



This document is one chapter from the EPA “Handbook for Developing Watershed Plans to Restore and Protect Our Waters,” published in March 2008. The reference number is EPA 841-B-08-002. You can find the entire document [http://www.epa.gov/owow/nps/watershed\\_handbook](http://www.epa.gov/owow/nps/watershed_handbook).

# **Handbook for Developing Watershed Plans to Restore and Protect Our Waters**

## **Chapter 13. Implement Watershed Plan and Measure Progress**

*March 2008*

Handbook Road Map

- 1 Introduction
- 2 Overview of Watershed Planning Process
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## 13. Implement Watershed Plan and Measure Progress

### Chapter Highlights

- Creating an organizational structure
- Implementing activities
- Preparing work plans
- Sharing results
- Evaluating your program
- Making adjustments

### Read this chapter if...



- You want to know what to do after you've developed the watershed plan
- You want to get organized for implementation
- You're ready to implement activities
- You want to prepare work plans that will outline implementation activities over time
- You'd like to share the results of your effort
- You want to evaluate your program
- You need to make adjustments to your watershed plan

## 13.1 What Do I Do Once I've Developed My Watershed Plan?

Although you've expended a tremendous effort to develop your watershed plan, remember that it is nothing if you don't implement it. Although many watershed planning handbooks end with development of the plan, the plan is just the starting point. The next step is to implement the plan in your watershed. Implementation can begin with an information/education (I/E) component or with on-the-ground management measures. Remember that implementation activities should follow the road map developed in your plan.

When implementation begins, the dynamic of your watershed group, as well as stakeholders' level of participation, might change. This is the time when most members of your watershed group are really excited that something more than a written plan will come out of the planning efforts. This chapter offers tips and suggestions on measuring implementation progress, determining when you need to make changes to your current plan, and sharing the results of your efforts with the rest of the community.


## 13.2 Create an Organizational Structure for Implementation

After the plan is completed, you need to determine how you want to continue to operate. Don't just assume that you'll proceed with the same group that helped to develop the plan. Take a hard look at the planning team and ask the team members if they want to continue to be involved in implementing the plan. It's useful to ask the stakeholders to evaluate the process used to prepare the watershed plan so that you can improve on the process during implementation. Use  Worksheet 13-1 to ask your stakeholders for input.  A blank copy of the worksheet is provided in appendix B.

Identify any gaps in skills or resources, and try to find some new faces with skills, energy, and enthusiasm to move the ball forward. Consider creating a watershed implementation team made up of key partners, whose responsibilities include making sure tasks are being implemented, reviewing monitoring information, identifying or taking advantage of new funding sources, and sharing results.

Make sure, however, that new players that join the team are committed to the plan and its goals. Seek a balance between bringing in new ideas and energy and allegiance to following through on your hard-won plan.

To help ensure that you can continue to implement your watershed plan for many years, consider "institutionalizing" your watershed team. Try to create several positions that are funded by outside sources to provide continuity and stability. These positions might reside in other organizations but are tasked with administering the watershed plan. For example, the county might fund a part-time watershed coordinator out of the environmental planning department to assist with implementing your watershed plan.

If you want to make your partnership official, many guides explain how to create a nonprofit organization such as a 501(c)3. Having this designation is often useful in applying for funding from foundations.  Go to [www.501c3.org](http://www.501c3.org) for information on how to set up a nonprofit organization.

 **Worksheet 13-1** *Sample Watershed Stakeholder Committee Evaluation*
**Possible Evaluation Questions for Participants**

Purpose: To determine how the level of participation in the Watershed Stakeholder Committee has changed over the past 2 years and why, and to assess the usefulness of the Committee.

Name/Affiliation: \_\_\_\_\_

**Participation**

1. How many Watershed Stakeholder Committee meetings have you participated in over the past 2 years?

2. If you have not participated in all the meetings, what factors would have increased your participation?

Hosting the meeting closer to where I live.

Hosting the meeting at a time that was more convenient for me, such as \_\_\_\_\_.

Providing more advance notice of where and when the meeting was to be held.

Including topics for discussion that were more relevant to my interests.

Other:

**Group Structure**

1. Do you feel the size of the group was adequate? Please explain.

2. Do you feel the composition of the group was representative of the watershed community? Please explain.

**Group Input**

1. Do you feel the meetings were held to optimize participation from the attendees? Please explain.

2. Do you feel that your input was incorporated into the watershed management planning process? Please explain.

**Overall Recommendations**

1. What do you think are the most useful aspects of the Watershed Stakeholder Committee?

2. What do you think can make the Watershed Stakeholder Committee more useful?

3. Would you like to be involved in future watershed protection efforts?

## 13.3 Implement Activities

Implementing the watershed management plan involves a variety of expertise and skills, including project management, technical expertise, group facilitation, data analysis, communication, and public relations. Your watershed plan implementation team should include members that can bring these skills to the table. The management measures you selected, schedules and milestones you set, financial and technical resources you identified, and I/E programs you developed in the course of assembling your plan provide a road map for implementation. Follow it. Take advantage of the partnerships you formed during plan development to work toward efficient implementation of the plan.

