Developing a Watershed Management Plan for Water Quality:

An Introductory Guide

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Introduction

This guide was written to help local units of government, nonprofit organizations, and citizens develop watershed management plans. It outlines a process for gathering people, information, and resources together to protect and improve Michigan's water resources.

A **watershed** is an area of land that drains to a common point. On a very broad scale, imagine a mountain, and think of the highest ridges on the mountain as the boundaries of the watershed. Rain, melting snow, and wind carry **pollutants** from the ridges and sides of the mountains into the water in the valley. The rationale for watershed management is that if we properly manage land activities on the sides and in the valley of the mountain, we will protect the water within that watershed. The concept is the same for Michigan's watersheds: if we manage activities on the land that drains to bodies of water, we will protect and improve the water resources of the state.

Almost every activity on the land has the potential to affect the quality of water in a community. Watershed planning brings together the people within the watershed to address those activities, regardless of existing political boundaries. By working together, individuals within the watershed can design a coordinated watershed management plan that builds upon the strengths of existing programs and resources, and addresses the **water quality** concerns in an integrated, cost-effective manner.

This guide also helps individuals develop watershed management plans that can be submitted to the Department of Environmental Quality (DEQ) for approval under the Clean Michigan Initiative (CMI). The CMI is a multi-million dollar environmental bond initiative overwhelmingly approved by Michigan voters in 1998. The CMI designates $165 million for water quality projects, including implementing approved watershed management plans. The steps outlined in this guide can be used to help meet the CMI watershed plan requirements. After the plan is approved by the DEQ, local units of government and nonprofit organizations may submit grant applications for CMI funding to implement portions of the plan.

A watershed is an area of land that drains to a common body of water.

TIPS AND TOOLS: Throughout this guide, this icon denotes useful tips and tools such as resources, contacts, and references to help you with your watershed management planning efforts.

Words highlighted in **bold** are defined in the glossary.

How were the steps for developing a watershed management plan derived?

Since 1988, the DEQ **Nonpoint Source** Program has provided grants to dozens of local units of government and nonprofit entities to develop and implement watershed management plans. The steps included in this document are based on a planning process that has been used successfully by Nonpoint Source grant recipients (grantees) since 1995. The specific steps in the planning process have been modified—and will continue to be improved—based on the experience of the grantees.

Watershed planning and implementation are iterative processes; so while all steps in the planning process are important, the order in which the steps are completed will vary. Some steps occur simultaneously, and some are repeated. For example, many projects conduct education and outreach activities while the plan is being developed, and continue them throughout the implementation process. Use the steps in this document as a general guide and adapt them to fit your needs.

Each chapter includes a list of *chapter products*, which are components of the watershed plan. You will use these products as you assemble the overall watershed management plan in Chapter 11.

This logo appears throughout the guide to denote items that will help you meet the requirement for "approved watershed management plans" in the CMI Nonpoint Source administrative rules, under part 88 of Public Act 451. Once a watershed management plan meets the requirements and is approved by the DEQ Surface Water Quality Division, local units of government and non-profit groups may apply for CMI funds to implement portions of the plan.

Does a watershed management plan address just surface waters?

Because **surface waters**—including rivers, streams, lakes, ponds, and **wetlands**—drain to and are recharged by groundwater, watershed plans sometimes include groundwater protection activities. This is particularly common in areas with predominantly sandy soils, since pollutants on the land can readily infiltrate the groundwater.

In addition to addressing water quality, this planning process can also be used for other resource issues, such as a community's desire to protect critical habitat for an endangered species. Often such "desired uses" help build community support for the water quality efforts in a watershed.

How long does it take to develop a watershed management plan focusing on water quality?

Based on DEQ Nonpoint Source Program experience, most watershed management plans take 12–24 months to develop, with 15–18 months being the average time frame.

Who can help?

As you develop your watershed management plan, you are encouraged to contact DEQ Nonpoint Source Program staff for assistance. They can provide:

- Water quality information available from the DEQ
- Suggestions on who to contact for additional water quality data
- Information about other watershed management plans that have been or are being developed
- Suggestions for successfully implementing each step in the planning process
- Input on selecting the most appropriate methods to address a water quality concern
- Ideas for informing and involving citizens
- Training on plan development and implementation
- Information about potential program partners

EXAMPLE WATERSHED

An "Example Watershed" is used throughout this guide to highlight the steps that are necessary in the watershed planning process. The Example Watershed information is shaded in green.

This icon indicates watershed projects in Michigan.

The box below lists the phone numbers for district DEQ offices. Appendix A lists additional contact information for DEQ staff and other organizations that may be able to help you develop your watershed management plan.

DEQ Nonpoint Source Program Contacts

Nonpoint Source Unit (Lansing)	517/373-2867
Cadillac District Office	231/775-3960
Grand Rapids District Office	616/356-0500
Jackson District Office	517/780-7690
Marquette District Office	906/228-6568
Plainwell District Office	616/692-2120
Saginaw Bay District Office	517/686-8025
Shiawassee District Office	517/625-5515
Southeast Michigan District	734/953-8905

What is needed to implement the plan?

Following the process outlined in this document gives you the framework that you need to implement your plan. The components of a good plan—involving local citizens and stakeholders, informing citizens about the plan, and focusing the plan on the part of the watershed that most affects water quality—are the very things needed to implement the plan. It takes locally informed people to support using local dollars to implement the plan. It takes stakeholders to not only develop the plan, but also to help implement it by providing time and resources. And it takes focusing limited resources in the right part of the watershed.

Chapter 1: Identifying and Networking with Local Agencies and Citizens

Chapter Objectives

- Identify water quality concerns
- Identify other groups or individuals with similar concerns
- Form a steering committee
- Identify a lead organization
- Discuss all existing and perceived concerns
- Define the geographic scope of the watershed based on the concerns
- Modify committee membership based on the geographic scope of the watershed
- Begin to develop a resource library

Chapter Products

- ❑ A watershed steering committee, lead organization, and technical committee
- ❑ A description of the watershed and a map with the watershed boundaries
- ❑ A resource library

How do you begin a watershed project?

If you are interested in starting a watershed management project to protect water quality, your first step is to identify your water quality concerns and find individuals or organizations who have similar concerns. Begin by contacting the people and organizations that you know. If they have an interest in water quality, they may be potential partners who can assist you with the watershed planning process.

Once you have contacted the people you know, consider other groups who may be interested in addressing water quality. Anyone who may have a stake in the watershed plan should be encouraged to share their concerns and offer suggestions for possible solutions. By involving **stakeholders** in the initial stages of project development, you will be helping to ensure long-term success. Consider contacting the potential stakeholders listed in the box at right, to determine if they have water quality concerns. They may also be aware of other individuals who might be interested in helping with the project.

Learn the local political landscape and identify all possible local partners. The earlier you locate local partners and make use of their knowledge, the better off you will be.

Potential Stakeholders

County/Regional Representatives
- Conservation District
- Councils of Government
- County or District Health Department
- Drain Commissioner
- Michigan State University Extension
- Planning Commission
- Road Commission
- Watershed Councils

Local Government (Municipality/Township) Personnel
- Managers/Supervisors
- Engineers
- Public Works Staff
- Parks and Recreation Staff
- Planners

State and Federal Agencies (local representatives)
- Michigan Department of Environmental Quality (DEQ) Surface Water Quality Division Nonpoint Source Program Staff
- Other DEQ Divisions
- Michigan Department of Natural Resources
- Michigan Department of Transportation
- US Fish and Wildlife Service
- US Geological Survey
- USDA Natural Resources Conservation Service

Business Representatives
- Developers/Home Builders Association
- Industries and Businesses
- Local Agribusiness
- Recreational Groups and Associations

Citizen Groups
- Churches
- Civic Organizations
- Homeowner/Neighborhood Associations
- Landowners
- Lake Associations
- Youth Groups

Universities, Colleges, and Schools

Environmental and Conservation Groups

If you are not familiar with these organizations or agencies and the type of assistance they may provide to a watershed project, see Appendix A for more information.

Most watershed groups contact **riparian** landowners who live in the watershed and invite them to participate in the project planning process.

The stakeholders that you involve will vary, depending on the pollutants of concern within the watershed and the suspected sources of the pollutants. Other factors such as predominant land uses and ownership and those who will likely be most affected by the watershed project may also influence who participates in the process.

How should you conduct a stakeholder meeting?

You will need to conduct at least one meeting with the group of stakeholders to talk about their water quality concerns. Start with a summary of your concerns, being as objective and factual as possible (i.e., avoid finger-pointing). Then, ask the participants to share their concerns, recording them on an easel or board to ensure that all participants have the opportunity to share their views.

In the Example Watershed, the stakeholders met and listed their concerns, which are shown in the box at right.

At the first stakeholders' meeting, begin by defining the term watershed and explaining how a watershed management plan can help the stakeholders address their water quality concerns. At the end of the meeting, explain that the next step in the planning process involves the development of a steering committee, which will provide the overall direction for watershed planning and implementation.

Who should serve on the watershed steering committee?

Steering committee membership, roles, and responsibilities vary depending on water quality conditions and the interest of the individuals. Invite the members of the stakeholder group to serve on the steering committee. Usually, one representative per stakeholder organization or agency is included. The steering committee should at a minimum include the individuals in the watershed who have some authority to implement change, since their participation and commitment are likely to be critical to the successful implementation of the watershed plan. You should also include people who will be affected by the change.

There is no predetermined size for the steering committee. You might begin the planning process with 20–30 stakeholders, and end up with an active steering committee of 7–10 people. Alternately, your initial stakeholder group may be very small, and increase in size as groups and individuals are encouraged to participate and serve as committee members.

Projects often begin with a large number of interested people in the early stages of the watershed planning process. More interest at the onset increases the chance that the individuals and agencies necessary to complete the project are already present. The initial public interest is also useful for future information and education activities.

Example Watershed Stakeholders' Concerns
Newspaper reports of algal blooms in the summer
Residents' complaints about the algae
Residents' complaints about eroding roadbed at two different road-stream crossings
Residents' complaints about livestock in the stream at two farms
General concerns about adequacy of septic systems

Example Watershed Perceived Concerns
"Fishing isn't as good as it used to be"
"River seems to flood more than it used to"

Bear Creek, Macomb and Oakland Counties Project

In this project, the lead organization contacted approximately 20 leaders in the Bear Creek watershed before setting up the first steering committee meeting. According to the project administrator, "Watershed management is as much about fostering collaborative relationships as it is about understanding the technical aspects of the watershed. Contacting the potential steering committee members in advance allowed us to build rapport between the committee members and the project lead agency. It also provided an opportunity for individuals to express their reservations about the watershed planning process in a private setting, before the first committee meeting."

At the first steering committee meeting, review the list of concerns developed during the stakeholders' meeting and add any additional concerns. All suggestions should be recorded.

Once the list is complete, use it to evaluate the membership on the steering committee. Given the existing and perceived concerns in the watershed, are

the steering committee members those who can make decisions and influence change? If not, contact the missing stakeholders and invite them to participate. Keep in mind that as concerns are identified and the plan is developed, the membership of the committee may change.

A steering committee provides overall direction for a watershed project. Members include decision makers, people with authority to make change, and people affected by the change.

Who should lead the steering committee?

Once the steering committee is in place, the next step is to identify a lead organization. This may be your organization or agency or another organization represented on the committee. The leader's role is to ensure that the watershed planning and implementation process continues to move forward. The most appropriate organization to lead the effort is the one that can represent the entire project area, and has the staff and resources necessary to carry out the plan.

The most appropriate lead organization also depends on the priority concerns within the watershed. For example, if the land use in the project area is predominantly agricultural, it may be appropriate for the local conservation district to provide leadership. If the primary concern is urban **storm water**, a drain commissioner's or township office might be an appropriate lead organization.

How should the steering committee operate?

To ensure that meetings run smoothly, it is important to identify some basic roles and responsibilities for the steering committee. For example, someone should serve as secretary to document the important decisions made at the meetings and distribute them to the group. If the group prefers to use an easel or chalkboard during meetings, you may need a note-taker for that purpose.

Some steering committees operate very informally, while others operate using formal partnership agreements. You will have to decide on the most appropriate structure for your group. The committee also needs to decide how they will make decisions—by majority vote, by consensus, or through another agreed-upon process.

Huron and Manistee River Projects

The Huron River Watershed Council divided their watershed into subwatersheds that are between 8 and 40 square miles. Each subwatershed has a "Creek Group" that is responsible for forging community networks to develop and implement a plan for their subwatershed. Steering committee members are selected from Creek Group membership, which is made up of:

- **Elected Officials**
- **Conservation District**
- **Business Owners**
- **University Representatives**
- **Homeowners**
- **Local Agencies**
- **Drain Commissioner**
- **Local Volunteers**
- **Parks and Recreation Department Personnel**

The Conservation Resource Alliance, which is responsible for managing the Manistee River project, invited all existing organizations and agencies in the area to participate in the planning process. Those who were able to play a role in the project entered into a formalized written partnership agreement stating the particular aspect of the watershed plan for which they would be responsible. Each organization is represented on the steering committee and one person is responsible for communication between their organization and the watershed steering committee. This model differs from the previous example because only organizations or agencies are encouraged to participate and the level of formalized commitment required is greater.

What is the role of a technical committee?

Since your steering committee will include decision makers that can bring about change in the watershed, it is helpful if they are supported by people that can provide them with technical information, such as water quality data or the impact of increased water volume on aquatic wildlife. A technical committee can play a valuable role if it includes professionals who are trained in various water-related disciplines. In addition to their professional expertise, technical committee members may have access to resources such as maps, data, and other materials that can assist in the planning process.

Using the list of water quality concerns from the steering committee's initial brainstorming session, identify the people that may be able to provide the missing information. For example, it might be helpful to have a DNR fisheries biologist to provide data on the fishery, a DEQ hydrologist to provide the hydrologic information, and an engineer to provide expertise in **Best Management Practices (BMP)** design. Refer to the resource listing in Appendix A for sources of information.

Depending on your situation, the technical committee may be a subgroup of individuals who also serve on the steering committee, or it may be a separate group that serves solely in an advisory capacity. Like the steering committee, the membership of this group may change over time as the planning process evolves.

How do you determine the geographic scope of your watershed?

One of the first tasks of the steering committee is to define the geographic scope of the watershed, which includes a description of the watershed and a map depicting the watershed boundaries and location of all surface waters.

In order to determine the watershed boundaries, the steering committee must first agree upon the size of the watershed that will be addressed. The size of the watershed depends on many factors, including the concerns that were identified at the stakeholder and steering committee meetings, and other watershed characteristics, such as land use and hydrology. In DEQ's Nonpoint Source Program, watershed projects have ranged in size from two square miles to several hundred square miles.

The geographic scope should include a map showing the watershed boundaries and the location of surface waters, as well as a description of the watershed.

The selected watershed may be a subwatershed of a larger one.

Gallagher Creek, Davis Creek, and Boardman River Projects

In the Gallagher Creek project, the planners were concerned about the effect of rapid development on a trout stream. They chose a small project area consisting of two square miles. With such a small watershed, they were able to meet with every developer and address all potential sources of sediment in the watershed.

In the Davis Creek watershed, the planning group decided to focus on one small tributary of the Kalamazoo River. Since most of the land use in the watershed was urban, with some agriculture in the headwaters area, the small size (16 square miles) was manageable.

The Boardman River project covered 295 square miles. The planning group focused their efforts on stream bank erosion. Although this project size would usually be considered too large to be manageable, it was appropriate in this case since this is primarily a forested watershed with one pollutant of concern: sediment.

An appropriate watershed boundary is a boundary that is **hydrologically distinct**. Your watershed might be:

- An entire river system, including all lakes and tributaries draining into the river
- A river tributary from its headwaters to its **confluence** with the main branch of the river
- A segment of river from its headwaters to a dam, or confluence of a tributary
- A lake watershed, including all contributing tributaries

Remember that larger watershed boundaries require the involvement of more individuals and agencies, and will likely create more challenges in designing a coordinated effort. Also, while planning can successfully occur at larger scales, project implementation ultimately needs to occur at a smaller scale. Although there are no maximum size limits, experience has shown that a manageable watershed is usually no more than 100,000 acres (156 square miles).

Once the geographic area of your watershed has been determined, review the membership of your steering committee. Are there representatives from all areas of the watershed? Are there groups or people that should be added to the committee?

You need to determine whether your project area is actually a subwatershed of a larger watershed, and make sure that your planned activities complement those broader-scale efforts. If you are not sure whether your watershed is part of a larger watershed project, you can begin by asking committee members or your district DEQ Nonpoint Source Program staff.

Your watershed map

A watershed map should clearly show the watershed boundaries and the location of all surface waters (lakes, rivers, streams, and wetlands). The development of the map is an appropriate task for the technical committee. **Topographic maps** can be used to delineate the watershed, with information from various sources, such as a **windshield survey** of the watershed, added to the map. If your committee has the necessary technology and expertise, the watershed map can be produced digitally in a **geographic information system (GIS)**, by referencing information from the Michigan Department of Natural Resources (DNR) Land and Mineral Services Division Resource Mapping and Aerial Photography (RMAP) Section, and other available data.

Your watershed description

Along with the watershed boundaries, your watershed plan must include a description of the characteristics that affect water quality. The description should include the following information:

- Hydrology
- Rainfall characteristics
- Topography
- Soil types
- Land use
- Significant natural resources
- Community profile (e.g., population, economic trends, demographics)

Writing this description is an appropriate task for the technical committee. The tip below suggests the type of information that will help the technical committee develop a watershed map and description.

Resources for Developing the Watershed Map and Description

- Topographic maps from DEQ Geological Survey Division, university libraries, bookstores
- Plat maps from county government office
- County soil surveys from local NRCS office
- GIS information from local governments, regional planning agencies, universities, DNR Land and Mineral Services Division–RMAP Section, MSU Center for Remote Sensing (CRS) and Geographic Information Sciences
- News articles from library archives
- Aerial photos from MSU-CRS, local government offices, USDA Farm Service Agency
- Photo inventory from stakeholders, committee members, windshield surveys
- Census data from U.S. Census Bureau, Michigan Information Center
- Past studies of the watershed
- Reports or studies produced by state agencies

What do you do with the information you collect?

Use the information you collect throughout the planning process to develop a resource library and encourage steering and technical committee members to contribute information to it. A central location for the information allows access to everyone involved in the project. The best location for the library may be the lead organization's office.

Information that you might want in the resource library includes:

- All data used to develop the watershed description
- Population and economic trends
- Information about other ongoing environmental and conservation projects in the watershed
- Information from other watershed projects
- Local land use plans, water quality regulations, and ordinances

Before going any further, make sure that you have:

- A watershed steering committee
- A lead organization
- A technical committee
- The geographic scope of your watershed, including:
  - a map showing the watershed boundaries
  - a description of your watershed
- A resource library

Chapter 2: Getting to Know Your Watershed

Chapter Objectives

- Identify designated and desired uses for your watershed
- Identify pollutants in your watershed
- Identify sources of pollutants in your watershed
- Identify causes of pollutants
- Develop goals based on designated and
- Develop an initial water quality summary

Chapter Product

❑ A water quality summary of designated and desired uses, known and suspected pollutants, sources and causes, and overall goals

Introduction

Once your steering and technical committees have been organized, the next step is to work from the list of water quality concerns and learn about your watershed. This chapter will help you understand the current condition of water quality in your watershed and help you determine goals for your watershed that focus on water quality. You will also develop a water quality summary that will serve as the foundation of your watershed management plan.

What are designated uses and how will they help you identify water quality concerns?

The primary criterion for water quality is whether the waterbody meets designated uses. **Designated uses** are recognized uses of water established by state and federal water quality programs (see box at right for a list of designated uses). In Michigan, the goal is to have all waters of the state meet all designated uses.

Designated Uses*

All surface waters of the state of Michigan are designated for and shall be protected for all of the following uses:

1. Agriculture
2. Industrial water supply
3. Public water supply at the point of intake
4. Navigation
5. Warmwater fishery
6. Other indigenous aquatic life and wildlife
7. Partial body contact recreation
8. Total body contact recreation between May 1 and October 31

**Certain waterbodies are also protected as a coldwater fishery*
Citation: R323.1100 of Part 4, Part 31 of PA 451, 1994, revised 4/2/99

Identifying the designated uses that are not being met and those uses that are threatened by activities on the land is a critical part of all watershed management plans.

Is your waterbody meeting designated uses?

Each of the water quality concerns that your steering committee listed for your watershed will correspond with one or more designated uses. In the "Example Watershed" introduced in Chapter 1, algal blooms are occurring. According to newspaper reports, these blooms are interfering with wading and fishing, which is associated with the designated use of *partial body contact recreation*. You can therefore say that the *partial body contact recreation* designated use is impaired in the Example Watershed.

Example Watershed Concerns	*Example Watershed Impaired Designated Uses*
Algal blooms	Partial body contact recreation, warmwater fishery
Eroding road-stream crossings and river flooding	Aquatic life/wildlife
Livestock in streams and poor fishing	Warmwater fishery

To evaluate all designated uses, your steering and technical committees should gather as much information as they can about the watershed. For example, if a Department of Natural Resources Fisheries Division survey reports that sediment from stream bank erosion is filling in spawning areas and decreasing fish productivity, then the *warmwater fishery* designated use may be impaired. For all water quality concerns in your watershed—including both verified and perceived concerns—the steering and/or technical committee should identify the designated uses that are impaired.

Who can help you determine if the waterbody is meeting its designated uses?

The DEQ Surface Water Quality Division Nonpoint Source Program staff can provide water quality data about various watersheds. The assistance they provide can be supplemented with other contacts in the community based on the pollutants you identify. For example, if the newspaper has reported "elevated ***E. coli*** levels," you might contact your local health department to verify that those levels exceeded water quality standards (i.e., to verify that the designated use, *total and/or partial body contact recreation*, is impaired). Other resource contacts in Appendix A may be able to provide information about your watershed.

You can also refer to the *Water Quality and Pollution Control in Michigan* report (available from DEQ), which provides an assessment of the designated uses of Michigan's lakes, streams, and rivers.

Will your water meet designated uses in the future?

In some cases, activities and resulting pollutants in the watershed may prove to be a threat to water quality. Threatened waterbodies are defined as those that currently meet water quality standards but may not in the future. For example, if a major residential or commercial development will be occurring in the future, **soil erosion** from the construction site may threaten the *coldwater fishery*. In this case, sediment from development activities should be identified as a potential threat to the *coldwater fishery*.

You should identify the threatened uses of your watershed and add any threatened uses to your list, as illustrated in the Example Watershed.

In the Example Watershed, the technical committee added public water supply as a threatened designated use because the public water supply test results showed increasing nitrate levels over the last ten years, and pesticide use was suspected in the watershed.

Example Watershed Impaired and Threatened Uses
Impaired Uses
Partial body contact recreation
Aquatic life/wildlife
Warmwater fishery
Threatened Uses
Public water supply

What are the desired uses for your watershed and how are they determined?

In addition to water quality concerns, desired uses within the watershed should also be identified. A desired use is simply how you might want to use your watershed or how you might want it to look. For example, although a nature trail is not a designated use, the community may desire one in the watershed. You may also want to protect all **riparian corridors** in your watershed and encourage development outside the riparian corridor. Additionally, you might want to identify and permanently protect natural areas and endangered aquatic species habitat, therefore creating a different "look" to your watershed. Desired uses are important because they will help to encourage community support for overall project activities. The Example Watershed steering committee developed a list of four desired uses.

Example Watershed Desired Uses
Developing a recreational trail along the river
Protecting the river corridor/trail system with permanent easements
Protecting prime agricultural land
Protecting unique habitat for an endangered species

Desired uses are based on factors important to the watershed community. They may include current or potential natural resource concerns, such as loss of farmland and open space, or preserving unique habitat for wildlife. Although many of these desired uses may not have a direct impact on water quality, they can be considered in your watershed planning process.

Suggestions for identifying desired uses include:

- Seeking stakeholder/steering committee input
- Contacting local newspapers or searching the Internet to inquire about previously published local interest stories on water quality, wildlife, or recreation in the watershed
- Talking to local park and recreation officials to determine if recreational plans have been developed for the watershed
- Checking with local recreation groups such as canoe livery operators and fishing clubs

At this point, you should have a list of the designated uses that are not being met and the designated uses that are threatened. You should also have a list of desired uses for your watershed.

How do you identify known or suspected pollutants?

The next step in developing your watershed plan is to identify the pollutants that are threatening or impairing the designated uses. A designated use is threatened or impaired because of the presence of one or more pollutants in the water. For example, if the designated use *warmwater fishery* is threatened due to urbanization, then one pollutant of concern may be sediment, since development activities may increase erosion and sediment **runoff**. The table top right provides a list of pollutants that are typically associated with each designated use. A more detailed description of typical pollutants is provided in Appendix B.

The list of pollutants that you develop at this stage is an initial "best guess" based on your familiarity with the watershed and available information. You will verify the presence of the pollutants later. To develop the initial list of pollutants, the steering or technical committee might contact organizations, universities, or local health departments that are likely to have monitoring reports and research studies.

Designated Use	*Typical Pollutants Affecting the Designated Use*
Agriculture	Hydrology (i.e., too little water to irrigate) Nutrients
Public water supply	Nutrients (nitrates) Pesticides
Navigation	Sediment
Warmwater fishery	Sediment Hydrology (i.e., "flashy" streams)
Other indigenous aquatic life and wildlife	Sediment Pesticides Temperature
Partial body contact recreation	*E. coli* bacteria Nutrients
Industrial water supply	Suspended solids

As information is collected, the steering and technical committees should begin creating a "Watershed Pollutants" chart that shows the known and/or suspected pollutants contributing to the impaired or threatened designated use. Remember, some "suspected pollutants" are based on local knowledge and perceptions.

In the Example Watershed, a DEQ biological survey stated that the aquatic life/wildlife and fishery were negatively affected due to the loss of habitat. The technical committee learned that the loss of habitat was due to sediment covering the cobble and gravel on the streambed. The committee therefore added sediment to the list of known pollutants. The technical committee also learned that nutrients were responsible for the algal bloom, so nutrients were added to the list of known pollutants. The committee speculated that the urban portion of their watershed was likely contributing oils, grease, and heavy metals and added these to the suspected pollutants list.

Example Watershed Known and Suspected Pollutants	
Impaired Use	***Pollutants****
Partial body contact recreation	Nutrients (phosphorus and nitrogen) (k) *E. coli* bacteria (k)
Aquatic life/wildlife	Sediment (k) Nutrients (k) Oils, grease, and heavy metals (s)
Warmwater fishery	Sediment (k) Nutrients (k) Hydrologic flow (s) Pesticides (s)
Threatened Uses	
Public water supply	Nutrients (nitrate) (k)

** k = known and s = suspected*

Keep in mind that the pollutant list should not only include the traditional types of pollutants—such as sediments and nutrients—but also pollutants such as increased temperature and increased hydrologic flow.

At this point, you should have developed a list of known and suspected pollutants for your watershed.

How do you identify sources of pollutants?

In order to reduce the pollutants impairing the designated uses in your watershed, you need to determine where the pollutants originate (i.e., the source(s) of the pollutants). Your list of sources will initially include both known and suspected sources of pollutants. This list will be a snapshot view, based on personal observation, input from your steering and technical committees, surveys, and other available information.

Begin by looking at the list of known and suspected pollutants. For each known and suspected pollutant, list all known and suspected sources.

In the Example Watershed, the technical committee reviewed newspaper articles, water quality data, research reports, and observations from anglers, and then added known and/or suspected sources for each pollutant. Road-stream crossings were determined to be a known source of sediment. Storm drains and impervious surfaces were added as a suspected source of oils, grease, and heavy metals. Failing septic systems were added as a suspected source of nutrients, as was residential fertilizer use.

Example Watershed Sources for Each Pollutant

*Pollutants**	*Sources*
Nutrients (k)	Livestock in stream (k) Failing septic systems (s) Residential fertilizer use (s)
Sediment (k)	Livestock in stream (k) Road-stream crossings (k) Stream banks (k)
E. coli bacteria (k)	Livestock in stream (k) Failing septic systems (s)
Hydrologic flow (s)	Urban storm water (s)
Pesticides (s)	Agricultural lands (s) Residential gardens (s)
Oils, grease, and metals (s)	Storm drains (s) Impervious surfaces such as parking lots (s)

** k = known and s = suspected*

Depending on the amount of available information, you may have few or no known sources of pollutants, but many suspected sources. Keep in mind that most suspected sources will either be confirmed or eliminated during the inventory of your watershed, as discussed in Chapter 4.

How do you identify the causes of each source of pollution?

For each known or suspected source, you need to identify the cause, or the condition that is creating the source of the pollutant. For example, if sediment (the pollutant) is resulting from stream bank erosion (the source), the cause of the stream bank erosion may be unrestricted livestock access, human access, or flow fluctuation. *This step is important because by identifying the cause of the pollutants' sources, you will be able to design the most successful control measures.* For information about organizations that may be able to assist you, see Appendix A.

To determine some of the potential causes, the technical committee in the Example Watershed reviewed the list of sources and determined a cause, either by accessing existing information about the watershed or by contacting local experts. They knew, for example, that livestock had unrestricted access to the stream since there were no fences or barriers to limit access. However, to determine the cause of several eroding road-stream crossings, they talked to an engineer at the Road Commission. They learned that the cause of the erosion was culverts installed in the 1970s that were now unable to handle the increased hydrologic flow. They also surmised that increased flooding due to poor storm water management practices in the river was scouring the banks and causing increased stream bank erosion.

At this point you should have a list of potential causes for each known and suspected source of pollution.

How do you develop goals for the watershed?

The goals that you develop for your watershed should be based on restoring and protecting the designated uses. Goals outline the anticipated future state of the watershed. They are usually broad and may change based on the data gathered during the inventory of your watershed. As you work through Chapters 6–10 of this planning process, you will develop specific objectives and tasks for each goal.

For each impaired and threatened designated use, work with your steering committee to develop goals for the watershed. You may also want to include goals tied to the desired uses. Goals related to desired uses may help you gain additional support for your watershed project. In the Example Watershed, goals for each designated and desired use were determined.

Example Watershed Causes for Each Source

Sources*	Causes
Livestock in stream (k)	Unrestricted access (k)
Failing septic systems (s)	Improperly designed and maintained septic systems (s)
Residential fertilizer use (s)	Improper application (s)
Road-stream crossings (k)	Undersized culverts due to increased hydrologic flow (k)
Stream banks (k)	Livestock access (k)
	Human access (s)
	Flow fluctuations (s)
Urban storm water (s)	Poor storm water management practices (s)
Agricultural lands (s)	Improper pesticide application (s)
Residential gardens (s)	Improper pesticide application (s)
Storm drains (s)	Improper oil disposal and vehicle maintenance (s)
Impervious surfaces (s)	More roads and parking lots due to development (s)

**k = known and s = suspected*

Example Watershed Goals

Impaired Uses	Goal
Partial body contact recreation	Restore recreational use by reducing nutrient and bacteria loadings
Warmwater fishery	Restore the fishery by reducing sediment and nutrients, and reducing peak flows
Aquatic life/wildlife	Same goal as warmwater fishery goal

Threatened Use	
Public water supply	Protect the supply by reducing nutrient loads

Desired Uses	Goal
Recreational trail	Establish a trail along river
Protect river corridor	Establish permanent easements along entire river corridor
Protect prime agricultural land	Develop zoning or other tools to identify and permanently protect prime agricultural lands
Protect unique habitat	Identify critical habitat for endangered species and ways to protect the habitat

At this point, you should have a list of water quality improvement or protection goals for your watershed, based on designated uses.

What is in a water quality summary?

Your watershed plan should also include a water quality summary. The water quality summary is a short and clearly written synopsis of water quality in the watershed. It includes the designated and desired uses addressed in the plan, the known and suspected pollutants, known and suspected sources of the pollutants, their known and suspected causes, and the goals for the watershed. Such a summary can be used to educate citizens, stakeholders, and local officials. An example initial water quality summary is given on the right.

At this point you should develop your initial water quality summary. After you have completed your inventory and analyzed the data in the upcoming chapters, you will modify and finalize the water quality summary (Chapter 11). The final summary will provide an accurate picture of your watershed and a clear link between the goals and conditions in the watershed.

Example Water Quality Summary (Initial)

The Example Watershed waterbody has three designated uses that are impaired: (1) partial body contact recreation, (2) aquatic life/wildlife, and (3) warmwater fishery. The designated use public water supply is threatened.

Project Goals

The first project goal is to restore partial body contact recreation use by reducing *E. coli* bacteria and nutrient loadings. The second goal is to…

Other goals based on the remaining impaired or threatened designated uses should also be stated.

Recreation

The designated use of partial body contact recreation is impaired due to undesirable algal blooms and *E. coli* levels. The only known source of these pollutants is livestock in the stream. Suspected sources include failing septic systems and the misapplication and/or over-application of fertilizer in residential areas.

Uncontrolled livestock access to streams results in *E. coli* and nutrient deposition directly into the water. When septic systems do not properly treat waste, nitrates can be transported from the septic field area to the waterbody, where they contribute to increased plant growth and dissolved oxygen depletion. The misapplication and/or over-application of fertilizers can result in nutrients being transported from the land to the waterbody where algal blooms are formed.

Your water quality summary should include a narrative for each designated use that is impaired or threatened, describing the relationship of the designated use to the pollutant(s), the pollutant to source(s), and finally the sources to causes.

At this point you should have all of the following for your watershed:

- A list of impaired and threatened uses
- A list of desired uses
- A list of known and suspected pollutants for each impaired and threatened designated use
- A list of known and suspected sources for each known and suspected pollutant
- A list of known and suspected causes for each known and suspected source
- Goals based on protecting and restoring designated uses
- Goals based on desired uses
- An initial water quality summary

Chapter 3: Defining a Critical Area

Chapter Objective

• Identify critical area(s) for your watershed

Chapter Product

❑ Designation of a critical area that geographically narrows the scope of your watershed project by focusing attention on the parts of the watershed that contribute the greatest pollution to the waterbody

Introduction

At this point in the watershed planning process, your steering and technical committees have considered or identified all of the potential pollutants and sources within the watershed that may be affecting designated uses.

In order to identify specific sources of pollutants, you will need to conduct a physical inventory of your watershed. Since the entire watershed may not necessarily contribute pollutants, you may not need to inventory the entire watershed. For example, one part of your watershed may have highly erodible soils, but if the soil does not reach the waterbody, it would not be considered a water quality pollutant. Another portion of the watershed may be part of a natural area protected with permanent easements. If neither of these areas contribute pollutants to your waterbody, they can be eliminated from your physical inventory.

What is a critical area?

A **critical area** is the geographic portion of the watershed that is contributing a majority of the pollutants and is having a significant impact on the waterbody. The concept behind identifying a critical area is to reduce the geographic scope of your watershed project and focus your attention on the part of the watershed that is contributing pollutants.

Why is it necessary to identify a critical area?

Focusing on the critical area will help you prioritize the concerns and subsequent actions within the watershed. Identifying a critical area will also save time in conducting your inventory, result in the greatest reduction in pollutants, expedite the restoration process, and save money by focusing limited financial and technical resources to the areas directly contributing the pollutants. During the implementation phase, financial incentives will be targeted to the critical area to obtain the greatest water quality improvements for the money invested.

How are critical areas determined?

To identify critical areas, you should consider the pollutants in your watershed and how they might be reaching the water. Identify the pollutant sources, where they likely originate, and assess their movement from the source to the water. You should also consider areas that may be vulnerable to groundwater contaminants, such as areas with sandy soils (where pollutants can infiltrate the soils and reach groundwater) or abandoned wells.

In the Example Watershed, one pollutant identified was sediment. The sources included livestock in the stream, road-stream crossings, and eroding stream banks. Using their watershed map, the Example Watershed planners drew a line parallel to the river at a distance 1/4 mile from the water's edge. This 1/4-mile wide stream corridor was part of the critical area because the banks and livestock were contributing pollutants to the waters. Planners in the Example Watershed then looked at other pollutants and sources in the watershed and expanded the critical area to include sources of other pollutants, such as oil and grease. One source of oil included storm sewers, since several local residents had recorded seeing oil sheens on the river during rain storms. The planners knew that some storm sewers emptied into the waterbody, so they worked with the local drain commissioner and township engineer to determine where the storm sewers originated. They then included the storm-sewered areas in the critical area.

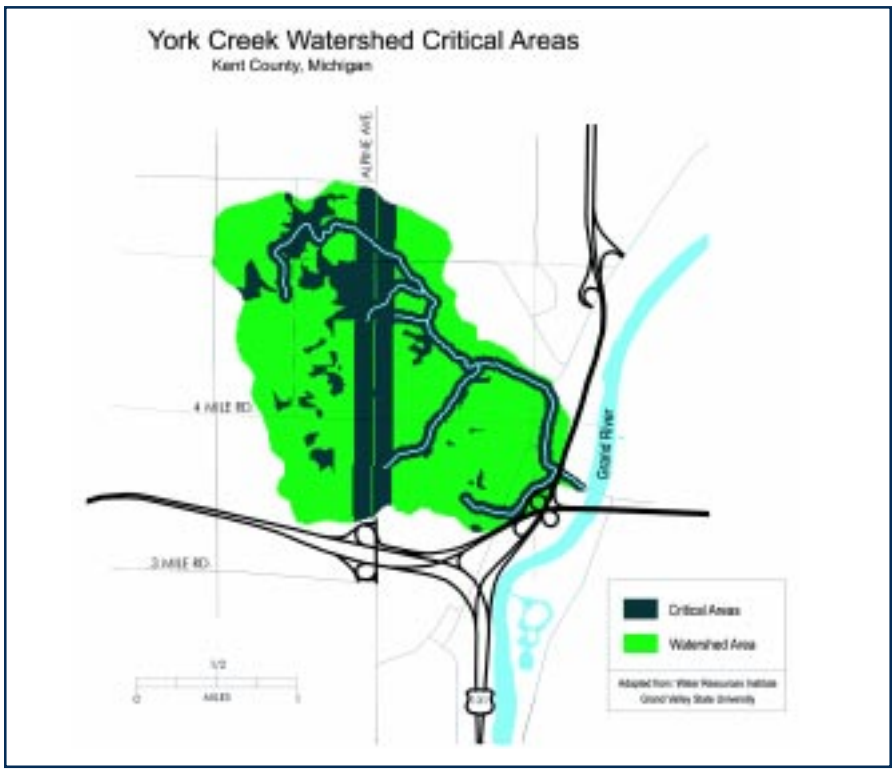
York Creek Project

In the York Creek watershed, planners identified eroding stream banks as a source of pollutants. They initially identified the critical area as simply the corridor along the stream. Other known pollutants included increased hydrologic flows due to development and increased storm water runoff. Because development was primarily occurring along a particular street, York Creek's critical area was expanded to include that street. In addition, the York Creek watershed is hilly, and the planners identified several areas with highly erodible soils, which they added to the critical area. York Creek's critical area, then, was a blend of a stream corridor, a development corridor, and patches of erodible land outside the corridors.

A critical area might also consist of one or more subwatersheds. Water quality data may show that within the watershed, only one or two upstream areas contribute the vast majority of pollutants to the waterbody.

Lake Macatawa Project

In the Lake Macatawa watershed in Ottawa and Allegan Counties, planners divided the watershed into multiple subwatersheds. They then created maps combining the subwatersheds based on three land use categories. This method allowed experts in each of the identified land uses to conduct an inventory of the subwatersheds. After the inventories were conducted, the planners were able to implement different strategies for each land use.



Occasionally, it makes sense to identify the entire watershed as the critical area. For example, in the two-square mile Gallagher Creek watershed, development was occurring throughout the watershed. The watershed organizers decided to work with all of the developers to protect the creek. In this case, the entire watershed was the critical area because the entire watershed was contributing pollutants to the waterbody.

At this point you should have identified a critical area or areas in your watershed. This will help you meet the CMI requirement for identifying the sources of pollutants that are critical to control.

Chapter 4: Surveying the Watershed to Inventory Your Critical Area

Chapter Objectives

- Conduct an inventory of your watershed
- Use the data collected to modify the list of known and suspected pollutants, sources, and causes

Chapter Products

❑ A list of sources and causes for each pollutant
❑ The location of sources for each pollutant
❑ A brief summary of the method(s) used to conduct your inventory

Introduction

After you identify the critical area, the next step is to complete an inventory of the critical area to refine your list of pollutants, sources, and causes. The focus of your inventory will be to either eliminate suspected pollutants, sources, and causes from the list, or add them to the list of known pollutants, sources, and causes. You will also be verifying the "knowns."

What methods are available for inventorying the critical area?

There are several methods available for inventorying a critical area, ranging from an in-depth walk of your watershed to computer modeling.

Based on ten years of watershed planning, the DEQ Nonpoint Source Program staff recommends that you walk, drive, and/or canoe the critical area in your watershed. Such "visual inventories" can provide a great opportunity to involve your steering committee in the project and familiarize them with the watershed.

Visual Methods

As you walk, drive, and/or canoe the watershed, look for signs to help you verify pollutants, sources, and causes. Some signs will be readily apparent, while others will be more difficult to determine. Note that if you only drive the watershed to conduct the inventory, you may miss information on the status of the watercourse between road-stream crossings.

In the Example Watershed, an algal bloom was easy to recognize, but it was more difficult to identify the source of the nutrients causing the bloom. The source may have been failed septic systems, animal waste from livestock in the stream, or homeowners applying excess fertilizers to their lawns. To help solve this puzzle, an inventory team, made up of steering and technical committee members, noted any livestock in the stream, manicured lawns leading to the water's edge, and houses next to the stream as potential sites for failed septic systems. This information helped identify the potential sources of the nutrients that created the algal bloom.

Before beginning your visual inventory, review aerial photographs, topographic maps, soil maps, and your watershed map, and determine how to proceed. Some watershed planners hire a certified pilot to fly over their watershed, both to obtain a clearer view of the watershed and the patterns on the land and to take aerial photographs.

If several groups of people are assisting with the inventory, you need to decide what data to collect and how you will standardize the data collection. Most watershed groups have used an inventory sheet that includes information such as:

- Land use (for example, is the land being used for agricultural row crops or is it an urban area developed adjacent to the stream bank?)
- The condition of stream bank vegetation
- Amount of tree canopy (i.e., shade)
- The slope of the bank
- The stability of the stream bank (for example, signs of erosion such as gullies)
- In-stream water quality indicators such as nuisance algal growth
- Stream bed composition
- The condition of road-stream crossings
- Storm water or drainage pipes discharging into the stream

You should decide who will collect the data, who will be responsible for making sure the data is consistently collected, and who will enter the data into your database (if you have one).

You should also determine what to do with the data collected. You may find it helpful to set up a database to enter, store, and analyze the data. If you don't have computer capabilities, you might want to set up colored file folders for different subwatersheds or different reaches of river.

Chippewa River and River Raisin Projects

In the North Branch Chippewa River watershed in Isabella County, the watershed planner conducted an inventory by walking the river and making visual observations on aerial photographs. In the River Raisin watershed in Lenawee County, the technical and steering committees divided into teams of two to four people who drove the watershed and recorded observations at road-stream crossings on a data sheet.

Advantages of a visual inventory are that it gives the watershed planner the most accurate picture of what is occurring in the watershed, and it familiarizes local stakeholders, decision makers, citizens, and agency personnel with their watershed. It also provides the opportunity to introduce the watershed project to riparian landowners. Two disadvantages are that it is time-consuming and data-intensive.

Some watershed planners have incorporated photographs into their inventories, which serve as a visual reference for the site, and provide a good "before" shot to compare with a photo taken after control measures are installed.

Photographs provide a visual image to illustrate problems that need to be corrected. They also:

- Generate interest in the watershed
- Show where improvements occurred
- Are inexpensive for the benefit they provide
- May help improve a proposal for grant funds

For before and after photographs, you need to document where you stood to take your "before" picture to find the same location for your "after" picture. You also need to label and properly store the images.

When taking photographs, take more than one picture at each site. Film is relatively inexpensive compared to the time it might take to return to the site. You should store photos in archival quality sheets (non-PVC, acid-free). Also, fine-point permanent markers work well for labeling slides, photos and archival sheets. Digital cameras can also be used and the images can be stored on your computer.

Modeling Methods and GIS

Computer models simulate real-world conditions. They are used to fill in missing data or information that cannot be readily obtained from direct measurements. Some models can evaluate the effects of different design scenarios, while others can run complex simulations based on observed data to help identify causes of a particular impact. Computer models can also be used to predict alternate scenarios.

Lake Macatawa and Brooks Creek Projects

In the Lake Macatawa watershed, a computer model was used to help planners decide where to focus their inventory in the watershed. By comparing phosphorus water quality data from each of the three primary subwatersheds, a model showed which one was the source of most of the phosphorus.

A computer model was used to show the watershed planners in the Brooks Creek watershed in Newaygo County what their watershed would look like if current development trends continued into the future. This "build-out" analysis was then compared to another scenario that assumed that an ordinance was developed to protect all stream corridors in the watershed. Based on the results of this model, planners in the Brooks Creek watershed concluded that they needed to develop an ordinance to protect the resources in their watershed.

It is important to remember that computer models are data dependent and will only be reliable if reliable data is used. Adequate data is often lacking or costly to obtain. Models are powerful tools to use in watershed analysis, but must be verified with field observations.

Another computer tool, a Geographic Information System (GIS), is excellent for creating watershed maps and **spatially-referenced data** layers that can be visually placed on top of each other. For example, a GIS can create a map of a watershed that combines the soils, elevation, and land use. If that map doesn't provide the watershed planner with enough information, other data layers, such as roads and county boundaries, can easily be added to the map.

A GIS is useful for storing and displaying information collected during the inventory. For example, after the necessary data layers have been added to the

map, symbols depicting the location of all severely eroding road-stream crossings, all severely eroding stream banks, or sites with livestock in the stream can be added. You can check with your local MSU Extension, DEQ district or conservation district offices to find out if a GIS is available in your watershed.

York Creek Project

In the York Creek watershed, a GIS provided local planners with the tools needed to evaluate site plans. The GIS included soils, elevation, land use, roads, waterbodies, and parcel information. The planner could click on the parcel, view the soil conditions, and compare the proposed construction site plan with the information in the database. The York Creek GIS also included information from the inventory, including photographs from eroding road-stream crossings.

The disadvantages of GISs are that the program requires a high level of expertise to set up, operate, and maintain. The equipment to run GISs can be expensive and the data may be difficult to acquire. Remember that the data generated from both GISs and models are only as good as the data entered. Field verification is always necessary.

Most Michigan watershed groups walked, canoed, and/or drove the entire watercourse during the planning process. Groups with global positioning systems (**GPSs**) found them invaluable for siting important attributes on topographic maps. Those groups with access to a GIS found it to be useful for cataloging current conditions and predicting future outcomes of their actions (or inaction). GISs were also helpful for communicating the watershed group's intentions to local officials and the public.

Public Surveying Methods

Another method for inventorying the watershed is to survey people who live in or near the critical area, either via telephone, mail, or in person. In some cases, you may survey individuals in the entire watershed. The survey should ask residents about their perceptions and observations regarding water quality. A local resident, for example, may know that most of the neighbors apply fertilizers to their lawns several times a year.

Before conducting a survey, you need to decide what you will do with the information. Will you use it to help identify educational needs in the watershed? Will you use it to determine changes in attitude as the watershed project progresses? These answers will help you formulate your survey.

When you develop your survey:

- Test the survey on three to five people to make sure it is understandable
- Have someone familiar with writing and designing surveys review it

When conducting the survey:

- Clearly identify yourself and state the goal of the survey
- Explain how the data collected will be used

After the survey:

- Send a summary of results to the respondents

Who should perform the inventory?

The person or people most suited to perform the inventory will depend on the type of inventory needed for the watershed. The steering committee and technical committee should:

- Review the available inventory methods.
- Determine the most appropriate methods for the watershed.
- Identify the most qualified person or agency to lead the inventory. You may want to consider including individuals with expertise in hydrology or soils. You may need to hire such individuals.
- Ask the lead individual to train other members of the "inventory team" so the inventory is conducted consistently throughout the watershed.

What do you do with the information collected?

Once the inventory data is collected, update your list of known and suspected pollutants. You may want to insert a new column next to the "knowns" to include files or documents that verify the knowns. If you still have items in the "suspected" column, make note of them and refer back to them when writing the detailed objectives for your watershed goals in Chapter 6.

In the Example Watershed, through the inventory and phone calls to local experts, the committee verified all "known" pollutants, sources, and causes. During the inventory, a sheen of oil was observed below a storm drain; therefore, oils and grease were moved from the suspected to the known pollutant list. Storm drains (which empty into the river) also became known sources of oils and grease. When a light rain storm resulted in flooding, planners contacted the U.S. Geological Survey for hydrology data. With this information, urban storm water was added as a known source of increased hydrologic flow, and poor storm water management practices were determined to be the cause. In addition, residential fertilizer use was added as a known source of nutrients because of the number of vivid green manicured lawns ending at the water's edge.

While many pollutants and sources became known in the Example Watershed, some pollutants, sources, and causes could not be confirmed as "knowns." No water quality data confirmed that pesticides were creating a water quality problem and no one observed heavy use of pesticides on agricultural lands or residential gardens. Thus, pesticides and their possible sources were eliminated from the "suspected" list. Although failing septic systems were not verified as either a source of nutrients or *E. coli* bacteria, the committee felt that more research was needed because there were areas in the watershed with soils that are not well suited for septic systems. Thus, failing septic systems were left on the "suspected" list to be addressed later.

Example Watershed Sources—Following the Inventory

Pollutants	Sources	Causes
Nutrients (P and N) (k)	Livestock in stream (k)	Uncontrolled access (k)
	Failing septic systems (s)	Improperly sited, designed, and/or maintained septic systems (s)
	Residential fertilizer use (k)	Improper usage (k)
Sediment (k)	Livestock in stream (k)	Uncontrolled access (k)
	Road-stream crossings (k)	Undersized culverts (k)
	Stream banks (k)	Livestock access (k)
		Human access (k)
		Flow fluctuations (k)
E. coli bacteria (k)	Livestock in the stream (k)	Uncontrolled access (k)
	Failing septic systems (s)	Improperly sited, designed and/or maintained septic systems (s)
Hydrologic flow (k)	Urban storm water (k)	Poor storm water management practices (k)
Oils, grease and metals (k)	Storm drains (k)	Improper oil disposal (k)
		Impervious surfaces such as parking lots (k)

k = known; s = suspected

If you haven't already done so, you will want to decide how to share the data collected during the inventory with other people in the watershed. You may find it useful to produce a watershed map and add photos, data, or notes to it.

Bear Creek, Kent County Project

In the Bear Creek watershed project in Kent County, the committee taped photographs of representative agricultural, stream bank, and transportation sites on a large watershed map to show the planning board and the public the sources of pollutants in the Bear Creek watershed. They also kept detailed information for each of the sites in individual file folders.

At this point you should have:

- *An updated list of all sources and causes for each pollutant in the critical area, which should be mostly verified (i.e., "knowns")*
- *The number and location of sites corresponding with each source*
- *A summary of the method(s) used to conduct your inventory.*

Chapter 5: Prioritizing Pollutants, Sources and Causes

Chapter Objectives

- Prioritize pollutants for your watershed based on the designated uses
- Prioritize sources and causes of the pollutants

Chapter Product

❑ A prioritized list of pollutants, sources, and causes for your watershed

Introduction

Based on your inventory of the critical area, you should have a thorough understanding of the pollutants, sources, and their causes. The next step is to prioritize them to help you decide which should be addressed first in your watershed management plan. By prioritizing, you may be able to achieve the greatest pollutant reduction while treating the fewest sources, leading to the greatest water quality benefit for your money.

How do you prioritize pollutants, sources, and causes?

To sort through all the information you have collected, gather your steering committee and inventory group to share the inventory findings. It may be advantageous to re-list on an easel or board all of the designated and desired uses, pollutants, sources, and causes. With this information, your steering and/or technical committee can begin to prioritize the lists. Often the steering committee, relying on their knowledge about concerns and priorities of watershed residents, decides which designated uses are most important.

In the Example Watershed, the technical committee could not come to consensus on which designated use was most important, so they began by prioritizing the list of pollutants impairing or threatening each designated use. Examining the data, they noted that sediment, hydrologic flow, and nutrients all had an impact on the warmwater fishery and other aquatic life/wildlife. To prioritize those pollutants, they looked at the known sources from the inventory. Since sediment can carry other pollutants, the committee ranked sediment number one. They continued ranking the other two pollutants for the warmwater fishery, then ranked the pollutants for each of the other designated uses. They completed this ranking based on their best professional judgment.

There is no single best method for prioritizing pollutants. You can do this based on the priority you gave each pollutant for each designated use or based on the number of designated uses the pollutant impairs or threatens. You might also base your prioritization process on what you think can be addressed first.

Example Watershed Prioritization of Pollutants for Each Designated Use

Designated Uses	*Pollutants*	*Priority Ranking*
Warmwater fishery	Hydrologic flow	3
	Nutrients	2
	Sediment	1
Other indigenous aquatic life/wildlife	Hydrologic flow	2
	Sediment	1
	Nutrients	3
	Oils, grease, and metals	4
Partial body contact recreation	*E. coli* bacteria	1
	Nutrients	2
Public water supply (threatened)	Nutrients (nitrate)	1

In the Example Watershed on the right, the technical committee looked at the pollutant rankings for each designated use and decided upon an overall ranking of pollutants for the watershed. They chose sediment as the number one pollutant to focus on because (1) it was the number one ranking for two designated uses and (2) nutrients are often attached to sediment, so by reducing soil erosion, nutrients would also be reduced. They continued by ranking all the other pollutants.

Although there is no best method for prioritizing pollutants, it is important to select and document a process that is acceptable to both the steering and technical committees.

Your next step is to prioritize the sources of each pollutant. To do this, you need to consider the magnitude of the source and how readily the pollutant moves from its source(s) to the waterbody.

Bear Creek and Davis Creek Projects

In the Bear Creek watershed in Kent county, for example, sediment and *E. coli* bacteria were identified as the two major pollutants. The watershed planners used four criteria and a numerical ranking scheme to prioritize sources. The sources were first grouped by category, so that road crossings were ranked against road crossings and agricultural sites were ranked against agricultural sites. A priority list of all sites was developed by comparing across categories.

In the Davis Creek watershed, an intensive water sampling and analysis study was provided free of charge by a consulting firm involved with the project. This information, coupled with observations of erosion problems, an abandoned oil refinery, and fluctuating flow conditions by "creek walkers" (people who volunteered to survey the creek), helped committee members prioritize their sources of pollution.

Example Watershed Overall Prioritization of Pollutants

Pollutants	Priority Ranking
Sediment	1
Nutrients	2
Hydrologic flow	3
E. coli bacteria	4
Oil, grease, metals	5

In the Example Watershed, the three sources of sediment were eroding stream banks, road-stream crossings, and livestock in the stream. The technical committee determined that the cumulative amount of sediment eroding from road-stream crossings in their watershed was significantly greater than either the cumulative amount of sediment eroding from stream banks or from livestock in the stream. The technical committee could also have used sediment delivery ratios, a stream bank rating system, or channel erosion equations for this decision.

To determine priorities for nutrient sources, the Example Watershed technical committee considered that all livestock standing in a stream affected water quality; however, they were unsure about the impact of residential fertilizer use and failing septic systems. They therefore ranked livestock in the stream as a higher priority, followed by residential fertilizer use and failing septic systems. Since failing septic systems were still an unverified source on their list, they were given a lower ranking than residential fertilizer use. The technical committee used the distance to the waterbody and the severity of the source on the waterbody as their criteria.

Example Watershed Prioritized Pollutants and Sources

Pollutants	Ranking	Sources	Ranking
Sediment	1	Road-stream crossings erosion	1
		Stream bank erosion	2
		Livestock in the stream	3
Nutrients	2	Livestock in the stream	1
		Residential fertilizer use	2
		Failing septic systems	3
Hydrologic flow	3	Urban storm water	1
E. coli bacteria	4	Livestock in the stream	1
		Failing septic systems	2
Oil, grease, and metals	5	Storm drains	1
		Parking lots	2

Criteria commonly used by watershed projects for ranking sources include the frequency of occurrence, the degree to which the source degrades the water, and an analysis of benefits and costs for addressing various sources.

After prioritizing pollutant sources, the next step is to review the causes of the sources. It may not be necessary to prioritize all of the causes, since some will logically need to be addressed before other causes or other sources. For example, if flow fluctuations are causing stream bank erosion, you will want to address the flow problem before you begin stabilizing eroding stream banks. The Example Watershed's prioritized causes are listed above right.

Example Watershed Prioritization Process for Sources and Causes of Sediment

Sources	Priority Ranking	Causes	Priority Ranking
Eroding road-stream crossings	1	Undersized culverts (increased hydrologic flow)	1
Stream bank erosion	2	Flow fluctuation (poor storm water management practices)	1
		Human access	2
Livestock in stream	3	Unlimited access	1

This table is not complete. You should prioritize for all sources and causes.

Is there any one specific prioritization process you should use?

There is no single best method for prioritizing designated uses, pollutants, sources, and causes. Consider the methods discussed in this chapter. After you complete this step, you may find additional information—such as the willingness of a landowner to participate—that might require you to revisit and re-prioritize your designated uses, pollutants, sources, and/or causes.

At this point, you should have a prioritized list of designated uses, pollutants, sources, and causes, and a description of the methods used to prioritize them.

Chapter 6: Determining Objectives for Your Watershed Goals

Chapter Objective

- Develop objectives for each of your watershed goals

Chapter Product

❑ A table showing objectives for each of your watershed goals

Introduction

Having completed the steps in Chapters 1 through 5 of the watershed planning process, you should have the necessary information to determine detailed objectives and tasks to meet your watershed goals. At this point, you should have goals for your watershed and understand:

- The physical characteristics of your watershed
- The pollutants that are impairing and threatening designated uses
- The sources and causes of pollutants
- The desired uses of your watershed

In addition, your pollutants, sources, and causes should be prioritized. In this chapter you will determine objectives for each of your goals.

Where do you begin?

An objective outlines how you will reach a goal. To develop objectives, begin by reviewing the initial goals that you developed in Chapter 2. In terms of this planning process, an objective is how you will reduce pollution from a source to protect or restore a designated use.

In the Example Watershed, three goals were identified in Chapter 2 to restore three designated uses. For the goal of restoring the warmwater fishery, one logical objective is to reduce nutrient levels by eliminating all livestock from the stream, while another objective is to identify and correct failing septic systems. Other objectives may relate to sediment reduction. These objectives should be listed in a table similar to the one below for the warmwater fishery.

Example Objectives for One Goal in the Example Watershed

Goal	*Objectives*
Restore the warmwater fishery	Reduce the amount of sediment by: • Stabilizing eroding road-stream crossings • Restricting livestock from the stream • Stabilizing eroding stream banks
	Reduce the amount of nutrients by: • Reducing fertilizer use on residential lawns • Restricting livestock from the stream • Identifying and correcting failing septic systems
	Reduce hydrologic impacts from fluctuating flows by: • Retrofitting and modifying existing infrastructure in the watershed to reduce high water (peak) flows • Identifying ways to manage urban storm water

In this table only a few objectives are included for one goal. You should have objectives for each of your goals.

How do you determine the tasks for reaching each objective?

Tasks are the steps needed to reach an objective. Implementing most objectives requires a combination of four types of activities, each with associated tasks. These include: (1) implementing best management practices; (2) reviewing and modifying existing projects, programs, and ordinances; (3) designing and implementing education and information activities; and (4) evaluating the effectiveness of planned activities. The next four chapters provide more specific guidance for these four types of activities.

Chapter 7: Identifying Systems of Best Management Practices Needed

Chapter Objectives

- Identify the Best Management Practices (BMPs) for each source or cause of pollution in your watershed
- Combine BMPs into systems

Chapter Product

❑ A table showing the systems of BMPs needed for each source or cause of pollution, and estimated costs

Introduction

At this point, you have a list of objectives for achieving each of your watershed goals. This chapter will help you identify the Best Management Practices needed to address the priority sources and causes of pollutants in your critical area.

What is a Best Management Practice (BMP)?

A Best Management Practice is a land management practice that a landowner implements to control sources or causes of pollution. There are three types of BMPs that treat, prevent, or reduce water pollution.

- Structural BMPs: "brick and mortar" practices that require construction activities to install, such as storm water basins, grade stabilization structures, and rock rip-rap
- Vegetative BMPs: that use plants, including grasses, trees, and shrubs, to stabilize eroding areas
- Managerial BMPs: that involve changing the operating procedures at a site

Why are BMPs applied as a system of practices?

Best Management Practices are typically applied as systems of practices because one practice rarely solves all water quality problems at a site, and the same practice will not work for all the sources and causes of a pollutant. All three types of BMPs may be needed to address a source of pollutants. For example, in the case of a storm water basin (structural BMP), if the side slopes were not stabilized with vegetation (vegetative BMP) the basin would likely erode, blocking the outlet and impairing the effectiveness of the basin.

The DEQ's Nonpoint Source Program has several documents available to help select BMPs:

- *Agricultural Best Management Practices Manual for Michigan's Nonpoint Source Pollution Program* includes 19 systems of BMPs to protect water quality on agriculture lands.
- *Guidebook of Best Management Practices for Michigan Watersheds* includes standards and specifications for more than 50 BMPs. It assists developers, contractors, county and township planners, engineers, architects, and local citizens in selecting systems of BMPs to control runoff from construction sites, urban areas, and recreational areas.
- *Water Quality Management Practices on Forest Land* includes siting and design considerations for new roads, skid trails, landings, and buffer strips. It assists forest landowners and timber harvesters in selecting and installing BMPs on forest lands.
- *Stormwater Management Guidebook* presents a guide for designing detention practices. Written for engineers and consultants, it includes design criteria to improve the quality of storm water, as well as control the quantity of runoff.
- *Natural Resources Protection Strategy for Michigan Golf Courses* provides practical information for golf course superintendents, including a checklist of management practices.

How do you identify appropriate managerial, structural, and vegetative BMPs?

To identify appropriate BMPs, review your list of sources and causes and then skim through some of the BMP manuals listed above. Use the BMP manuals and the expertise of your technical committee to determine the system of BMPs needed for each source in your critical area.

The Example Watershed technical committee developed a table showing each source of pollutants in the critical area and the most logical BMP manual to use. Using these guides, they identified an appropriate system of BMPs to address each source. If the source would primarily be addressed with information/education efforts, they wrote "I/E" in the table.

For each source in your watershed, you should develop a table of sources, information resources, and the name of the systems of BMPs most appropriate for the source.

Source	BMP Manual	Potential System of BMPs
Road-stream crossings	Guidebook of BMPs for Michigan Watersheds	Watercourse crossings BMP, Detention basin BMP
Stream banks	Guidebook of BMPs for Michigan Watersheds	Stream bank stabilization BMP
Urban storm water	Guidebook of BMPs for Michigan Watersheds; Stormwater Management Guidebook	Dependent upon hydrologic analysis
Storm drains	Stormwater Management Guidebook; I/E	Dependent upon hydrologic analysis
Impervious surfaces	Guidebook of BMPs for Michigan Watersheds	Dependent upon hydrologic analysis
Livestock in stream	Michigan Ag BMP Manual	Resource Management System -2 pasture management
Failing septic systems	I/E	—
Residential fertilizer use	I/E	—

In the Example Watershed, flow fluctuations were identified as a cause of erosion and flooding. Because erosion and flooding are problems throughout the watershed, the technical committee recommended that a hydrologic analysis be conducted to identify the degree to which flow needs to be controlled, and how future and existing flow could be controlled. The technical committee used a hydrologic analysis to identify where watershed-wide BMPs could be installed, including storm water basins, buffer strips, and infiltration practices. They also determined criteria such as maximum discharge rates for all new storm water basins.

A hydrological analysis can range from a simple review of high flow data, to a detailed study of flow fluctuations and the best storm water controls.

The next step is to consider the causes for each source. For example, if one of your objectives is to reduce sediment from road-stream crossings, you may have several types of road-stream crossings causing sedimentation—some that require replacing culverts or bridges and others that require extending short culverts. By determining the causes at each source in your critical area, and the package of BMPs typically needed, you will be able to obtain better cost estimates for your BMPs.

In the Example Watershed, the technical committee created a table of objectives by source (see Chapter 6), causes for that source, the typical system of BMPs needed based on the appropriate BMP manual, the number of similar sites, and an estimate of cost per site. You should develop a similar table for your critical area and include systems of BMPs for all of your sources.

Objective by Source	Causes	Typical System of BMPs	Number of Similar Sites	Estimated Cost/Site
Reduce sediment at eroding road-stream crossings	Eroding road-stream crossing needing culvert replacement	Replace culvert with single-span bridge or new culvert, reshape and vegetate side slopes, install water turnouts with stabilized outlets, rock at abutment. Some paving of approaches; some detention or infiltration for treatment of runoff.	10	$50,000
Reduce sediment at eroding road-stream crossings	Eroding road-stream crossing needing culvert extensions	Culvert extensions, reshape and vegetate side slopes. Some water turnouts and stabilized outlets.	10	$23,000

Note that the example is not complete. Your table should include the objective by source, causes, systems of BMPs, number of sites, and cost estimates for all sources.

What is involved in estimating the costs for BMPs?

One of the primary reasons for dividing the objective by source column into various causes is that it makes it easier to estimate costs. To estimate costs of BMPs, your steering and/or technical committee will likely need to contact or meet with other agencies with experience in implementing these or similar BMPs. Be sure to include all costs needed to implement BMPs, including engineering design, materials, labor, and the purchase of land, where needed. Your estimated costs will likely be based on professional judgment; more accurate costs will be determined as you develop site-specific systems of BMPs.

In the Example Watershed, the technical committee included a column in their table for estimated costs per site. To determine estimated costs for road-stream crossings, they worked with the road commission staff to estimate the cost of the average crossing needing a culvert extension and the average crossing needing a culvert replacement.

At this point, you should have a list of systems of BMPs needed for each objective (as appropriate), and an estimated cost for those BMPs.

How do you organize and describe the BMPs selected for your watershed?

The systems of BMPs selected for your watershed should be organized in a table similar to the one on the right. Notice one difference between it and the previous table is that the causes column has been renamed a task column, and the wording in the column has been modified. Note also that a responsible party, milestones, and timeline have been added for each task. A responsible party, milestones, and timeline help ensure the task will be implemented. The timeline can be presented by quarters, years, or short-term and long-term. This table will be added to similar tables in Chapters 8 through 11.

Objective by Source	Task	Responsible Party	Typical System of BMPs	Milestones	Timeline	Estimated cost/site
Reduce sediment from road-stream crossings	Stabilize eroding road-stream crossings needing culvert replacement	Road commission	Replace culvert w/single-span bridge or new culvert, reshape and vegetate side slopes, install water turnouts w/ stabilized outlets, rock at abutment. Some paving of approaches; some detention or infiltration for treatment of runoff.	Develop a plan for each of the 10 sites. Implement plan at 5 sites. Implement plan for 5 sites.	Year 1 Year 1 Year 2	$50,000
	Stabilize eroding road-stream crossings needing culvert extensions	Road commission	Culvert extensions, reshape and vegetate side slopes. Some water turnouts and stabilized outlets.	Develop a plan for each of the 10 sites. Implement plan at 5 sites. Implement plan for remaining sites.	Year 1 Year 2 Year 2	$23,000

Note that the example is not complete. Your table should include the tasks, responsible party, systems of BMPs, milestones, timeline, and cost estimates for all objectives by source.

At this point, you should have a list of tasks needed to implement the systems of BMPs for each source in your watershed, and their estimated costs.

When and how do you select specific systems of BMPs?

Identifying the specific BMPs needed at each site usually occurs during the implementation of your watershed management plan, and therefore is not a necessary part of developing your plan. Information is provided here so you can learn more about site-specific BMPs, and what happens during the early stages in the implementation of your watershed management plan.

Criteria for selecting site-specific BMPs include:

- The BMPs must meet the goals or criteria of the watershed plan
- Effectiveness or appropriateness of the BMPs based on what the BMPs do and the site-specific characteristics
- Implementation costs
- Expected life of each practice
- Management costs
- Acceptability of the practices to the landowner and community
- Maintenance requirements

Before BMPs are implemented, the factors above are considered for a site, and the BMPs are grouped into a site plan. A site plan shows the location and type of BMPs to be installed, elevation and grades, and design specifications. A site plan is usually designed by an engineer or a landscape architect. Site plans must be developed for all projects submitted for CMI Nonpoint Source funding, many projects submitted for federal nonpoint source funds, and many projects submitted for CMI Clean Water Fund funding. All BMPs need to meet the standards and specifications explained in the BMP guidance manuals previously described. For more information on site plans, contact the DEQ Nonpoint Source Unit for a copy of *BMPs, Site Plans and Engineering Review.*

Au Sable River Project

In the Au Sable River Watershed project, the primary focus was on stabilizing eroding stream banks to protect the world-class trout fishery. The watershed planner developed site plans and presented them to the steering committee for approval. The steering committee consisted of key users of the river—canoe livery owners, anglers, and owners of Au Sable river boats. Each site plan had to meet the needs of all the key users. In one case, a site plan for a boat launch with rock at the river's edge was unacceptable to owners of the Au Sable river boats, so the plan was changed, and cedar logs were installed instead. Small changes in the site plan led to acceptance of the plan by the key users of the river. This process was time-consuming, but every site stabilization project on the Au Sable River was completed with the interest and support of its users.

Chapter 8: Identifying and Analyzing Projects, Programs, and Ordinances

Chapter Objectives

- Identify the local programs, projects, and ordinances that currently impact water quality
- Evaluate them to see if they are consistent with the goals of your watershed plan
- Identify opportunities to coordinate with or improve upon existing programs

Chapter Product

❑ A summary of existing local projects, programs, and ordinances, and any modifications needed to meet the watershed goals

Introduction

In this chapter, you will assess the local programs that impact water quality within your watershed. The goal is to build upon and coordinate with existing projects and programs. You will also assess whether local ordinances are adequately protecting water quality.

Where do you begin?

With input from your steering committee and the work that has been completed in the previous chapters, you are probably familiar with many of the projects, programs, and ordinances that address water quality in your watershed. For example, you might know that an annual stream cleanup is held along a stretch of the river, or that a storm water ordinance exists in the township that encompasses your critical area. Now, you will obtain more specific information about these projects, programs, and ordinances.

If you are not aware of the water quality projects, programs, and ordinances in your watershed, begin by asking members of your steering and technical committees for their input. In addition, review the archives of your local newspaper to help you identify federal, state, and local water-related initiatives within the watershed. Gather written information about them, and speak with the individuals who represent those programs.

You should begin with the projects, programs or ordinances with which you are familiar. Ask yourself the following questions:

- How does the project or program relate to the goals of the watershed project?
- Is the project, program, or ordinance effectively protecting water quality? If not, how can it be improved?
- What partnerships exist and how well are they working?
- Do opportunities exist for launching new activities in cooperation with an existing project, program, or ordinance?

Note how the agencies and organizations in the watershed operate, as well as their legal and jurisdictional authority. For example, you may need to ask the local road commission staff about their maintenance schedule and how they set priorities for upcoming work. Begin by summarizing the roles and limitations of each of your stakeholder groups. For example, you may need to research the authority and limitations of the drain commissioner or planning board. This step is important because you do not want to make a recommendation in your watershed management plan that no one has the authority to carry out.

You should also familiarize yourself with any land use ordinances or restrictions within the watershed, such as wetland or storm water ordinances, setback requirements for new development projects, or any other ordinances that relate to water quality or land use. This can be a very time-consuming task. However, since land use controls are a critical component of watershed management plans, this is an important step in the process.

In the Example Watershed, the technical committee reviewed the sources and causes of the pollutants within the critical area, and listed the ongoing projects, programs, and ordinances that address those pollutants. Beginning with their priority pollutant—sediment—and their number one source—road-stream crossings—they listed their observations from the watershed inventory:

- Some culverts are too short and need to be extended
- Some culverts are too small (i.e., the water is backing up) and need to be replaced
- Some structural BMPs installed in the past are not being maintained

To address these problems, the committee realized that they needed more information about the design criteria used by the road commission, as well as procedures that are in place within that office.

To address another of the priority sources, urban storm water, the committee needed to know about any storm water ordinances within the county, township, or municipality, and what they entailed. When they reviewed their desired uses, they realized that to implement a recreational trail, they needed to learn about any recreation master plans as well as programs that might allow for the establishment of permanent easements.

The group developed the table at right to summarize who they needed to contact and the information that they needed to collect.

Example Watershed's Programs, Projects, and Ordinances to Research

Designated Use/ Desired Use	Pollutant	Source	Objectives by Source	Who to Contact	Types of Information
Warmwater fishery; aquatic life/ wildlife	Sediment	Road-stream crossings	Reduce sediment from road-stream crossings	Road Commission	Operational procedures and design criteria
Warmwater fishery; aquatic life/ wildlife	Hydrologic flow	Urban storm water	Reduce flow fluctuations from urban storm water	Township, city, and county planners and engineers	Ordinances or procedures impacting storm water quality and quantity
Recreational trail along the river	—	—	—	Township, city, and county planners	Local recreation master plans; program, or process for establishing permanent easements

What do you do with the information collected?

The purpose of researching the projects, programs, and ordinances in your watershed is to determine what is already being done and what can be improved upon to protect water quality and meet the goals of your watershed plan. Once you have identified gaps or opportunities for new activities, define tasks that will be included in your watershed management plan.

For example, if one of your goals is to protect the *warmwater fishery*, your research may have shown that a local ordinance requires that new homes be set back 25 feet from the river. A subsequent task in your watershed management plan might be: "Work with the township to increase the setback to a minimum of 100 feet."

Once the tasks have been identified, designate an individual or organization to be responsible for ensuring its completion. Complete your table by developing milestones that will help you meet each of the tasks, as well as a timeline and cost estimate for implementing the tasks.

In the Example Watershed, technical committee members met with the county road commission and learned that collapsed culverts were being replaced with culverts of the same size, which were too small to handle the increased flow caused by development elsewhere in the watershed. They also found that in some cases, the BMPs were not being maintained due to restrictions on truck driver responsibilities. With this information, they developed the table on the next page.

Example Watershed Goal: Protect Warmwater Fishery

Objective	Tasks	Responsible Organization	Milestones	Timeline	Estimated Costs
Reduce sediment from eroding road-stream crossings	Work with local road commissioner to: 1. Change design criteria to accommodate current stream flows	Lead agency and road commission	1a. Set up committee to evaluate existing design criteria 1b. Modify road commission design specifications	short-term long-term	$2,500
	2. Explore methods for improving maintenance practices		2a. Review existing maintenance practices 2b. Meet with appropriate staff to discuss alternative practices	short-term short-term	$500

Note that the example only includes tasks for one objective by source. Your table should include tasks for all of the sources in your critical area.

At this point, you should have summarized the local projects, programs, and ordinances within your watershed and have tasks, responsible parties, milestones, and a timeline for improving or adding to those projects, programs, and ordinances.

Chapter 9: Informing and Involving the Public

Chapter Objectives

- Identify target audiences
- Develop messages for the target audiences
- Select delivery mechanisms for disseminating the messages
- Use this information to develop an information/education strategy for your watershed

Chapter Product

❑ An information and education strategy for your watershed that involves the public and stakeholders

What is an information/education strategy and how will it help?

An information/education (I/E) strategy is a tool used to inform the public and motivate them to take action. It is a coordinated strategy tailored to the specific water quality concerns and people within your watershed.

An I/E strategy is needed because the majority of behavioral changes that will be needed to address the sources and causes of pollution in the watershed will be voluntary, rather than be required by law. And, before individuals will consider changing their behavior, they need to understand the watershed concerns and how their individual activities can play a role in protecting the quality of their water. A well designed and implemented I/E strategy will improve public participation in your watershed project, because it will provide information to the individuals who are most likely to have an impact on water quality and motivate them to make necessary changes.

How do you begin to develop an I/E strategy?

Your steering committee should begin by reviewing the goals and tasks developed in Chapters 6 through 8, as well as the list of pollutants, sources, and causes in the critical area that were prioritized in Chapter 5.

Review also the I/E notations if you made a table similar to the Example Watershed Table in Chapter 7. You should note those tasks that will require information, education, or public involvement activities in order to be accomplished.

Some steering committees develop the I/E strategy, while others form a subcommittee made up of educational and outreach experts. You may want to invite people with specific educational, outreach, or public involvement experience to help design and implement your strategy.

What are target audiences and why are they important?

While reviewing the goals, tasks, and prioritized list of pollutants, sources, and causes, you should identify groups or individuals whose support or action will be needed to achieve the watershed project's goals. These people will become your target audiences. The information/education and involvement activities will be directed toward them.

In the Example Watershed, the steering committee reviewed the list of sources and causes, adding a list of target audiences for each. For example, to address livestock in the stream, they identified agricultural landowners as the target audience. They identified homeowners as the target audience for failing septic systems, residential fertilizer use, and storm drains; and recreational groups for eroding stream banks.

Once you have identified the target audiences, it is important to describe them as specifically as possible. By organizing the target audiences into groups with common characteristics, you will be able to streamline your I/E activities. The audiences might be grouped according to location, occupation, other demographic characteristics or by current behaviors. Whatever groupings you select, the result should be distinct target audiences. For example, landowners whose wastewater is handled by a municipal treatment plant would be excluded from I/E activities that address septic system maintenance. Apartment dwellers may not need to know about proper lawn care, but might be included in an I/E activity that addresses proper disposal of used motor oil.

In the Example Watershed, the committee divided the target audiences into separate, distinct specific target audiences, as shown at right. Note that not all sources in the Example Watershed are shown.

How do you learn about the priority target audiences?

Once you have identified the target audiences, you need to select the priority audiences—those most critical to achieving the watershed goals. In the Example Watershed, the committee added another column to their table to show the priority given to each specific target audience. They prioritized target audiences based on the priority given to the source.

Next, you need to learn about your priority target audiences. In addition to basic demographic information that may have already been collected, it is helpful to collect other types of information about these target groups, including:

- Existing knowledge of water quality problems in the watershed
- Perceptions about water quality and other project-related issues
- Barriers that may prevent the messages from reaching the target audience
- How they access information
- Who or what they consider to be reliable sources of information (TV, videos, newspapers, Internet, neighbors, etc.)

There are several methods of gathering this information. Members of the steering committee and other subcommittees may have information about the various groups in the watershed. Sometimes the inventory process will lead to information about existing knowledge, attitudes and behavior, or barriers that might impede project success. You might also gather information by conducting telephone or mail surveys, **focus groups**, or one-on-one interviews. A review of demographic databases or discussions with local trade associations or public agencies might also lead to useful information.

Example Watershed Target Audiences

Sources	*Target Audiences*	*Specific Target Audiences*	*Priority*
Failing septic systems	Homeowners	Riparian homeowners with septic systems; homeowners who live in areas with sandy (vulnerable) soils	4
Residential fertilizer use	Homeowners	All non-agricultural homeowners in the critical area who use fertilizers or commercial lawn care companies	3
Livestock in stream	Agricultural landowners	Riparian agricultural landowners who own livestock	2
Storm drains	Homeowners	Urban residents, individuals who change oil in their cars	5
Eroding stream banks	Recreational groups	Canoists, canoe livery owners, anglers	1

Davis Creek Project

In the Davis Creek Watershed, an agricultural and urban watershed in Kalamazoo County, project leaders conducted focus group sessions of residents from various neighborhoods, agricultural areas, local governmental offices, and businesses. The project leaders asked each group about their priorities, their vision for the creek, and potential obstacles and solutions. Through this process, they learned what was most important to one neighborhood whose residents did not typically take part in environmentally focused activities. These concerns were incorporated into project activities. This led to long-term commitment to the project, and the involvement of those watershed residents in project activities.

What information will encourage the target audiences to change their behaviors?

After you have gathered information about the priority target audiences, you will need to develop specific messages for each of them. The messages should answer the following questions:

- What is the problem?
- How does it affect me?
- Why should I care?
- What can I do?

Effective messages are action-oriented, understandable, and appealing. They encourage the audience to do something to protect water quality. In the Example Watershed, the committee developed messages for each of the priority target audiences, some of which are shown in the table on page 34.

How do you deliver the message to the target audience?

Choose your delivery mechanisms for each target audience based on how each group typically accesses information, and who or what they consider to be reliable sources of information. Delivery mechanisms include:

- One-on-one contacts
- Presentations to targeted groups
- Press releases and news articles in local papers
- Public service announcements or programs on local cable channel
- Watershed project newsletter
- Watershed project web site with links to related sites
- Watershed tours
- Watershed signs
- Inserts in agency newsletters
- Workshops targeted to specific audiences
- Special events and activities such as water festivals, stream clean-ups, or storm drain stenciling
- Presentations at regularly scheduled meetings of townships, planning commissions, associations, or other groups

The Example Watershed steering committee included a column in the table on page 34 showing delivery mechanisms.

Many watershed projects have found that one-on-one contact is a very effective method of delivering messages. Working with a respected member of the target audience to share the information is also useful. For example, an agricultural producer who has successfully incorporated changes might share his or her experiences with other producers in the watershed.

In addition to the above examples, steering committee members can share information with individuals from their respective organizations or agencies. If other groups are interested in reaching similar audiences, you should explore opportunities to combine your efforts. Remember that continual education and repetition are key to raising awareness and changing behavior.

What if basic water quality information is needed throughout the watershed?

During the planning process, you may find a need for basic education about water quality and watershed concepts. If so, you will need to provide this information before developing specific messages for those groups. You should select the most-accessed information sources for broad visibility. Articles in local papers or presentations to local organizations are often effective for reaching a large number of people. This basic education campaign should begin before the watershed planning process is completed.

Use existing community events to share your information, especially in the early stages of the planning process. Participating in community events allows you to reach an existing audience with minimal time and effort.

How do you know if your message is being heard?

A feedback loop is very important for I/E and public involvement activities. Identify evaluation methods when planning activities. Evaluation might be as simple as recording participation rates at various events, or as complex as conducting pre-and post-interviews or surveys with those who participated to determine what aspects of the event were most useful. Plan on modifying subsequent activities if the original activities are not effective.

The Example Watershed steering committee included a column in the table on page 34 showing potential evaluation methods.

Suggestions from existing watershed projects for implementing an I/E strategy include:

- Create a public outreach subcommittee to develop and implement the I/E strategy
- Keep the messages simple and straightforward, and only communicate one or two messages at a time
- Use graphics, photos, etc., to illustrate your point. A picture is truly worth a thousand words and leaves a lasting impression
- Events that bring people to the watercourse will help to establish a sense of ownership, and will facilitate future policy implementation
- Your partnerships are your lifeline! Communicate with them and through them, and build on the strength of these relationships
- Be as visible as you possibly can be, and remember that quality is very important, whether it is the paper that your newsletter is printed on or the wording of a press release
- Increase visibility by creating a logo for your watershed project

How do you combine the I/E activities?

At this point, you should have identified your priority target audiences, developed the messages, chosen the delivery mechanisms for them, and identified potential evaluation methods. Now, you can combine this information.

Example Watershed I/E Strategy

Pollutant	Source/Cause	Target Audience	Messages	Delivery Mechanisms	Potential Evaluation
Sediment	Stream bank erosion/ human access	Anglers, canoeists, canoe livery owners	Protect your river; use stairs rather than the stream bank	Involve local angler groups and canoe liveries in stream bank stabilization activities; feature activities in local media; post signs at stabilized sites; display posters at local bait shops and canoe liveries	Track the number of groups and individuals participating; conduct focus group session with local livery owners
Oils, grease and heavy metals	Storm drains and impervious surfaces/ improper disposal	Urban residents; individuals who change the oil in their cars	We all live on the river; what we do in our homes and yards affects the river; recycling used oil is easy	Implement storm drain stenciling project in cooperation with local watershed council or youth group; develop a public service announcement for local radio stations; distribute flyers with recycling locations at auto supply stores and service stations	Survey watershed residents; track oil recycling volume
Nutrients	Livestock in the stream/ unlimited access	Riparian agricultural landowners who own livestock	Controlling livestock access to surface water and providing alternative watering sources can improve herd health by reducing exposure to pathogens	Work with Conservation District staff to conduct one-on-one contacts; provide articles for local agricultural publications	Survey agricultural landowners, number of livestock owners who install livestock access controls

Note that the example is not complete. Your table should address all pollutants and sources in your watershed.

After you have outlined this information, identify the specific tasks that will be needed, the responsible organization, milestones to keep you on track, a timeline, and cost estimates for each task, as shown in the example table on the next page. Note that an I/E strategy should also identify potential funding mechanisms for its implementation.

Some watershed projects dedicate staff to focus on I/E activities, while others hire local experts. Some projects have encouraged local experts to donate their time and expertise to the project.

How should you encourage public participation?

A DEQ-approvable watershed management plan must include a summary of the public participation process used in developing your plan. A wide variety of interests should be encouraged to provide input during the plan development process.

One benefit of an I/E strategy is that it identifies who needs to participate as well as ways to get them involved. If you have developed your I/E strategy following the process outlined in this chapter, you should be able to show that a variety of organizations and interests have been or will be involved in the watershed planning effort. You should be able to summarize:

- The list of organizations represented on your steering committee and technical committee
- Any activities included in your I/E strategy that were implemented during the development of the watershed plan
- Any other opportunities the public had to provide input into the planning process, including public hearings, presentations, or one-on-one meetings

In the summary, also discuss how the public will be involved in the implementation of the watershed plan.

Where can you go for assistance?

DEQ Nonpoint Source Program staff and the Nonpoint Source I/E Coordinator in Lansing can provide assistance upon request.

Example Watershed I/E Tasks Table

Delivery Mechanism	Tasks	Responsible Organization	Milestones	Timeline	Estimated Costs
Involve local angler groups and canoe liveries in stream bank stabilization activities	Meet with local Trout Unlimited chapter to share project information and discuss how to involve their group	Livery owner on steering committee	Set meeting date; provide written project ideas following the meeting	1st quarter	$100
	Meet with local canoe liveries to share project information and discuss ways to educate canoeists		Set up one-on-one meetings; develop plan for coordinated education campaign	1st quarter 2nd quarter	$200
Feature activities in local media	Meet with local reporters at regular intervals to discuss project activities	Watershed council	Contact newspaper and television reporters prior to project kick-off	3rd quarter	$200
	Contact media about upcoming watershed festival		Prepare press release for distribution; set up radio interview 3rd quarter	3rd quarter	$100

Note that only some examples are included in this table. Your I/E strategy should include information for each target audience and delivery mechanism.

At this point, you should have an I/E strategy and a summary of the public participation process that was used, showing the opportunity for public comment and partners involved in developing the plan.

Chapter 10: Developing an Evaluation Process

Chapter Objectives

- Understand why evaluation is important
- Understand methods for evaluation
- