure to more than one contaminant. This exposure scenario also does not increase the risk of systemic adverse health outcomes in those who would regularly consume fish from Lake Como.

These findings demonstrate that historical contamination has attenuated, resulting in reduced fish tissue concentrations. Because of the actions taken to restore Lake Como, and since PCBs and the pesticides bioaccumulating in fish tissue are all banned, TCEQ believes levels in fish tissue will continue to decline. On the basis of the DSHS findings, TCEQ determined that Lake Como is fully supporting its fish consumption use and removed the lake from the state's 2008 303(d) impaired waters list. Periodic monitoring of fish tissue in the future will serve to confirm that concentrations remain below levels of concern.

Fort Worth contributed to the project by educating the public and collecting hazardous household waste. USGS investigated legacy pollutants in sediments. TCEQ and USGS each contributed $39,000 for the joint investigation. TCEQ contributed approximately $25,000 in EPA section 319 funds to cover the DSHS's analytical expenses. DSHS matched the grant with salaries and in-kind services to collect the samples and develop the risk characterizations.

10.5.7. *Future Assistance*

Texas has identified the following issues and needs for enhancing their programs and processes for measuring, tracking, and reporting on water quality improvements:

- Sufficient time and staff to develop a comprehensive strategy for monitoring the effectiveness of their watershed programs;
- Additional resources to enhance existing efforts in program planning and development, and to perform trend analyses on ambient data;
- Storm water (wet weather) monitoring and data analysis protocols are needed in order to standardize the procedures and facilitate statistical analysis;
- Additional flexibility in the use of Federal grant funds would be beneficial; and
- Standardization of approaches to managing and analyzing data across state programs would also be beneficial.

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10.6. Virginia

10.6.1. *Overview of Current Programs*

The Virginia Department of Environmental Quality (VADEQ) has seven regional offices, one satellite, and one central office. With the central office serving in a technical and regulatory resource capacity, each of the regional offices independently implement the core water quality programs – monitoring and assessment, surface water investigations, fish consumption advisories, TMDLs, permits, etc. In addition, central office staff also provide the regional offices with interagency and interstate liaison support as needed. Each of the regional VADEQ offices is involved with collecting data and information used to measure and track water quality improvements. In recent years, there has been progress in better coordinating reporting efforts. For example, within VADEQ, the TMDL program contributes to the annual report developed by the Section 319 Program; likewise, information from the 319 report is taken into account in developing the annual TMDL Progress Report.

In addition to the regional offices, the following agencies also collect data and information useful for measuring and tracking water quality improvements: Virginia Department of Game and Inland Fisheries (VA DGIF); Virginia Department of Conservation and Recreation (VA DCR); Virginia Department of Health (VDH); Virginia Department of Forestry (VA DOF); and Virginia Department of Mines Minerals and Energy (VA DMME). Each of these agencies has internal reporting mechanisms for tracking various data and information; however, there is no central (state) repository or tool for tracking these data. Of these agencies, VADEQ works closest with VA DCR, VDH, and VA DMME on tracking and reporting on water quality improvements.

VADEQ is not easily able to calculate how much of their resources (budget) they put toward collecting, analyzing, and evaluating data to measure and track water quality improvements. VADEQ does not currently have personnel working solely on measuring water quality improvements. Many of the staff in VADEQ and the other agencies assist in measuring and tracking water quality improvements to some degree. Some staff monitor water body improvements, some maintain databases, some evaluate data trends, and so on. Combined, each of these efforts contributes to measuring and tracking water quality improvements in Virginia.

In addition to the state agencies that play a role in water quality improvement tracking, a number of local agencies also play a role in these efforts. As one example, there are a number of small, localized watershed groups in the state who receive grants and other sources of funding (including volunteer support) to support projects and efforts that provide data or information useful for measuring water quality improvement. Also, VADEQ actively supports and promotes utilization of citizen's monitoring data. Though some of these watershed groups receive a small amount of funding from VADEQ, many of the groups (e.g., the Save Our Streams (SOS) Program[42]) also use their own funding to support their monitoring efforts. VADEQ has a full-time citizens monitoring coordinator to track these activities and to process all non-agency data received.

Virginia is somewhat unique in that they are required by state law to implement TMDLs, which includes developing Implementation Plans (IP). The development of the IP involves coordination with major stakeholders (e.g., agricultural and urban representatives or mining or manufacturing associations), VA DCR, VA DMME (in mining areas), etc. VADEQ works closely with all of these groups to determine the best practices that will address the impairments. VADEQ also works with the groups to identify funding to support the management practices. VADEQ uses a staged approach to implementing TMDLs, which provides opportunities for periodic evaluation of the effectiveness of the implementation actions and adjustment of efforts to achieve water quality objectives in a timely and cost-effective manner. VADEQ does

[42] SOS is a nonprofit program in Virginia that trains and certifies volunteer water monitors throughout the state. Data collected by the SOS-certified monitors are sent to state agencies for use in water quality assessments.

not have a set protocol in place for determining when and on what basis TMDLs or IPs need to be re-evaluated or revised. However, each TMDL IP is required to have a specific monitoring and evaluation schedule specific to the stressor – impairment relationship and timeline for implementation; including a projected end date.

VADEQ has several mechanisms for reporting on water quality improvements, including the Chesapeake Bay and Virginia Waters Cleanup Plan[43] (an annual report to the Governor) and the Annual Virginia TMDL Progress Report.[44] The Annual TMDL Progress Report describes progress the state has made in each step of the TMDL process and discusses needs for continuing to move successfully though the TMDL process. Among other things, the report highlights TMDL implementation case studies – both full successes where possible and improving trends or incremental successes. The annual report to the Governor includes a number of different measurable environmental outcomes that each of the state agencies, including VADEQ, has to report on (e.g., number of TMDLs completed, number of IPs completed, number of IPs being implemented, etc.).

VADEQ TMDL staff identified "program fragmentation" as the biggest obstacle they face in collecting information to report on water quality improvements. Numerous agencies (with multiple programs within each agency) are involved in these efforts; however, each of these agencies is driven by their own goals and by different sources of funding. VADEQ staff believes that identifying one or more common reporting goals would be a great challenge. VADEQ staff note that there have been gradual improvements over time with coordination of efforts and reporting on common measures (e.g., interagency and inter-program meetings are held to discuss ways to enhance data sharing and to identify measures that could be applicable to multiple programs); however, there is much work that still remains to be done regarding coordination. VADEQ staff believes that the bottom line goal is to try to link management measures and efforts to improvements in water quality. Availability of resources also drives the speed with which this coordination will be accomplished.

10.6.2. *Available Data*

VADEQ currently collects the following data and information for use in measuring water quality improvements: public health; water column chemistry; sediment; bacteria (fecal coliform); benthic assessment (e.g., biological diversity, taxa richness, species pollution tolerance, etc.); toxics; fish tissue; habitat (physical); toxicity testing; and flow /hydrological modification. These data are collected at both a site-specific and state-wide level (depending on the constituent). VADEQ also uses probabilistic monitoring techniques and trend analyses to support decision-making for water quality improvements. The state also monitors for point source discharger compliance, tests well-water, and tracks BMPs. VA DCR tracks a variety of information about BMPs (e.g., location, number of river miles, etc.). VADEQ coordinates with VA DCR on monitoring water quality upstream and downstream of BMPs in order to measure and track effectiveness of BMPs on improving water quality.

VADEQ works with VDH to determine shellfish water and fishery health. VADEQ also works with VA DGIF to determine the health, effectiveness, recreational values, and productivity of huntable and fishable populations within watersheds.

VADEQ has several different databases and spreadsheets for tracking water quality improvement monitoring data and information on TMDLs (development schedule, status, draft reports, final approved reports, public notice meetings, etc.); IPs; and monitoring and assessment. These databases, which include mapping functions, are accessible on-line.[45]

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[43] http://www.naturalresources.virginia.gov/Initiatives/WaterCleanupPlan/docs/ChesBayVaWatersCleanupPlan0107.pdf
[44] Available at: http://www.deq.virginia.gov/export/sites/default/tmdl/pdf/06prgrpt.pdf
[45] http://gisweb.deq.virginia.gov/ & http://www.deq.virginia.gov/tmdl/develop.html

VADEQ's ambient monitoring is carried out within a 2-year or 3-year (for some Chesapeake Bay monitoring) rotating basins program. As a result, some basins have data gaps (i.e., a rotation without data). VADEQ is, however, working to conduct monitoring in watersheds where significant implementation activities are underway. At this time, VADEQ TMDL group attempts to obtain sufficient water quality improvement tracking data to the extent resources allow. Also, there is a need to better standardize the tracking of implementation activities between agencies and stakeholders, including coordination efforts, prioritization, planning, budgeting, development, regulation and permit development, enforcement actions related to watershed management (NPS and PS), and monitoring of various groups' BMPs.

The greatest challenges VADEQ faces in collecting data to show progress toward meeting water quality standards for impaired watersheds include:

- Lack of sufficient funding (short-term budgeting);
- Lack of a standardized system that integrates historical and new impaired segmentation and assessment units into one database for tracking and evaluation; and
- Lack of standard implementation practices (i.e., prioritization, planning, development, and tracking), which minimizes duplication of efforts among all of the involved agencies, subgroups within agencies, and non-governmental stakeholders involved in implementation.

10.6.3. *Evaluating Watershed Improvement*

VADEQ evaluates improvements in impaired water bodies through follow-up monitoring (post-implementation) to collect data that are used for trend analysis (i.e., static, declining, improving, or attainment). Improvement determinations are made through comparison of post-implementation data against water quality criteria. VADEQ also works with local stakeholders to obtain information on whether recommended practices (from the IP) are occurring, the number of BMPs being implemented, and stakeholders' position on the result of implementation actions on water quality in the impaired segments. Historically, VADEQ's NPS program has used the number of BMPs installed (e.g., feet of fencing, miles of riparian buffer, number of repaired septic tanks, etc.) as a measure of the degree of water quality improvements. And while this information is useful and important to track, VADEQ TMDL staff believes that ultimately, the impact on water quality is what needs to be assessed. BMPs need to be linked to improvements (or lack of improvements) in water quality. VA is moving to such assessment methodology.

More than ten years ago, VADEQ reported on incremental progress toward improving water quality, as the state did not have full restoration or "major" success stories to report on. Following changes in the Federal Section 319 Program, VADEQ was reportedly told by EPA that "incremental success stories" are not useful for reporting on water quality improvements and that EPA would rather have "delisting success stories." As a result, a number of higher quality watersheds in Virginia with only a few exceedances of water quality standards were ignored. Years later, after it has now become apparent that there are very few "delisting success stories," VADEQ staff and EPA are now looking for different ways to show the effectiveness of actions on improving water quality (e.g., permits, BMPs, etc.) including reporting on interim progress, and no longer just 100% full attainment with water quality standards. VADEQ documents incremental improvements in impaired watersheds, in their annual Virginia TMDL Progress Report, the Virginia Chesapeake Bay and Impaired Water Clean-up Plan Report, the annual NPS Program Report, and on their TMDL Web page.

Currently, the greatest challenges VADEQ faces in evaluating data to show progress toward meeting water quality standards for impaired watersheds is a lack of funding to support adequate monitoring (both staff and analytical resources).

10.6.4. *Effectiveness Measures*

The State of Virginia has a strategic plan (the Chesapeake Bay and Virginia Waters Cleanup Plan[46]) for water quality. For the most part, the same "measureable environmental outcomes" are reported on from year to year (i.e., updates in meeting the various measures). VADEQ makes every effort to be consistent with both EPA and State strategic planning measures for water quality assessment and improvement. Further, VADEQ does not use preset criteria for selecting specific watersheds for use in reporting effectiveness measures. Rather, they report on all watersheds that have sufficient data to illustrate improving trends or attainment with water quality standards.

The Governor's Office requires that VADEQ report on measures that will fulfill SP-12 and other Federal target measures. VADEQ plans to use modifications to the reporting measures in the governor's report as the basis for reporting SP-12 measures of performance to EPA. VADEQ TMDL staff intend to report SP-12 measures using Option 2 because it uses the multiple lines of evidence approach which is perhaps the most objective of the methods to demonstrate watershed improvement.

Virginia is directing some funding toward monitoring to evaluate for improvements in general, as well as for SP-12 watersheds specifically. All monitoring, assessment, and TMDL development is implemented in Virginia with SP-12 (and other performance measures) in mind.

10.6.5. *Communication*

Water quality improvement results in Virginia are reported to the public through press releases, the 305(b)/303(d) Integrated Report, Annual TMDL Progress Reports, The Virginia Chesapeake Bay and Impaired Water Clean-up Plan Report, Annual NPS Program Reports, and via VADEQ's TMDL Web page. VADEQ has found that reporting water quality improvements to the public helps to increase momentum. Many different stakeholders (e.g., general public, local governments, and industry) and interested organizations have embraced VADEQ's clean-up plans (i.e., TMDLs) and are taking ownership of their watersheds often without regulatory intervention.

VADEQ has memorandums of understanding in place with EPA, DGIF, VDH, VA DCR, VA DMME, USACE, DOF, and USGS to provide information regarding watershed and water quality improvements. Many of these agencies also share information with VADEQ (e.g., VADEQ provides sediment and fish tissue data to VDH and VDH provides VADEQ with shellfish data). The Virginia General Assembly expects reports from VADEQ on a regular basis that answer an array of questions they have regarding the quality of the state's waters.

10.6.6. *Case Studies*

<u>Lynnhaven Bay</u>

Lynnhaven Bay is one of Virginia's significant water body restoration success stories. Lynnhaven Bay had been closed for shellfish harvesting due to elevated levels of fecal coliform bacteria since the 1930s. Through the TMDL process, VADEQ successfully engaged the City of Virginia Beach and the City Council passed a resolution to clean up Lynnhaven Bay. Following the TMDL, stakeholders, including the Hampton Roads Planning District Commission and the City of Virginia Beach, worked together to develop an Implementation Plan for the TMDL. Over the course of two and a half years, the following infrastructure problems were addressed: failing septic systems were repaired or replaced; a no discharge zone for boating was designated for the bay; a number of stormwater BMPs (e.g., retention ponds, solar-powered aerators, anti-microbial mats in storm drains, etc.) were put in place; and wetlands were reclaimed. All of these actions contributed to

[46] http://www.naturalresources.virginia.gov/Initiatives/WaterCleanupPlan/docs/ChesBayVaWatersCleanupPlan0107.pdf

attainment with water quality standards and the re-opening of Lynnhaven Bay for shellfishing. A lack of rainfall may have been a contributing factor in bacteria declines, and monitoring will continue.

Muddy Creek

Muddy Creek, which was impaired by bacteria, is occupied by the Virginia Amish community. Through VADEQ's persistent outreach efforts, the state developed a relationship with the leader of the community. As a result, the community decided to take it upon themselves to clean up Muddy Creek without state or Federal funding assistance. To address livestock and cropland contributions to the water quality problem, the agricultural community developed systems to manage waste, reduce soil compaction, and minimize runoff from livestock resting areas. The community has been very successful in its efforts and water quality has significantly improved to the point that the water body is very close to attaining water quality standards.

10.6.7. *Future Assistance*

VADEQ has identified the following issues and needs for enhancing their programs and processes for measuring, tracking, and reporting on water quality improvements:

- Improved coordination among different agencies, divisions within agencies, stakeholders, etc. on efforts to implement restoration activities, as well as measure, track, and report on those activities;
- A majority of Virginia's state waters are impaired due to nonpoint source issues. VADEQ would like EPA to place greater emphasis and focus on addressing nonpoint source issues and supporting projects that examine things such as linking the effectiveness of BMPs to changes in water quality for NPS-impaired streams;
- VADEQ would appreciate greater flexibility (from EPA) to address certain impairments (mainly nonpoint source) with more efficient development of a TMDL(s);
- EPA needs to provide a TMDL implementation tool of last resort (regulatory) for nonpoint source pollutant sources; and
- Much of what VADEQ and other state agencies do is driven by a consent decree. For example, 700-750 TMDLs have been completed in Virginia; however, only 60-70 of those TMDLs have Implementation Plans in place. The driving force of the TMDL process has been to meet the requirements of that consent decree (i.e., developing TMDLs). VADEQ recognizes that after the requirements of the consent decree are met development of TMDLs will still be a high priority. However, more timely improvements in water quality will be emerging as a priority. EPA and the states will need to focus on resolving the impediments to TMDL implementation and restoration. Accelerating the pace of restoration and attainment successes depend upon two things. First there has to be a continuing commitment of fiscal and human resources for TMDL effort. Second there needs to be the adoption (preferably Federal) of a TMDL implementation tool of last resort (regulatory component) for reductions in the nonpoint source contributions. It only takes a few non-participants to prevent the restoration of impaired waters.

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10.7. Washington

10.7.1. *Overview of Current Programs*

Several programs within the Washington Department of Ecology (WA DOE) measure and track water quality improvements, including but not limited to the following programs: Ambient Monitoring Program, Status and Trends Monitoring for watersheds, Environmental Monitoring and Assessment Program (EMAP), Water Quality Assessment, wastewater discharge, nonpoint source pollution planning, financial assistance grants and loans programs, Water Cleanup Plan (TMDL) Program, TMDL effectiveness monitoring program, Intensive Monitored Watershed for Salmon Recovery Program, Puget Sound Water Quality Management Planning, Ground Water Management Planning, and the Underground Injection Control Program, as well as the Family Forest Fish Passage Program within the Washington Department of Natural Resource (WA DNR). These programs do not manage information within a single, integrated tracking tool, but such a tool would be beneficial.

The WA DOE is the delegated agency primarily responsible for implementing the requirements and provisions of the Clean Water Act and its data collection and reporting requirements. The majority of WA DOE's monitoring resources are housed in the agency's Environmental Assessment Program (EAP). The program receives funds from sources such as state general funds, dedicated funds (i.e., water quality permit fees), and EPA 319 and 106 grants. The program has also received money from a county for effectiveness monitoring evaluation, though this is rare. The effectiveness monitoring program within EAP tries to develop partnerships with other agencies to measure and track watershed improvements statewide. Previous partnerships included working with King County and many of the County Conservation Districts. Currently, one member of the TMDL effectiveness monitoring staff is working with Clark County Clean Water Program to assess the effectiveness of BMPs on Salmon Creek. This level of program participation varies from year to year.

WA DOE uses the EAP Study Tracker database for tracking studies that include effectiveness monitoring. The tracking process involves logging final data into another database, called Environmental Information Management (EIM), whose outputs (mostly numerical) are available for comparing with TMDL targets and water quality criteria. EIM data outputs containing information related to effectiveness monitoring projects are available online.[47] Another database, Watershed Attainment Tracking System (WATS), contains limited information on implementation activities and monitoring projects. The WATS database is available on the internet and accessible to the public. The TMDL database includes information on TMDL status, scheduling, and implementation activities and integrates more mapping capabilities. The TMDL database is not yet public-accessible. Eventually, the TMDL database will be made available to water quality professionals and key planners to aid with implementation.

A major obstacle to the state's water quality improvements monitoring program is inadequate funding. Both the Water Quality and Environmental Assessment Programs produced an assessment of the workload to meet the 15-year schedule in the memorandum of agreement with EPA and to address the impaired waters on the 1998 303(d) list. The EAP assessed the workload to conduct effectiveness monitoring for all of the TMDL projects on the 2004 list, plus all of the TMDLs that have already been completed. Following this process, the program estimated that it would take 10 staff people and $230,000 in lab funds per year to accomplish the work by 2014. The EAP presently has three staff people and $80,000 per year (in addition to the salaries for the three staff people) to support effectiveness monitoring. This translates into a shortfall for effectiveness monitoring of 7 FTEs and $150,000 in lab funding per year.

[47] Available at: http://apps.ecy.wa.gov/eimreporting/Search.asp

Another obstacle to monitoring the effectiveness of TMDLs is the lack of ability to track all of the activities occurring in the watershed that might impact water quality. This is related to the difficulty in designing monitoring that accounts for potential impacts from unknown watershed activities.

The resources committed to TMDL-associated efforts focus on development of TMDLs, so other program elements such as implementation and monitoring get the amount that is left.

10.7.2. *Available Data*

WA DOE routinely measures physical and chemical indicators for the aquatic environment to assess attainment with water quality standards or impairment of beneficial uses. Additional indicators may be added 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. The following core indicators are routinely measured by WA DOE: dissolved oxygen; temperature; pH; conductivity; turbidity; total suspended solids (TSS); stream flow; fecal coliform; e. coli (included in BEACH program and some TMDLs); total phosphorus/soluble reactive phosphorus; total nitrogen (nitrate-nitrite); ammonium ion; chlorophyll a; water clarity; total mercury at 12 stations bi-monthly; total recoverable: arsenic, cadmium, chromium, copper, lead, nickel, silver and zinc at 12 stations bi-monthly; and hardness. Ambient monitoring of these parameters is conducted by WA DOE once per month at 62 permanent stations (which translates to approximately 1 to 2 stations per watershed) and 20 rotating stations at chosen locations (i.e., where TMDLs are being developed, where a permit is up for renewal, etc.).

Increasingly biological data are collected through EPA's EMAP and WA DOE's Status & Trends monitoring programs. In some instances, WA DOE would like to substitute biological monitoring for water quality indicators that are costly to measure (e.g., toxics) or have a transient nature (e.g., dissolved oxygen). Surrogate data such as biological conditions can only be used for tracking interim targets, but not for final decisions upon standards compliance. WA DOE previously had a bioassessment monitoring program that included sampling at reference sites, but recently lost the staff associated with this program. WA DOE is concerned about the use of bioassessment data because of past EPA applicability concerns. As there are no numerical criteria for biological indices, assessing conditions can sometimes be difficult.

WA DOE would like to collect information on BMPs such as degree of use, cost of implementation, and performance. These data would be useful to associate monitoring data with the effects of implementation activities. Conservation District programs have this type of data, but it is often difficult for WA DOE to gather the information. It would be helpful if EPA disseminated information related to BMP effectiveness and applications to nonpoint sources—especially for the arid Western States. WA DOE staff feel it is difficult to isolate and account for variables to provide certainty that water quality conditions are a direct result of TMDL implementation.

10.7.3. *Evaluating Watershed Improvement*

Washington State's 303(d) list is based on stream segments whose boundaries are defined by land grant township-range section lines. As a result, the average length of a segment is about one mile. Since the list is organized by pollutant parameter/segment combinations, effectiveness monitoring and improvement evaluation focuses on the same combinations. Improvements have always been evaluated on a watershed basis when communicating with the public. The new EPA performance measures have increased the breadth of improvement evaluations as WA DOE looks for potential future success stories. WA DOE has not performed evaluations on a scale larger than Option 1 under SP-12 reporting. Option 1 of SP-12 reporting requires a great deal of data, but is more simple and straightforward than the other options. WA DOE staff feel that Option 2 is even more data-intensive (e.g., Option 2a would require a robust statistical assessment of the data).

Washington State's effectiveness monitoring program uses an approach and rationale for selection of monitoring designs and sample sites that best serve its monitoring objectives. In support of the overall objective, the monitoring is designed to provide information on the condition of the watershed, which will improve future management decisions. For example, the monitoring design for most watershed restoration projects or TMDLs includes multiple means of assessing the quality of water and the support of beneficial uses. The elements of the monitoring design support the determination of whether water quality standards or TMDL target limits are being met from the watershed restoration activities or implementation of the TMDL. The final effectiveness monitoring plans incorporate appropriate methods to control decision errors and balance the possibility of making incorrect decisions with known levels of precision and confidence.

To evaluate whether water quality is improving, WA DOE looks at long-term trends in data that have been collected over time. They evaluate information from monitoring projects conducted through grant and loan projects, volunteer monitoring, directed studies, and other means to compare with previous data and water quality criteria. This information is compiled in EIM and packaged into watershed-focused information documents for general audiences as success stories.

WA DOE uses a five-year rotating basin schedule to determine when and how TMDLs, Watershed-Based Plans, and other watershed restoration strategies should be re-evaluated. Specifically, every five years, a watershed area is up for re-evaluation by the TMDL staff. Where implementation measures and other activities have had adequate time to be effective, effectiveness monitoring evaluation projects are carried out to determine the effectiveness in meeting targets and standards. Where implementation has been accomplished but does not seem to be adequate to meet standards, the TMDL may be revised.

Apart from inadequate funding, WA DOE staff feels that there is not enough systematic planning and documentation of implementation activities or restoration projects within the state. This information is critical in effectiveness monitoring projects to show progress toward meeting water quality standards for impaired watersheds. WA DOE does not routinely use biological measures to assess attainment of beneficial uses, and samples only a small subset of the 340 water quality criteria adopted in state or Federal regulations. Consequently, water quality condition is only partially assessed.

10.7.4. *Effectiveness Measures*

WA DOE uses state strategic planning measures directed from the Governor's office to track progress in achieving water quality improvements. An attempt to correlate national measures with state measures is made wherever possible.

WA DOE uses a 2-phase process to select candidate watersheds for reporting effectiveness measures: WA DOE's scoping process and the Environmental Assessment Program's annual project planning process. This scoping process involves the original TMDL developers, project managers, agency planners, TMDL/Watershed leaders, and local partnerships to determine which watersheds are ready for effectiveness monitoring. In the second phase, the EAP undertakes an annual project planning process to prioritize monitoring project requests from regional and headquarters staff, and watershed leaders statewide. The annual process leads to staff and laboratory funding allocation decisions and determines to a large degree which specific TMDLs, intensive studies, annual monitoring locations, etc. will be implemented the following year.

WA DOE feels that the national performance measures (e.g., SP-12) lack specific target levels for concluding the confidence that is ascribed to a conclusion on attainment of water quality criteria and standards. If comparability and consistency are objectives in the performance measures, then this is one area that should be addressed. WA DOE feels that if each state and region is left to its own metrics, then this should be acknowledged. WA DOE's monitoring strategies can be modified to address the confidence targets, if known. Otherwise, outputs from WA DOE's data can be compiled to address performance measures, but the

conclusions will not be comparable to other states. WA DOE feels that Measure SP-12 should be revised to allow reporting on more incremental watershed improvement (*note: EPA has since confirmed that Option 2 does allow for reporting on incremental improvements)*. WA DOE uses smaller stream identification numbers than most states, which can cause consistency problems.

WA DOE plans to report improvements by using Option 1 under SP-12. Projects that include monitoring in 2002 impaired water segments will be initiated soon so that results are available prior to the initiation of the 2012 water quality assessment.

Washington is not directing funds specifically to monitoring for SP-12 reporting purposes; however, activities that provide information for SP-12 reporting among other objectives are funded. Washington is beginning to modify their approach to effectiveness monitoring to include sampling and data analysis to address SP-12 (HUC 12 watershed scale) metrics that are likely additional, different locations than the original TMDL segments.

10.7.5. *Communication*

WA DOE maintains a well-developed public website, which it uses as an effective communication tool. The range of users varies from the general public and community-based organizations to other agencies, academia, scientists, and consulting firms. WA DOE publishes monitoring program summaries, Water Cleanup Plan (TMDL) Technical Reports, TMDL effectiveness monitoring reports, integrated reports on water quality, watershed plans, NPDES studies, nonpoint source studies, and numerous other documents every year. In addition to these reports, WA DOE contributes specific data or summary information to a variety of regional and national water quality and environmental indicator reports such as the State of Salmon in Watersheds Report, EPA's National Coastal Condition Report, and the Georgia Basin/Puget Sound Environmental Indicator Report. Other communication measures include focus sheets, conference presentations, EPA reports on success stories, and presentations to local watershed groups.

WA DOE is required to submit data to EPA and the Governor's Government Management, Accountability, and Performance Process (GMAP) and state legislature, but also contributes specific data or summary information to a variety of regional and national water quality and environmental agencies such as USGS, U.S. Fish and Wildlife, NOAA, State Fish and Wildlife, WA DNR, counties, cities, conservation districts, litigants, and the general public. WA DOE also voluntarily submits information to watershed and volunteer monitoring groups.

10.7.6. *Case Study*

<u>Portage Bay and Nooksack River</u>

Portage Bay and a portion of the lower Nooksack River are located on the Lummi Indian Reservation in western Washington. Fecal coliform loadings from upstream dairy and livestock operations, municipal wastewater treatment plants, and malfunctioning septic systems caused a portion of Portage Bay to be closed to commercial shellfish harvesting. Monitoring in 1997 and 1998 showed that numerous segments in the lower Nooksack River Basin violated Washington's water quality standard for fecal coliform bacteria in freshwater. The lower Nooksack River is a Class A water, which requires that fecal coliform levels not exceed a geometric mean value of 100 colonies (col) per 100 milliliters (mL) and not have more than 10 percent of all samples obtained for calculating the geometric mean value exceed 200 col/100 mL. In 1996 and 1998 Ecology added 20 Nooksack River Basin segments to the state's CWA section 303(d) list for fecal coliform impairments.

In June 2000 Ecology developed a TMDL establishing fecal coliform pollution limits for the Nooksack River Basin. Ecology worked closely with the Lummi Nation, Whatcom Conservation District and other

stakeholders to develop and implement 2002 detailed implementation plan to help guide efforts to reduce fecal coliform loading. Through the development of the TMDL, state implementation of new dairy industry regulations, permit modifications, and treatment plant upgrades, fecal coliform concentrations have been reduced by 63 percent in the Nooksack River and between 40 and 80 percent in its major tributaries. Approximately 75 percent of the "restricted" (based on National Shellfish Sanitation Program standards) Portage Bay shellfish beds have been upgraded to "approved" for shellfish harvesting.

Data show that three segments—the two uppermost segments of Double Ditch Drain (tributaries of Fishtrap Creek) and the uppermost segment of Tenmile Creek—have consistently met both water quality standards and TMDL targets, prompting Ecology to remove them from Washington's impaired waters list in 2008. Recent data show that the mainstem Nooksack River meets both the water quality standards and the more stringent TMDL targets at a number of monitoring sites. Data also show that many of the tributary segments are meeting the first part of the standard (100 col/100 mL geometric mean) but do not yet meet the second part (no more than 10 percent > 200 col/100 mL) or the more stringent geometric mean TMDL targets. Ecology is continuing to monitor progress to determine if additional segments should be removed from the list of impaired waters in the future.

Dungeness River and Matriotti Creek

The Dungeness River and Matriotti Creek (a tributary of the Dungeness River) were placed on the state's 303(d) list for fecal coliform contamination. Similar to Portage Bay, shellfish beds in Dungeness Bay (downstream of the Dungeness River) were closed to commercial shellfish harvesting. High bacteria levels are attributed to failing septic systems and improper management of livestock and pet wastes. Fecal coliform TMDLs were approved for several streams in the Dungeness River basin, including Dungeness River and Matriotti Creek, and for Dungeness Bay.

The Clean Water Work Group, a consortium of local and state agencies and interested individuals, worked to identify bacterial sources and cleanup methods and to coordinate cleanup activities in advance of the TMDL. The Clallam Conservation District worked with local farm operators to develop conservation plans and implement agricultural BMPs. Clallam County Environmental Health addressed failing septic systems by developing an operations and maintenance plan and distributing educational materials about proper septic tank maintenance. The Jamestown S'Klallam Tribe coordinated post-TMDL monitoring and used 319 grants to support cleanup projects and sponsor public outreach activities. All sites monitored in Matriotti Creek have shown improvement in fecal coliform levels and several sites are meeting the TMDL target levels. Concentrations in the Dungeness River have slightly improved during the irrigation season. Unfortunately, shellfish harvest restrictions still remain in portions of Dungeness Bay.

Lower Yakima River

Erosion from irrigated agricultural areas caused the lower Yakima River in south-central Washington to be impaired by suspended sediment, turbidity, and the pesticide DDT. A TMDL was established by the WA DOE and a partnership between two irrigation districts was formed to implement the TMDL. The partnership worked with local farmers and other landowners to establish a comprehensive Water Quality Policy that set on-farm turbidity targets. If the targets are not met, the landowner is responsible for submitting both a short-term and long-term Water Quality Plan to describe how the targets will be achieved. In addition to using various erosion control BMPs, farmers voluntarily converted over 20,000 acres of land from using water-intensive and erosive irrigation methods to using sprinkler or drip systems. Effectiveness monitoring indicated that TMDL targets for turbidity were met for three of the four major agricultural drains and a load reduction of approximately 80 percent was achieved in the fourth drain. A comparison of 2003 sampling data to data collected in 1995 in the Yakima River mainstem showed reductions of suspended sediment loadings ranging from 50 to 70 percent.

10.7.7. *Future Assistance*

WA DOE considers inadequate funding to be a major obstacle to the state's watershed improvement monitoring program. WA DOE has estimated a shortfall for effectiveness monitoring of 7 FTEs and $150,000 in lab funding per year. Often, TMDL implementation and monitoring are funded with whatever is left after TMDL development. Monitoring is perceived as less productive in terms of restoring waters, but it is vital to assessing watershed improvement.

WA DOE feels that the national performance measures (e.g., SP-12) lack specific target levels for concluding with confidence on the attainment of water quality standards. WA DOE also feels that Measure SP-12 should be revised to allow reporting on more incremental watershed improvement .

10.8. Wisconsin

10.8.1. *Overview of Current Programs*

Wisconsin has over 15,000 lakes, 32,000 miles of perennial streams, and 5.3 million acres of wetlands. Over 640 waters are listed on Wisconsin's 303(d) Impaired Waters List. The task of monitoring each water body is daunting. To manage this effort, the Wisconsin Department of Natural Resources (WDNR) designed a monitoring program that includes three tiers of monitoring.[48] Tier 1 employs standardized sampling protocols used to collect statewide data. This approach ensures broad spatial coverage of state aquatic resources, and is designed to identify broad trends and water quality issues. Where water quality issues are flagged, more intensive sampling occurs under Tier 2 to determine the cause and extent. WDNR is currently developing the numeric criteria that will trigger Tier 2 monitoring. This site-specific monitoring of targeted areas can be used to develop management plans for corrective action. Tier 3 employs follow-up studies on targeted waters to determine the success of management actions. Tier 3 monitoring is also used to evaluate levels of compliance of facilities regulated for effluent discharges to waterways, and to determine effectiveness of permit conditions. Other efforts associated with Tier 3 include the following programs, which are funded through both state and Federal funds:

- Runoff Management Program: WDNR has been trying to encourage watershed-based tracking of the administrative aspects of agricultural performance standards implementation.[49] However, this tracking is currently conducted on a county basis (not a watershed basis) due to county staff reporting. At the county level, tracking includes: level of commitment of staff and cost-sharing, partner arrangements, ordinance development, tracking compliance, informing landowners, and information and education efforts. County staff are also asked to estimate levels of compliance with performance standards and manure management prohibitions based on on-site visits.
- Wisconsin Pollutant Discharge Elimination System (WPDES) Program: In most cases, permittees responsible for whole effluent toxicity (WET) testing are required to collect receiving water samples (upstream and out of the influence of the permittee's outfall) to be used as diluting substances or controls in the tests. For most WET tests being completed, background ambient toxicity is also being measured. Receiving waters samples used in WET tests are also analyzed for temperature (upon collection), hardness, alkalinity, ammonia, and pH. In addition, chemistry samples are collected at outfalls for WPDES compliance. WDNR allocates approximately $15,000 per year as a basic agreement with point sources; however, this monitoring is not mandatory and the recommendation to monitor is at the discretion of the wastewater basin engineer.
- Citizen Based Monitoring Program: Since the amount of data collection for Tier 3 monitoring is limited, there are a few projects in the state where citizens are volunteering to collect data to document changes due to recent conservation efforts (installation of BMPs).[50] The goals of the monitoring programs are to alert WDNR staff that waters are responding to the practices and to ultimately remove waters from Wisconsin's Impaired Waters List.
- Stormwater Program: WDNR's stormwater program includes 12 ongoing urban monitoring projects to evaluate performance and effectiveness of stormwater BMPs. Evaluation of different types of control measures for stormwater has helped to develop technical standards and performance standards for Wisconsin administrative rules in the past, and helps the state to identify gaps and needs for the future.

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[48] http://dnr.wi.gov/org/water/monitoring/strategy.htm (EPA reviewed the monitoring program in 2006 and approved of the approach)

[49] Wisconsin's administrative rules for agriculture can be found at: http://dnr.wi.gov/runoff/admrules.htm

[50] An example citizen based monitoring program is described at: http://watermonitoring.uwex.edu/level3/impaired.html

Wisconsin's monitoring program is not 100 percent implemented due to other program priorities and lack of funding. Since the majority of available fiscal and staff resources are used for the Tier 1 program, WDNR currently has minimal staff hours available to support efforts to collect, analyze, and evaluate data to measure and track water quality improvements. A small amount of funding is provided for laboratory services related to water quality improvements monitoring. WDNR is currently conducting a work planning analysis to develop a better feel for current staff and state funding available for the monitoring program. However, a gap analysis was completed for the state in 2001 to look at projected costs needed for monitoring. At that time, $3.9 million dollars was dedicated to Tier 1 monitoring efforts (including fish assessments). An estimated cost of $4.6 million, including 38.7 FTE positions, was projected as the additional funding needed to implement a robust monitoring program; approximately $1 million of this amount would be needed specifically for Tier 3 monitoring. WDNR suspects that this funding gap is greater now due to the loss of 104(b)3 grants and state funds, and fisheries moving to a different bureau.

Portions of staff time and funding are allocated from Federal Section 319 Incremental and Section 106 Supplemental Funds as shown in Table 1.

Table 1. Federal Funding Amounts per Current EPA Grants

Grant	FY 2008	FY 2009
Section 319 Incremental	$41,749	$11,469
Section 106	$2,922	$16,986

Other funding is not widely available, but collaboration exists among local universities and colleges, USGS, Land and Water Conservation Departments, and other agencies to help WDNR meet its goals for measuring and tracking water quality improvements in Wisconsin.

Currently Wisconsin is trying to integrate tracking watershed effectiveness monitoring data and reporting requirements by:

- Watershed planning;[51]
- Impaired waters listings and delistings; and
- Watershed assessment measures (Region 5 Environmental Performance Partnership Agreements (EnPPA) and the core performance measures that are part of the EnPPA), including those coordinated by Federal agencies by use of the state's WATERS (Water Assessment, Tracking, and Electronic Reporting System) and SWIMS (Surface Water Integrated Monitoring System) databases.

In Wisconsin, one barrier to successful evaluation of watershed improvement is having a very limited understanding of the reasons why many of the state's water bodies were placed on the 303(d) list. Monitoring data and subsequent documentation of the reasons for listing water bodies prior to 2006 are very sparse. In many cases, the reasons for listing were anecdotal and without quantitative data to support the decision. Beginning in 2006, WDNR has improved its documentation of reasons for including a water body on the state's impaired waters list.

Furthermore, the number of cases where watershed improvements would be expected is minimal and mostly associated with implementation of the state Priority Watershed Program. This program provides financial assistance to local units of government in selected watersheds to address land management activities that contribute to runoff. The program is scheduled to expire in 2009 and funding will be exhausted in 2010 for the last few counties that were Priority Watershed grant recipients. Over time, funding allocations for the

[51] http://dnr.wi.gov/org/water/watersheds/planning/

Priority Watershed Program were reduced and often follow-up monitoring was not funded toward the end of the projects.

In addition, WDNR's monitoring program has been substantially modified in the past 10 years to reflect a dwindling resource base—both funding and staff. The program places a higher priority on Tier 1 (Statewide Baseline Monitoring) and Tier 2 (Targeted Evaluation Monitoring), leaving very little for Tier 3 (Management Effectiveness and Compliance). It is possible that some additional Federal (Section 106) funding may be available for Tier 3 monitoring in future years, but it is too early to project how much.

As noted above, the Priority Watershed Program is the main program where implementation of water quality management actions has occurred in recent years. With the program ending in 2009, WDNR will need to turn to implementation actions linked to TMDLs to improve water quality. This will require more resources for monitoring, modeling, and developing TMDLs, as well as funding for implementation for completed TMDLs. Funding is the critical link—especially in Wisconsin where state law currently prevents WDNR from requiring BMP installation and management if WDNR cannot provide 70 percent of the cost of the BMPs (under most circumstances).

10.8.2. *Available Data*

WDNR collects various data and information to measure and assess water quality improvements. The collected data and information vary by site, pollutant, and impairment and include, but are not limited to: water chemistry data (in-situ, grab samples, or effluent samples), biological indicators (fish and macroinvertebrate populations), and qualitative data such as aquatic habitat and streambank erosion surveys. In addition, WDNR is starting to collect land use data and record where BMPs have been installed to help track water quality improvements.

As mentioned above, WDNR currently uses the state's SWIMS[52] database to manage chemical, biological, and physical data. WDNR plans to expand the programming in the WATERS[53] database to track assessment and planning, effectiveness monitoring data, SP-12 indicators, and performance measures (from the beginning of a project to post-implementation monitoring).

WDNR would like to expand its current tracking efforts to include the following:

- Collect additional flow data for use in determining loading estimates;
- Gain better access to property/landowner-specific implementation actions funded with National Resources Conservation Service (NRCS) cost sharing. Currently, WDNR is unable to tie NRCS-funded BMPs to a location and a particular water body;
- Incorporate QA/QC elements into all surface water monitoring projects;
- Track training information (of data collectors) and documentation of standard procedures and methods;
- Incorporate standard protocols/methods and target specific water quality standards and endpoints (in development);
- Compile data from the counties and WDNR regional staff conducting watershed response monitoring to land use changes, and updating assessment data in databases derived from that monitoring;
- Collect data on percent imperviousness at the subwatershed level;

[52] http://dnr.wi.gov/org/water/swims/
[53] http://dnr.wi.gov/org/water/WATERS/

- Incorporate stream stability measures;[54] and
- Incorporate overall water quality attainment by watershed and subwatershed.

The greatest challenges facing Wisconsin in collecting data to show progress toward meeting water quality standards include:

- Competition for limited funding to conduct monitoring of all types;
- Reduction in both staff and the funding available for equipment, analytical support, and travel, which has reduced the number of sites that can be monitored;
- Gaining a clear understanding of the causes of "impairment" so that WDNR can efficiently monitor the correct parameters when evaluating for water quality improvements;
- A general reticence of program managers to concentrate monitoring efforts in a particular basin or watershed. A wider distribution of effort seems to be more appealing than monitoring a small number of basins or watersheds more holistically. This statewide approach results in a large number of sites being monitored, but less data being collected to measure progress in the selected water bodies; and
- Unrealistic expectations of the public and Legislature. Due to variation in water response time, it may take decades for many streams and lakes to respond to implementation measures and show improvement.

10.8.3. *Evaluating Watershed Improvement*

WDNR is currently developing an assessment strategy to evaluate how biological or chemical parameters will be used on an individual segment/water body/watershed basis and in turn, defining a more consistent, focused process for evaluating improvements. This strategy will result in objective, consistent "scoring" of water quality, which will allow comparisons after management practices have been applied.

Currently, evaluating the effectiveness of a watershed project is based on a qualitative assessment of water quality. A concentrated effort to install BMPs in one area is helpful. At that point, the water body is monitored to see if physical and chemical parameters are showing a response to implementation efforts and meeting water quality standards. Monitoring data from before the project is desirable for comparison to post-implementation results, but sometimes is not feasible.

Clear guidance for whether or not a water body is meeting its designated use will be outlined by Wisconsin's Assessment Methodology (under development). To date, the state has used chemical and biological data (including habitat, fish, and macroinvertebrate surveys), as well as best professional judgment to determine whether or not the water body is meeting its designated use.

WDNR is currently exploring using non-traditional data, such as biological responses and social and behavioral aspects in the watershed to measure incremental improvements.

WDNR is also currently developing guidance for the Impaired Waters Program (which includes watershed based TMDLs) and the process of re-evaluating watershed restoration strategies will be considered. WDNR hopes that through the development of the WATERS database, they will be able to review and track implementation/restoration information. This information will allow WDNR to determine whether a water body has successfully responded to BMPs or whether the TMDL has to be re-evaluated.

[54] http://www.epa.gov/warsss/

WDNR feels its greatest challenges in evaluating data to show progress toward meeting water quality standards include:

- The lack of a definitive Assessment Methodology. For more than two years, WDNR has been attempting to develop a more definitive process for assessing water quality. This document has not been completed and must be to standardize the decision process;
- EPA's policy on independent application of water quality assessment approaches. There are many water bodies that display a robust and balanced fish and aquatic life community even though a numeric water quality criterion is occasionally exceeded. Professional judgment and appropriate documentation should be allowed in these circumstances to show that a water body is meeting national and state water quality goals; and
- A substantial amount of monitoring is often required for some water bodies to capture the central tendency of the measurements amidst natural variations in water quality. Due to the program limitations described earlier, the state rarely has the amount of data needed to characterize overall water quality in such water bodies.

10.8.4. *Effectiveness Measures*

WDNR is beginning to use strategic planning measures developed by the WDNR Impaired Waters Team to measure water quality improvements, ranging from assessing water bodies for 303(d) listing to re-evaluating the waters after implementation of TMDLs.

On a regional level, EPA and Region 5 states have worked closely to develop a set of five shared environmental goals to enhance joint efforts to protect and restore valuable water resources and to measure accomplishments. The enumeration of measurable goals is a significant step in collectively defining the long-term vision for clean and safe water. The goals will be used to more comprehensively report on the progress in, and status of, improving water quality in the Great Lakes Region. The agreed upon shared environmental goals are:

- Goal 1: All waters in Region 5 will support healthy aquatic biological communities.
- Goal 2: All waters in Region 5 will support fish populations with safe levels of contaminants.
- Goal 3: Designated swimming waters in Region 5 will be swimmable.
- Goal 4: All people in Region 5 served by public water supplies will have water that is consistently safe to drink.
- Goal 5: The quantity and quality of critical aquatic habitat in Region 5, including wetlands, will be maintained or improved.

These goals will assist EPA and Wisconsin in joint priority setting and planning to more effectively target their programmatic work.

WDNR selects candidate watersheds to be used for reporting effectiveness measures where BMPs have been implemented and there exists potential for meeting water quality standards in the near future. A review of progress is completed with local project coordinators and local government agencies.

WDNR does not feel that the state's existing monitoring strategies are effective at addressing the needs of national performance measures such as SP-12. WDNR has used available data to meet the needs of measures SP-12 to date; however, based on above-listed challenges and barriers, improvements need to be made to meet target measures in the future.

Historically, WDNR has used subjective data analysis in the spirit of a "weight of evidence" comparison to show that watershed conditions have improved. For example, if fish populations have returned to a given water body after BMPs have been implemented, the water body may be considered to be restored. As the state's Assessment Methodology is completed, a more objective approach to establishing baseline conditions and a more objective approach (data driven) to evaluate post-implementation conditions will allow a more thorough demonstration of improvements on both a water body segment and watershed scale. Options 1 and 2b are the primary options that Wisconsin will be using to demonstrate improvement under SP-12.

Wisconsin does direct some funding to evaluation of SP-12 waters; however, the exact funding amount is difficult to quantify. The following watersheds are currently being monitored or have been monitored in recent years specifically for SP-12 reporting: Adams Creek - LaCrosse County; Bass Lake - Marinette County; German Valley Creek - SW Dane County; Lake Superior - Allouez Bay; Little Hay River - Chippewa County; Otter Creek - Sheboygan County; Silver Lake - Manitowoc County; and Upper Sugar River - Dane County.

Wisconsin has not altered or expanded their monitoring programs to gather information specifically for SP-12 reporting; however, their current monitoring program includes a component to allow for "management evaluation" monitoring and the state directs a limited amount of funding to that component annually. The sampling design is case-specific and is intended to show whether or not previous on the ground management has resulted in environmental success.

10.8.5. *Communication*

The WDNR website provides tools that the public can use to find information on water bodies, including the Surface Water Data Viewer.[55] Wisconsin reports water quality improvements in the 305(b) reports and 303(d) delisting processes.[56] WDNR has several programs that highlight success stories on their website. Press releases, the WDNR Natural Resources Magazine, and fact sheets are other tools that have been used in Wisconsin to report successes. However, WDNR feels that communication is an area that can be improved. Once the state has more water quality improvements and success stories to share, dispersing information about these positive developments may help WDNR to gain buy-in from citizens and stakeholders across the state and get the message out that there is hope for restoring water quality. Currently WDNR does not have an effective tool to gauge what sort of impact reporting has had on the public.

WDNR is required to provide information regarding watershed and water quality improvements to EPA, the Wisconsin State Legislature, and the Land and Water Conservation Board. Though not required, WDNR also provides watershed and water quality improvement data to USGS, various universities, and the public through the WDNR website. Some information is provided through periodic "Basin Briefs" newsletters to the public as well.

10.8.6. *Case Study*

The Narrows Creek in south-central Wisconsin had long been known as a prime fishing area for smallmouth bass and many other species of fish. Over the years, the fishery declined due to poor water quality and lack of habitat. By 1987, the bass population was described as poor. In 1989, WDNR selected the 175 square-mile Narrows Creek-Middle Baraboo River watershed as a priority watershed project. Sauk County began implementing the project on October 27, 1992, and it officially ended December 31, 2005.

Located in central Sauk County, the project area encompasses 175.6 miles of streams and rivers and 2 impoundment lakes. A portion of the watershed is partially located in the driftless region, characterized by steep hillside slopes and narrow valleys. The remainder of the watershed lies within the outwash plain of

[55] http://dnrmaps.wisconsin.gov/imf/imf.jsp?site=SurfaceWaterViewer
[56] 2008 was the first year Wisconsin submitted an integrated report to encompass both of these processes.

glacial Lake Wisconsin with topography ranging from gently rolling hills to steep slopes. The majority of the watershed is agricultural, primarily dairy farming. The topography combined with agricultural uses creates a high potential for water quality impacts from nonpoint source pollution.

The project met and exceeded 3 of its 4 specific goals. The accomplishments include:

- Reduction of phosphorus loads by two-thirds (16,500 pounds/year) with the installation of 178 barnyard runoff control systems. 148 of these projects were in the high priority sub-watersheds allowing staff to exceed goals by targeting sites in these critical areas.
- Reduction of sediment loss from cropped fields by nearly 3,700 tons/year, meeting 83% of the reduction goal and 17% of the total upland sediment load.
- Reduction of streambank erosion by 6,306 tons/year with the installation of 16,139 feet of rock riprap protecting streambanks and instream habitat.
- Control of sedimentation from gully erosion by 4,017 tons/year.

The success belongs to the landowners in the watershed. Seventy-five percent of the eligible landowners committed to the project and worked with county staff to implement conservation on their properties. State expenditures for installing conservation practices totaled $3.8 million, which was below the plan's projections. The community's dedication to the resource has resulted in many new assets; new parks along the stream, new boat and canoe landings for increased access, and the removal of dams to allow fish passage and improved recreational opportunities. In addition, WDNR fisheries staff continues to monitor the rebounding small mouth bass populations resulting from both upland and in-stream restoration. The cooperative effort between the landowners, county and WDNR staff, local governments, private groups, and other state and Federal agencies is helping Narrows Creek and the Baraboo River to be once again the valuable water resource and fishery long-time residents remember.

10.8.7. *Future Assistance*

Specific areas where assistance could enhance WDNR's programs and efforts to document water quality improvements include:

- Specific guidance from EPA on how they are consolidating their performance measures along with ease and consistency in various program reporting measures to EPA. If the directives and reporting requirements are similar for Federal programs (NPDES, Section 319, TMDLs), state staff can work together to save resources, to be more efficient, and provide consistent reports.
- Funding to hire water quality planners and more biologists to integrate water quality activities—specifically, funding to implement watershed targeting for CWA 305(b), 303(d), SP-12, and other measures.
- Funding for technical support to update WDNR databases (input of monitoring data, status of projects, GIS layers, etc.) for tracking and reporting measures.
- Funding for GIS map development to track:
    - Soil phosphorus concentrations (from farmer nutrient management plans);
    - Past and current soil erosion rates (more corn = more erosion?);
    - Critical wetland restoration areas for water quality (quantity);
    - Groundwater contamination susceptibility areas;
    - Critical groundwater recharge areas;

- Streambank erosion/critical buffer area needs;
- Critical watershed related fish and wildlife habitat areas; and
- Critical contaminated sediment areas (mass and depths)

- Funding for pilot programs to seek out innovative solutions at the watershed level for watershed improvements (funding for new BMPs, remote sensing tools, BMP implementation monitoring, alternative measures such as social indicators, etc.).
- For the WDNR nonpoint source program, support is needed to maintain stream gages (through USGS) to collect flow data and, in some cases, automated samples to assess for water quality improvements. A better way to track physical changes in streams is needed. Also, assessment of upland vs. stream valley sediment sources is needed.
- To support the Wisconsin Buffer Initiative,[57] funding to assess the phosphorus index on farmers' fields and to assess and map geomorphology in specified areas. This will help WDNR track compliance of farmers and monitor affects of phosphorus in nearby water bodies.
- For the WDNR stormwater program, compliance is measured by the design and application processes of municipal separate storm sewer systems (MS4s). WDNR feels that if they had additional funding and support, they could design a system where the application process was automated and it would save on staff time and provide more information for individual water bodies in MS4 communities. In addition, the means to support a BMP "toolbox" for communities to seek out BMPs that may work best in their urban/suburban areas would be useful.
- To support monitoring and tracking on a larger basis, the Citizen Based Monitoring Program could use funding to hire regional WDNR staff to train citizens to monitor to help capture improvements in water quality after BMPs have been implemented. Training and guidance would lead to trusted, experienced citizens collecting and recording valuable monitoring data.
- Tracking of Federal programs that provide resources for the NRCS programs: Environmental Quality Incentives Program (EQIP) and the Conservation Reserve Enhancement Program (CREP) as authorized in the US Farm Bill. WDNR feels that it needs to be able to find out where other BMPs have been installed in watersheds, so that they do not duplicate efforts. This tracking would also allow the state to monitor areas where the BMPs have been installed to track water quality improvements.
- Specific outreach by EPA to WI communities to explain the successes of various water quality improvement programs.

[57] http://bombadil.lic.wisc.edu/WBI/index.htm

10.9. Wyoming

10.9.1. *Overview of Current Programs*

Currently, Wyoming Department of Environmental Quality (WDEQ) conducts its water quality improvement monitoring and reporting as a component of Section 319 Program implementation projects. Following completion of a 319 project—usually a three-year duration—the monitoring effort generally ends as well. State field monitoring crews have been involved to a limited degree in conducting follow-up assessment work in some watersheds as part of the state's overall monitoring program. The state nonpoint source program has submitted a Project Implementation Plan to EPA Region 8 to fund the state's monitoring program using Section 319 funds. However, this program has not been fully initiated due to staffing constraints. In addition, the state and USGS are presently engaged in a Joint Funding Agreement to collect surface water quality data at a select number of fixed stations. Occasionally, long-term monitoring is funded through conservation districts, though this monitoring is not always comprehensive enough to definitively identify water quality improvements.

The following resources associated with tracking watershed improvements are available to WDEQ and other partner agencies:

- Surface Water Quality Monitoring – 7 FTEs and 3 seasonal interns are available to collect, analyze, and report all surface water quality monitoring data (state monitoring program, complaint investigation, project effectiveness monitoring, etc.). This is funded with Section 106 funding and other state funds. Approximately 5% of the seven FTEs' time could be considered effectiveness monitoring and water quality improvement reporting.
- EPA has given authorization to use Section 319 funds ($59,600 for FY07) to support monitoring activities. That effort has not been initiated to date. Some of these funds could go toward water quality improvement monitoring and reporting.
- Section 319 Grants – 4 FTEs involved in project management (project management averages 10 to 20% of their time) to review interim and final project reports that include information on water quality monitoring data.
- Section 319 Project Sponsors – Approximately 7% ($91,500) of the FY07 Section 319 funding is issued to sponsors for projects and is used for monitoring. Approximately two-thirds of that $91,500 is earmarked for projects in impaired waters. Forty percent of the total project cost must come from non-Federal matching funds, so it is common to see a 40% cash and/or in-kind match for this monitoring component.
- Section 604B (Planning and Assistance Projects) – The state awards $40,000 each year to local governments for planning and assistance. These two-year grants have included monitoring projects. Twenty-five percent of the total project cost must come from non-Federal matching funds. To date, none of this funding is used for water quality improvement monitoring; however, it is possible that this funding could be used for completing Section 319 project monitoring in the future.
- Wyoming Department of Agriculture typically receives $300,000 every two years to award grants to local conservation districts (maximum of $20,000 per award). These grants have historically been used for monitoring and assessment efforts.
- Federal agencies (e.g., Bighorn National Forest) have been doing some limited assessment work on impaired waters in order to see if management actions are working.

WDEQ's process for tracking water quality improvement monitoring data is very limited and unstructured. Typically the state relies on a third party to submit data as part of a delisting request. WDEQ has created a Microsoft Access database for Section 319 project sponsors to input data. The database meets EPA

STORET requirements and provides a consistent method for data entry by multiple parties. However, it is difficult for WDEQ to get consistent use of the database; some project sponsors do not fill out the data template completely.

WDEQ identifies the following obstacles to the state watershed improvement monitoring program, not presented in rank order:

- State monitoring staffing deficiencies;
- State nonpoint source program staffing deficiencies;
- Third party monitoring data that are of questionable quality and interpretation;
- Third party monitoring data that are not in a standardized format for comparison either spatially or temporally;
- Reluctance on the part of citizens and some Federal agency professionals to utilize models to better understand data trends and predictors.

10.9.2. *Available Data*

WDEQ collects the following data to assess watershed improvement: biological data (macroinvertebrates and periphyton); bacteriological (E. coli); physical data (survey data for stream channel pattern, profile, and dimension); chemical data (general suite of constituents plus constituents of concern); stream discharge; temperature loggers at select locations; and permanent photo points. Some sites are monitored for all of these parameters, while others are monitored for just a few.

Photo points provide an inexpensive, qualitative means of evaluating whether changes are occurring by comparing photographs of a restoration project site over time. These photos are collected according to Oregon Watershed Enhancement Board Guide to Photo Point Monitoring guidelines.[58] Most of the photo points are not georeferenced.

Sediment, total nitrogen, and total phosphorous load reduction estimates are placed in EPA's GRTS for Section 319 water quality improvement projects with implementation activities to address sediment or nutrient stressors.

WDEQ does not presently use a database to track water quality improvement monitoring data, but would like to in the future. WDEQ could possibly rework their current Section 319 project Access database to include information for tracking purposes. Again, inconsistent use of the database by third parties presents challenges.

WDEQ feels that much more comprehensive and site specific stream discharge data and meteorological data would be useful to collect in addition to current tracking data. Also, developing models to predict load reduction for implementation projects completed by other entities (e.g., NRCS) and third party data with sufficient ancillary information (discharge, land use observations, etc.) would be useful. More modeling would be useful to extrapolate monitoring data that are collected during baseflow conditions to estimate levels during high flows. However, it is often a challenge for project sponsors to develop and use models.

WDEQ finds that collecting a sufficient amount of data to demonstrate a defensible change in water quality from systems that typically have extremely high variability is one of the greatest challenges in collecting data to show progress toward meeting water quality standards. WDEQ also feels that there are challenges associated with having partners collect sufficient data that represent critical time periods (flow- or seasonality-

[58] http://www.oregon.gov/OWEB/docs/pubs/PhotoPoint_Monitoring_Doc_July2007.pdf

based) and locations in the watershed when and where the water quality limiting condition is most likely being expressed.

10.9.3. *Evaluating Watershed Improvement*

WDEQ evaluates the effectiveness of watershed projects by examining water quality improvement project monitoring data, department project follow-up monitoring data, output from load reduction models for a few completed projects, project site visits, and operation and maintenance (O&M) information from project sponsors. WDEQ uses numeric and narrative criteria to determine whether water quality is improving. Numeric criteria are used to evaluate data collected for the constituent of concern during the time and under the conditions when an impairment is most likely to occur. Those specific data are tracked until data demonstrate the pollutant/segment combination no longer exceeds state criteria as outlined in the state's listing methodology. Biological and physical data are evaluated with respect to narrative criteria. Biological data are collected and compared to the state's bioassessment conditions indices derived from the Reference Stream Project. Physical data are collected and compared to a set of "reference reach" data.

Incremental improvements in impaired watersheds are observed by tracking changes in bioassessment metrics, changes in the physical survey data (e.g., width to depth ratio, bank cover, bank stability), changes in the physical attributes of the channel (e.g., embeddedness, pool quality, overhead cover), changes in overall pollutant loads, and observable changes at permanent photo point locations.

Wyoming has found success in the use of basic models (e.g., EPA's STEPL – Spreadsheet Tool for Estimating Pollutant Loads; Wyoming's Septic Load Reduction Model; and Utah's UAFRRI – Utah Animal Feedlot Runoff Risk Index) as effective field decision support tools for project sponsors. A project sponsor will use a simple watershed model loaded on a laptop to present the effectiveness of the recommended BMPs to the landowner. With the landowner visually seeing the improvement via the model scenario, they are more likely to agree to the recommend BMP.

Wyoming recently finalized a 10-year TMDL workplan that includes mandatory TMDL evaluations every 5 years to determine if modifications in estimated loading sources or load reductions are necessary. Major land use changes may necessitate a revisit at an earlier point in time. This portion of the workplan is in partial response to local watershed stakeholder complaints that there is no credit mechanism for efforts undertaken to improve impairments in the watershed. Revisiting TMDLs is a way to recognize these interim improvements prior to complete watershed restoration. Arguments against this have been that it is too comprehensive and labor intensive.

WDEQ feels that staff time limitations, the ability to obtain all available data and then assemble those data in a consistent format, the ability to obtain data in a timely manner, and the need for training in modeling and model development—plus showing the value of such tools—are the greatest challenges associated with evaluating data to show progress toward meeting water quality standards.

10.9.4. *Effectiveness Measures*

The state's strategic planning measures take into account national measures so that only one set of measures need to be collected and reported. The strategic planning process looks at pollutant/segment combinations on the state's Section 303(d) list as the universal population. Individual measures include approved watershed plans, watershed plans substantially implemented, removal from Category 3 (303(d) list), and watershed restoration. Watershed restoration is the final measure.

Candidate watersheds for reporting water quality improvement are chosen based on WDEQ staff familiarity with the watershed through nonpoint source water quality improvement project management, site tours,

and/or departmental monitoring efforts. Other drivers for candidate watershed selection include pressure from project sponsors and stakeholders to confirm that their watershed has been restored.

WDEQ program protocols, staff training, and staff experience are sufficient to address national performance measures such as SP-12. However, due to other work demands, staff resources are insufficient to fully address the target measures. WDEQ has recently hired a new staff person to look at how target measures (e.g., SP-12) are being met, and prepare the state's Integrated Report. Four Measure WQ-10[59] success stories were submitted to EPA in August and September 2008. These success stories will be the basis for upcoming SP-12 reporting.

The state hopes to develop a tracking tool for all 12-digit HUC basins in the state with impaired and threatened waters. The specifics of this tracking system have not yet been determined. This tracking system will identify the reaches and pollutants listed within the HUC. As specific pollutants are mitigated or reaches are restored, that information will be included in SP-12 reporting. WDEQ has not yet decided whether they will use Option 1 or Option 2 for reporting under SP-12 guidelines.

Wyoming occasionally conducts monitoring specifically to addresses SP-12 reporting needs; however, monitoring is typically conducted through conservation districts, with some funding from Section 319 grants. Wyoming has not, however, made modifications to their monitoring programs to gather information specifically for SP-12 reporting.

10.9.5. *Communication*

The public is informed of water quality improvements through Sections 303(d) and 305(b) of the Wyoming Integrated Water Quality Assessment Report, the annual water quality improvement report produced by the Wyoming Association of Conservation Districts covering the successes of the individual conservation districts, and nonpoint source project success stories. Current staff resources are not sufficient to do this form of communication as much as desired. The state hopes to use Measure WQ-10 and SP-12 documents as the basis for poster and newsletter presentations to the general public.

The impact of past watershed improvement reporting to the public is unknown. There has not been a noticeable increase in demand for Section 319 funds, increase in volunteerism, or increase in contacts from the public as a result of program communication.

WDEQ is required to provide information regarding watershed and water quality improvements to the EPA through the Integrated Report, the Citizen's TMDL Work Group (a group of 16-18 members that represent various interests across the state), the general public (through the Integrated Report), and Other Federal Partners (e.g., USFS) via annual meetings. Though not required, WDEQ also provides water quality improvement information to any interested party requesting information.

10.9.6. *Case Study*

Hunter Creek

Hunter Creek is a tributary to Clear Creek where cold water fisheries beneficial uses were not fully supported due to excessive sediment (sand) covering spawning gravels and cobbles that reduce the benthic community. The source of the sediment was due to drainage off a gravel surface owned by the USFS running parallel to the stream for a considerable distance.

[59] http://www.epa.gov/water/waterplan/pamsfy09/def_wq09.html#wq10

Restoration activities included the Forest Service re-grading the crown of the road to redirect all road surface runoff to the ditch opposite the creek. A sediment collection structure (sump) was designed and constructed at the lower end of the drainage ditch immediately upstream of where Hunter Creek enters North Clear Creek. The Forest Service actively monitors sediment accumulation in this sump and removes material to maintain the desired freeboard.

Data for Hunter Creek were collected from two macroinvertebrate collection sites and numerous substrate composition samplings. The monitoring data showed an increase in the diversity and population characteristics of the benthic community along with a dramatic decrease in the amount of sand comprising the substrate. Substrate composition was shown to become cobble and gravel dominated. Total monitoring costs are grossly estimated to be $10,000 (5 visits at $2,000 per visit for time, travel, equipment, sample analysis, and reporting).

Rock Creek

Rock Creek originates in the Bighorn Mountains, along the northwestern boundary of the Powder River Basin. Rock Creek was placed on Wyoming's 2006 303(d) list because of excessive sediment loading, which was threatening aquatic life by eliminating important streambed habitats. The Lake DeSmet Conservation District (LDCD) conducted a Section 205j planning and assessment project in 1997 to determine the source of this pollutant. The results of this investigation suggested that the major sources of sediment were likely from the combination of heavy cattle and horse grazing operations and the inefficient irrigation systems in the watershed. In 1999, the LDCD was awarded Section 319 project funding to address these water quality issues as part of a cooperative effort between the LDCD, USDA, and private landowners. The primary goals and objectives of the project were to improve irrigation infrastructure and application methods through proper BMPs. Specifically, irrigation efficiency was improved by burying pipelines and installing modern sprinklers systems. LDCD then supplemented these structural changes with an educational workshop during 2001 which was aimed at improving pasture and hay culture management by landowners in the watershed. To determine the effectiveness of BMPs, LDCD collected chemical, physical, and biological data at several study sites between1999-2001.

BMPs improved irrigation efficiency within the watershed from approximately 12% to 40%; application efficiency from approximately 18% to 41%; water conveyance efficiency from approximately 46% to 99%; and water usage decreased from approximately 19,978 acre-feet to 6,011 acre-feet. While these results clearly describe a marked improvement in the irrigation efficiency within the watershed, the corresponding effectiveness monitoring data collected by LDCD during the term of the project were determined to be inconclusive. Because the immediate term effectiveness monitoring efforts showed inconclusive results, WDEQ re-evaluated the stream in 2003. This post implementation effectiveness monitoring found the substrate in Rock Creek to be relatively free of sediment with its ability to support aquatic life uncompromised. Because of these habitat improvements, Rock Creek was removed from Wyoming's 303(d) list in 2004, following the success of this NPS restoration project.