Key implementation activities include the following:

- Ensuring technical assistance in the design and installation of management measures
- Providing training and follow-up support to landowners and other responsible parties in operating and maintaining the management measures

- Managing the funding mechanisms and tracking expenditures for each action and for the project as a whole
- Conducting the land treatment and water quality monitoring activities and interpreting and reporting the data
- Measuring progress against schedules and milestones
- Communicating status and results to stakeholders and the public
- Coordinating implementation activities among stakeholders, among multiple jurisdictions, and within the implementation team

To keep the implementation team energized, consider periodic field trips and site visits to document implementation activities in addition to the necessary regular team meetings.

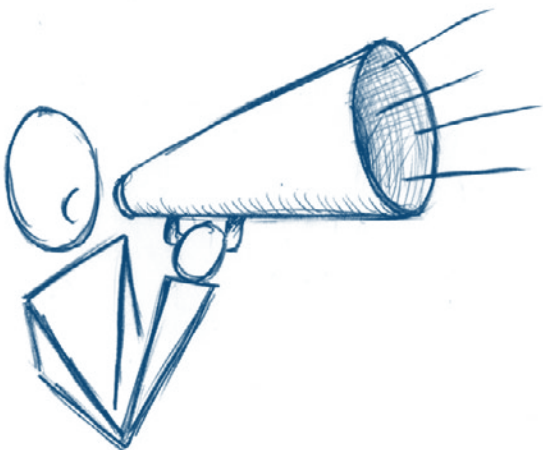
### 13.4 Prepare Work Plans

You'll use your overall watershed plan as the foundation for preparing work plans, which will outline the implementation activities in 2- to 3-year time frames. Think of your watershed plan as a strategic plan for long-term success; annual work plans are the specific to-do lists to achieve that vision. Work plans can be useful templates for preparing grant applications to fund implementation activities. Depending on the time frame associated with your funding source, your work plan might need to be prepared annually with quarterly reporting. It's also possible to update work plans and make some changes, within the original scope of the work plan, as needed. However, completely changing the focus of the work plan after receiving funding is unacceptable to most funding sources. Table 13-1 presents similarities and differences in the scope and breadth of a hypothetical watershed plan with a hypothetical 319 grant application/work plan for the same area. A written work plan would go beyond this tabular format and explain each parameter in much greater detail.

There are two other key pieces of information to include in your work plans. To help keep track of what will need to be done in the future, it's important to document what will *not* be done in your proposed work plan that relates to the overall watershed plan. This approach helps to provide continuity from year to year. In addition, you should indicate other activities that will be conducted using other funds, as well as activities conducted by other cooperating groups as part of the watershed plan implementation.

### 13.5 Share Results

As part of the I/E program developed in chapter 12, you should have included opportunities to publicize the plan to increase awareness of the steps being taken during implementation. Continuous communication is essential to building the credibility of and support for the watershed implementation process. Lack of communication can impede participation and reduce the likelihood of successful implementation. This is especially critical if you're using a stakeholder-driven process. Transparency of the process builds trust and confidence in the outcome. Regular communication also helps to strengthen accountability among watershed partners by keeping them actively engaged. Such communication might also stimulate more stakeholders to



**Table 13-1.** Comparison of Example Parameters in a Hypothetical Watershed Plan and 319 Work Plan

Parameter	Lake Fraser Watershed Management Plan	319 Work Plan #1
Period	2003–2013	2003–2006
Geographic scope	180,000 acres	24,000 acres
Critical areas	52,000 acres	7,000 acres
Goal statement	Improve watershed conditions to support sustainable fisheries	Reduce sediment loadings from priority subwatershed X
Example objectives and key elements	<ul style="list-style-type: none"> <li>• Increase the Index of Biotic Integrity (IBI) from 30 to 75</li> <li>• Identify causes and sources of sediment</li> <li>• Identify load reduction expected</li> <li>• Identify management practices needed</li> <li>• Identify critical areas</li> </ul>	<ul style="list-style-type: none"> <li>• Treat 5,000 acres of cropland with crop residue management (CRM) practices</li> <li>• Install six terraces to treat 1,200 acres</li> <li>• Establish five buffer strips for a total of 8,000 feet</li> </ul>
Implementation	<ul style="list-style-type: none"> <li>• CRM: 2,000 acres of row crop/year into CRM</li> <li>• Terraces: 4 fields/year, 40 fields total</li> <li>• Buffers: restore 1 to 1.5 miles of riparian area/year, 8 miles total</li> <li>• Field buffers: 100 fields total</li> </ul>	<ul style="list-style-type: none"> <li>• Develop training materials on CRM in year 1</li> <li>• Hold two workshops each in years 2 and 3</li> <li>• 2 terraces/year</li> <li>• One buffer strip in first year and two each in years 2 and 3</li> </ul>
Costs	<p>\$4.02 million over 10 years</p> <ul style="list-style-type: none"> <li>• \$800,000 for information and education (I/E)</li> <li>• \$600,000 for monitoring and reporting</li> <li>• \$1,980,000 for buffers (18,000 acres at \$110/acre)</li> <li>• \$140,000 for 40 terraces</li> <li>• \$500,000 for CRM</li> </ul>	<p>\$250,000 over 3 years</p> <ul style="list-style-type: none"> <li>• \$50,000 to prepare training materials and give five workshops on CRM</li> <li>• \$160,000 for management practice cost-sharing</li> <li>• \$40,000 for monitoring and reporting</li> </ul>
Schedule	<ul style="list-style-type: none"> <li>• Begin slowly and accelerate (build on successes)</li> <li>• Establish interim milestones <ul style="list-style-type: none"> <li>– Cropland: 2008 – reduce soil erosion by 80,000 tons/year</li> <li>– Streambanks: 2006 – stabilize 10,000 feet of eroding streambanks</li> <li>– 2010 – stabilize 30,000 feet of eroding streambanks</li> </ul> </li> <li>• Push I/E early and complete by year 6</li> <li>• Prepare annual reports that track progress</li> <li>• Coordinate with partners</li> </ul>	<ul style="list-style-type: none"> <li>• See above</li> <li>• Annual progress reports</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>• Environmental – water quality, IBI, acres treated, tons of soil erosion reduced, feet of streambank stabilized</li> <li>• Administrative – contracts approved, funds expended, and funds obligated</li> <li>• Social – landowners contacted</li> <li>• Changes in public understanding resulting from I/E</li> </ul>	<ul style="list-style-type: none"> <li>• Attendance at CRM training workshops</li> <li>• Acres of cropland using CRM</li> <li>• Feet of stream buffers established</li> <li>• Feet of field buffers established</li> <li>• Number of terraces</li> <li>• Environmental: reduction in sediment loads</li> <li>• Administrative: contracts approved and funds expended</li> <li>• Social: landowners contacted</li> </ul>

get involved in the effort and offer new ideas or suggestions. Sharing results can also help to ensure more consistent watershed approaches across subwatersheds.

More ideas regarding sharing success are provided in the Section 319 Nonpoint Source Success Stories at [www.epa.gov/owow/nps/Success319](http://www.epa.gov/owow/nps/Success319)

The many stakeholders that have invested time and money in the watershed plan will want to know if the plan is making a difference. They're also likely to want to know what resources have been used to make that difference and what resource gaps remain. You can be accountable to stakeholders by regularly reporting information. You should provide

information on interim results and report the ways in which the plan is working and how you plan to address the deficiencies. Encourage stakeholders to contribute ideas on how to make improvements.

Progress and implementation results can be shared through various media formats, such as press releases, ads in local newspapers, television or radio public service announcements, or presentations at community meetings such as those of homeowner associations and local civic organizations, PTA meetings, or other gatherings of members of the watershed community. You could secure time on the local cable access station to discuss the watershed plan and share monitoring results with the public. You might also consider hosting a press conference with local officials and the stakeholders as a way to thank them for their participation and to inform the larger community about the plan's contents and how they can participate in implementing the plan. (See section 12.2.2 on developing an I/E program.)

Remember to publicize the project team's accomplishments to county commissioners, elected local and state officials, watershed residents, and other major stakeholders. The group might wish to issue a watershed "report card" (figure 13-1) or develop a fact sheet, brochure, or annual report to highlight its successes. Report cards let the community know whether water quality conditions are improving overall. They also allow people to compare results across specific areas to see if things are improving, whether some aspects seem to be connected, and whether a change in direction is needed to bring about greater improvements. This is an effective way to build awareness of the watershed issues and the progress of watershed plan implementation. In addition, when people see progress, they'll continue to work toward making the plan a success.

## 13.6 Evaluate Your Program

Once you've started to implement your watershed plan, you need to monitor both water quality and land treatment to ensure smooth implementation and to measure progress toward meeting goals. The adaptive management approach is not linear but circular, to allow you to integrate results back into your program. You need to create decision points at which you'll review information and then decide whether to make changes in your program or stay the course. Figure 13-2 illustrates how the adaptive management approach feeds back into your program based on information gathered from monitoring and management tracking. As part of your evaluation efforts, you'll periodically review the activities included in your work plan and the monitoring results to determine whether you're making progress toward achieving your goals.

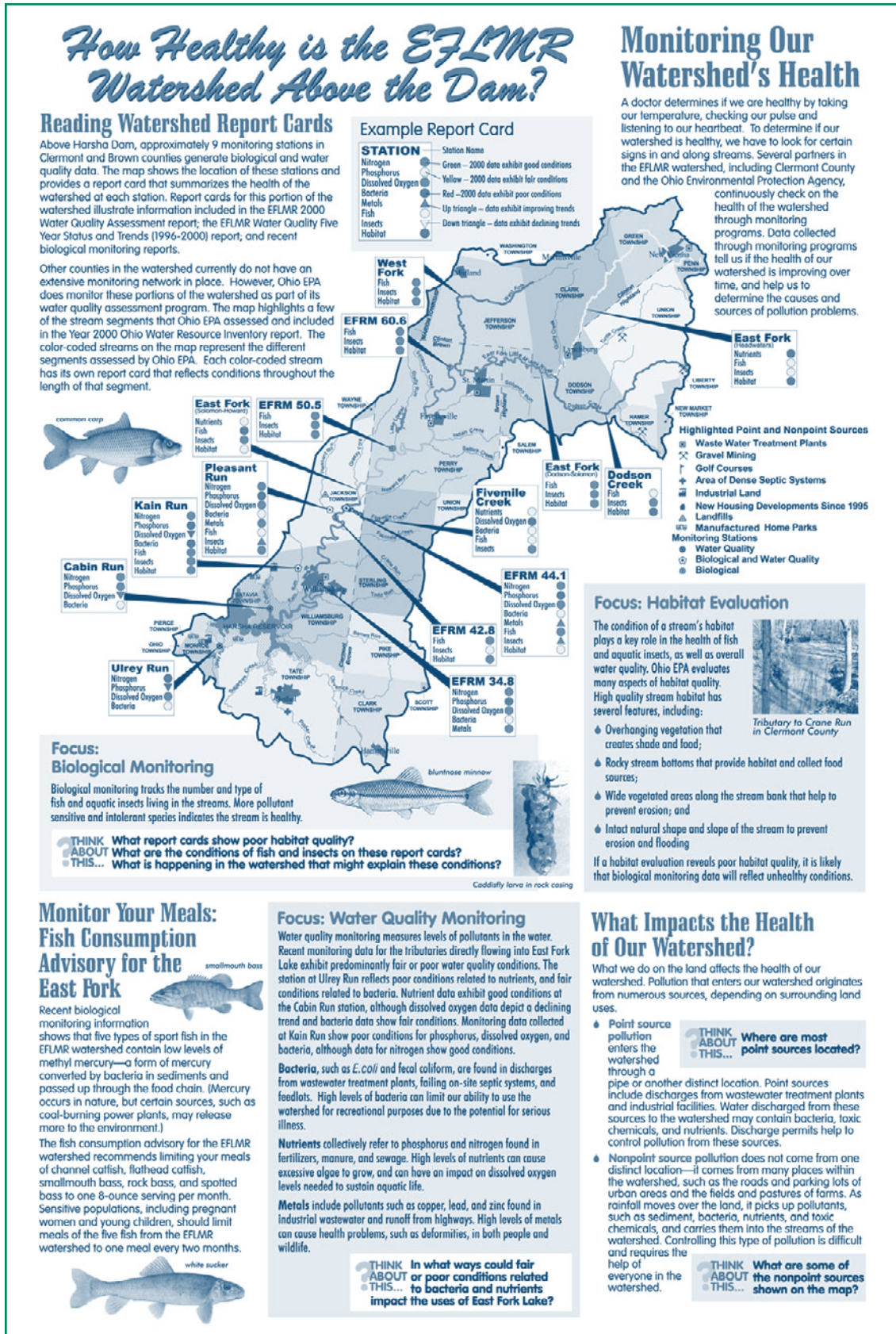


Figure 13-1. Watershed Report Card for Clermont County, Ohio



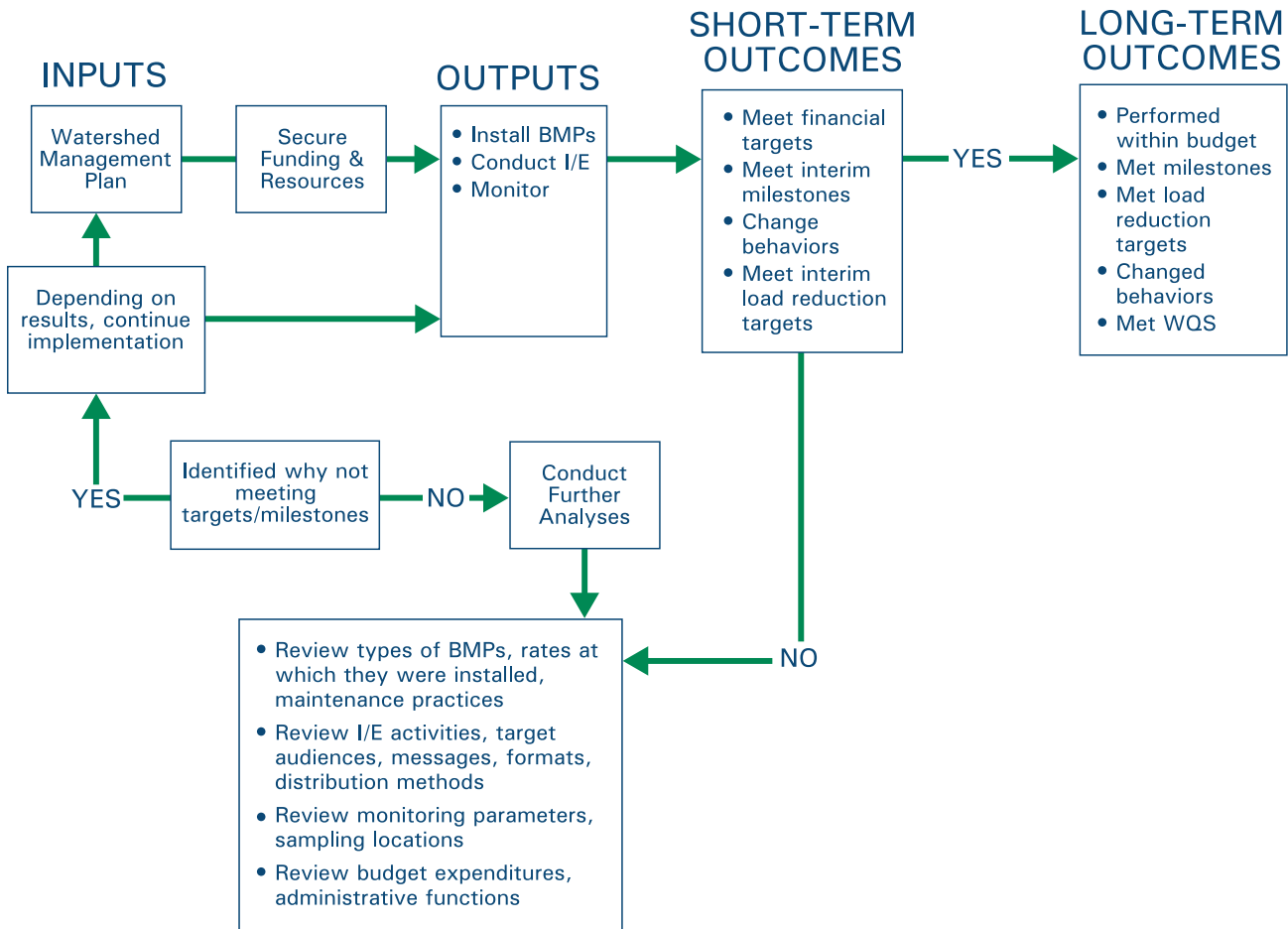




Figure 13-2. Example Adaptive Management Approach Using a Logic Model

### 13.6.1 Track Progress Against Your Work Plans

As part of developing your implementation plan, you devised a method for tracking progress (see section 12.10). Using that tracking system, you should review the implementation activities outlined in your work plan, compare results with your interim milestones, provide feedback to stakeholders, and determine whether you want to make any corrections. These reviews should address several key areas:

- *The process being used to implement your program.* This process includes the administrative and technical procedures used to secure agreements with landowners, develop specifications, engage contractors, and the like.
- *Progress on your work plan.* Check off items in your annual work plan that have been completed.
- *Implementation results.* Report on where and when practices have been installed and have become operational.
- *Feedback from landowners and other stakeholders.* Review information on the stakeholders' experience with the implementation process and with operation and maintenance of the practices.

Schedule reviews regularly and formalize the routine procedures. A simple way to gather this information is to provide worksheets to the project team at their regularly scheduled meetings. Use  Worksheet 13-2 to check in with the group and evaluate how things are going.  A copy of the worksheet with detailed questions is provided in appendix B. Maintain agendas, minutes, and other records so that important issues and decisions are well documented. Consider tying each meeting to a simple progress report so that all team members stay up-to-date. Above all, involve *all* team members, not just those directly involved in the specific items outlined above. Communication and sharing of knowledge among team members are essential ingredients for success.

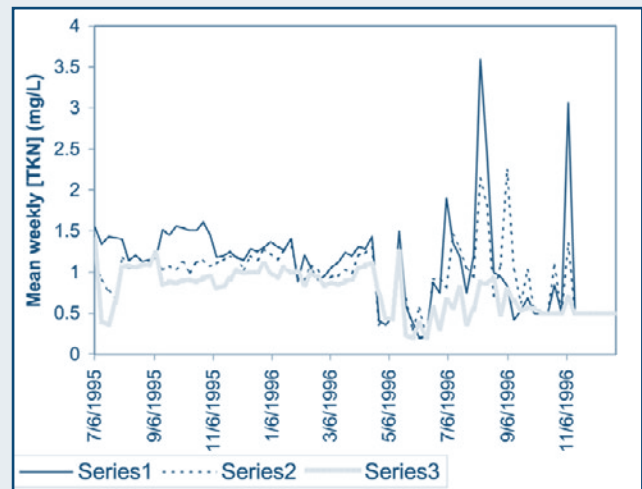
### 13.6.2 Analyze Monitoring Data

As part of the monitoring component developed in section 12.6, you have determined how and where the data are stored, how frequently they are compiled and analyzed, the types of analyses that will be performed, and how results will be interpreted. Two types of analyses should be considered during the implementation phase: (1) routine summary analysis that tracks progress, assesses the quality of data relative to measurement quality objectives (i.e., whether the data are of adequate quality to answer the monitoring question), and provides early feedback on trends, changes, and problems in the watershed and (2) intensive analysis to determine status, changes, trends, or other issues that measure the response to the implementation of the watershed plan.

Routine summary analysis should examine both water quality and land treatment monitoring data fairly frequently. Simple, basic data analysis should be done at least quarterly as part of the regular review process. Progress reports (self-imposed, not necessarily reports to funding agencies or the public) and regular team meetings are effective ways to accomplish this. Even though the process might seem demanding, early suggestion of trends or problems

#### Evaluate Your Data Routinely

This time series plot of total Kjeldahl nitrogen (TKN) data collected in three Vermont watersheds illustrates the importance of frequent data evaluation. Obviously, something happened around May 1996 that caused a major shift in TKN concentrations in all three streams. In addition, it is clear that after October, no values less than 0.5 mg/L were recorded. In this case, the shift was not the result of some activity in the watersheds but an artifact of a faulty laboratory instrument, followed by the establishment of a detection limit of 0.50 mg/L. Discovery of this fault, although it invalidated a considerable amount of prior data, led to correction of the problem in the lab and saved the project major headaches down the road.



#### Worksheet 13-2

#### Sample Topics to Discuss at Quarterly Review of Watershed Management Plan

- Administrative and management activities
- I/E activities
- Monitoring activities
- Additional issues

## **Review Your Land-Treatment Tracking Data**

### ***Inventory of practices/measures implemented***

Where and when were measures implemented? Consider locating implementation as points or areas in a geographic information system (GIS) and developing standard maps.

### ***Status of practices/measures implemented***

How were structural measures built or maintained? Are landowners following management practices? For practices that “grow in” such as riparian buffers, report on growth of vegetation.

### ***Index of effects of implementation***

What is the magnitude of implementation? What are the estimated effects? In agricultural watersheds, for example, the number or proportion of acres treated or animal populations under management practices in the critical areas can be useful indices of how much treatment has been implemented. Where land treatment tracking data allow, report estimates of changes in nitrogen and phosphorus application under nutrient management. If possible, estimate changes in soil loss using tools like the Revised Universal Soil Loss Equation (RUSLE).

can prevent major headaches down the road by detecting changes or problems early. Feedback from monitoring can be invaluable in tracking the effectiveness of your plan and making small adjustments. To promote consistency and continuity, consider appointing a single team member as the primary gatekeeper for routine data analysis.

Routine data analysis in this context does not have to be complex or sophisticated. Your primary goals are to make sure that your monitoring effort is on track and that you get a general sense of what’s going on in your watershed.

Because many watershed activities can affect nonpoint source loads, you should pay attention to broad watershed land use patterns such as overall land use change (e.g., abandonment of agricultural land, timber harvest, large urban development); changes in agriculture, such as acres under cultivation or animal populations; and changes in watershed population, wastewater treatment, stormwater management, and so forth. An annual look at watershed land use is probably enough in most cases.

## ***Types of Data Analyses***

In general, intensive data analysis should be conducted at least annually in a multiyear watershed plan. The types of data analyses you perform on the monitoring data depend on the overall goals and objectives, the management approach, and the nature of the monitoring program; several types

of analyses might be appropriate depending on the monitoring questions. For example, an assessment of the Clinch River watershed in Virginia used a variety of statistical analyses to relate land use/land cover data and biological or stream habitat indices. Some of these analyses involved relatively simple procedures, such as correlations between percent urban area and fish Indices of Biotic Integrity (IBIs). Other analyses were more complex, involving multivariate procedures such as clustering, multiple regression, or factor analysis to tease out the stressors most responsible for fish community impairments in the watershed. Where analysis and evaluation of management practices are the focus of monitoring, it might be feasible to use relatively simpler analyses, such as t-tests comparing indicator levels before and after implementation, levels above and below implementation sites, or levels in areas where management options were implemented and areas where they were not. Where adequate pre-implementation data are not available, trend analysis can be used to look for gradual changes in response to your implementation program. In some cases, more sophisticated statistical techniques like analysis of covariance might be required to control for the effects of variations in weather, streamflow, or other factors.

## ***Determine Who Should Review the Data***

Monitoring data might need to be reviewed by several types of personnel depending on the complexity of the data. For large watershed projects, it’s often necessary to enlist the help of an expert in GIS applications because maps and land use relationships are usually critical to the analyses. A statistician is often required to review the data and help design appropriate analyses. Note that even the most capable statistician cannot completely compensate for

a weak monitoring design. Consult a statistician during the development of your monitoring design (see section 12.6). Additional specialists might be necessary depending on the types of data reported. For example, a toxicologist should review toxicity data and a biologist should review bioassessment data. Finally, the watershed coordinator should review the results of analyses to ensure that they are on track and to help determine whether midcourse changes are needed.

### ***Run Models to Compare Actual Results with Predicted Results***

Under some circumstances, models might be useful to evaluate the progress of implementing your plan. You can, for example, compare the predictions of a model that has been validated for your watershed against actual monitoring data. Such a comparison can confirm that you are on track toward your load reduction goals or can tell you that something is amiss. If data do not match predictions, you might be able to track down possible reasons. The failure of a treatment measure to reduce pollutant load as expected, for example, could be due to problems in installation or management that can be corrected.

Models are also useful when you need to extrapolate monitoring data to the watershed scale. For example, you can't monitor every inch of stream and runoff from every square inch of land. In fact, often you'll be lucky if there are monitoring stations (or more than a couple) in your watershed. With modeling techniques, you can sometimes extrapolate data from monitoring stations to other locations to check instream flows, concentrations, loads, or other parameters.

However, always use models with caution. You should not use models as the sole means of assessing progress or evaluating the effectiveness of your efforts. Models incorporate many assumptions about how management practices perform, and without good monitoring data, model predictions can overstate or misstate changes in water quality. In the Chesapeake Bay, for example, model results have suggested major reductions in pollutant loads that are not borne out by monitoring data, leading to a great deal of controversy and uncertainty over the status and direction of the Bay restoration plan. Always remember that you're working to reduce pollutant loads to a real waterbody and that is where you should look to evaluate the effectiveness of your plan.

## **13.7 Make Adjustments**

If you've determined that you are not meeting the implementation milestones or interim targets that you set for load reductions and other goals, what should you do? There are several possible explanations for why you haven't met your interim milestones or why pollutant loads aren't being reduced. Sometimes it takes much longer to see results in the waterbody than anticipated. Sometimes management practices have been installed but are not being used or

### **Review Water Quality Data**

#### ***Evaluate data collection effectiveness and data quality***

Are all planned samples and measurements being collected? If not, why not? Are there technical, logistical, laboratory, or financial issues? Are measurement quality objectives being met? Is the laboratory meeting the stated detection limits and quality control standards?

#### ***Screen data***

Are the data reasonable? Are there major outliers that suggest sampling or analytical errors that require attention or something going on in the field that needs investigation?

#### ***Conduct exploratory data analysis***

What can the data tell you? Characterize the data with simple descriptive statistics like mean, median, and standard deviation. Plot the data as a time series that is added to each quarter. This approach allows the team to visualize seasonal patterns, compare data from different locations, and compare current data with data from previous years.

#### ***Look at supporting data***

What other data are available to support your monitoring? Weather data from the local National Weather Service station, for example, are often key to explaining patterns in your data and putting the data in context. Was this year unusually wet or dry? Did a 100-year storm occur in part of the watershed?

maintained properly so they have lost their effectiveness. Before making any modifications to your watershed plan, ask yourself the questions in sections 13.7.1 and 13.7.2.

### **13.7.1 Not Meeting Implementation Milestones**

#### ***Did weather-related causes postpone implementation?***

Installation of many management practices depends on favorable weather conditions. If you were unable to install these practices because of weather conditions, you might want to stay the course, assuming you'll be able to install them in the near future.

#### ***Was there a shortfall in anticipated funding for implementing management measures?***

You might have identified funding sources to implement several of the management measures. For example, the availability of crop subsidies or funding for cost-share (e.g., USDA Environmental Quality Incentives Program [EQIP]) can affect the installation and maintenance of management practices. If these sources were insufficient or became unavailable, you need to determine whether the management practices can still be installed and adjust new targets for the milestones.

#### ***Was there a shortage of technical assistance?***

Many management practices require technical assistance (e.g., Natural Resources Conservation Service [NRCS] engineers, Extension personnel, or private crop management consultants) in design and construction or in management. Lack of such assistance can slow implementation. You should consult with NRCS and other sources of technical assistance to determine future availability and possibly adjust your timetable accordingly.

#### ***Did we misjudge the amount of time needed to install some of the practices?***

Installation of structural practices, growth of vegetative measures, or adoption of management or behavioral changes might take longer than predicted. You might want to adjust your timetable to reflect this new reality.

#### ***Did we fail to account for cultural barriers to adoption?***

Cultural or social barriers to the adoption of some practices exist. Some stakeholder groups might avoid participation in government programs. Traditional aesthetic preferences might conflict with development of riparian buffers. If such factors become evident, you might need to increase incentives to landowners or undertake additional I/E efforts.

### **13.7.2 Not Making Progress Toward Reducing Pollutant Loads**

#### ***Are we implementing and using the management measures correctly?***

Are structural practices being installed, operated, and maintained correctly? Remember that the existence of an animal waste storage structure does not itself guarantee effective animal waste management. Are management changes being followed? Don't assume that phosphorus inputs are automatically reduced by a set amount for each acre of nutrient management implemented. Changes in phosphorus applications following nutrient management must be documented. This is one big reason for the land treatment monitoring discussed earlier. If you have instituted erosion and sediment control regulations in portions of the watershed but the sediment loads are not decreasing, determine whether the regulations are being followed, with the proper setbacks, installation of silt fences, and so forth. If management measures are

not being implemented or followed correctly, more education or technical assistance might be needed.

***Has the weather been unusual?***

Extended wet periods or storm events of unusual magnitude or unfortunate timing can increase nonpoint source loads. Furthermore, many management practices have a finite capacity to control nonpoint source loads, and this capacity might be exceeded during extreme weather events. Before concluding that your implementation program needs to be revised, check to see if unusual weather events might have contributed to the failure to reach milestones.

***Have there been unusual events or surprises in the watershed?***

One purpose of land treatment and land use monitoring is to identify factors other than the implementation program that might affect water quality. Are there new sources of pollutants that you did not consider? Before setting off to revise your implementation program, check to see that no surprises, disasters, or bad actors have created problems in the watershed that affect your progress or mask the progress that your plan implementation has made elsewhere.

***Are we doing the right things?***

If all your measures are being implemented according to specifications and there has been no unusual weather or other unusual events, you might need to examine the specifications themselves. If erosion and sediment control regulations have not reduced sedimentation problems enough, you might need to extend the setback or increase the inspections of construction sites for those areas. If your nutrient management practice is nitrogen-based but phosphorus loads remain high, you might need to move to phosphorus-based nutrient management. Alternatively, you might need to expand the level of implementation so that more watershed area comes under improved management.

***Are our targets reasonable?***

If load reductions were predicted on the basis of models, plot studies, or idealized systems, the milestones set for load reductions could be overly optimistic. For most management practices, reports of effectiveness vary widely, depending on the pollutant inputs, climate, and monitoring regime. Riparian buffers, for example, might perform well in plot studies when runoff occurs as sheet flow, but in the real world concentrated overland flow might bypass the treatment processes. You might need to revisit your assumptions about expected load reductions.

***Are we monitoring the right parameters?***

Despite your best efforts to develop a monitoring program that's targeted to measuring progress, review the parameters you selected to ensure that they truly will tell you if load reductions are occurring. Data on turbidity, for example, might not tell the whole story on the success of erosion control measures if high turbidity results from fine clay particles that are not controlled effectively by your management practices.

***Do we need to wait longer before we can reasonably expect to see results?***

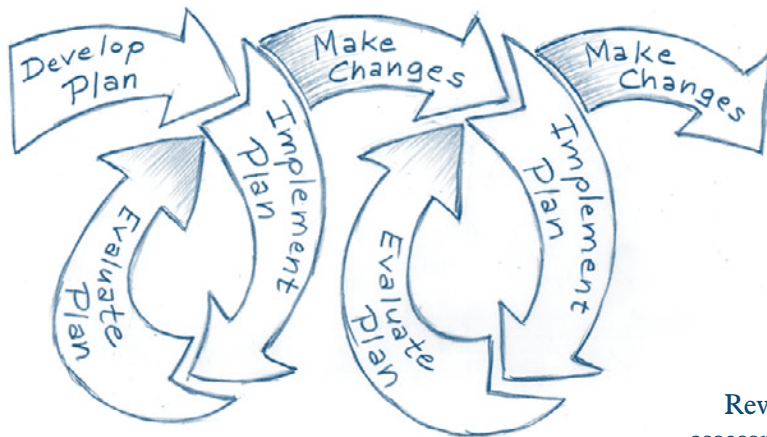
The nonpoint source problems might have taken time to develop, and it might take time to clean them up. Pollutants like phosphorus might have accumulated in soils or aquatic sediments for decades. Sediment could continue to move through drainage networks even after upland erosion has been reduced. It might be a mistake to expect an immediate response to

your implementation program. You might want to rethink your targets or timetable for some pollutants.

### ***Revisit the watershed plan***

If you've ruled out all the above possibilities, you need to consider whether your plan has called for the right management measures. It's possible that the identification of the causes and sources of pollutants earlier in the planning process was not completely correct or that the situation has changed. For example, from 1978 to 1982, the New York Model Implementation Project attempted to reduce phosphorus loads to the Cannonsville Reservoir by implementing improved management of dairy barnyards and barnyard runoff. This approach

was based on an assessment that had identified barnyards as the main source of the excessive phosphorus load. When the phosphorus load reduction targets were not met, the project team determined that winter spreading of dairy manure, not barnyard runoff, was the actual culprit (Brown et al. 1989). In such a case, no amount of barnyard management would address the fundamental problem.



Revisiting the plan and reexamining earlier assessments of the sources of pollutant loads might be the only answer at this point. The good news

is that the land treatment and water quality monitoring data you've collected during this process can contribute to a better understanding of your watershed. The watershed team can change any of the elements on the schedule of activities, especially a management measure or responsible party. It can also change priorities and shift resources to achieve a high-priority milestone.

## **13.8 A Final Word**

Volumes have been written on watershed management, and not all the permutations and combinations that you might encounter in your watershed planning effort could be included in this handbook. However, the authors have tried to provide a framework to help you develop a scientifically defensible plan that will lead to measurable results and an overall improvement in the water quality and watershed conditions that are important in your community.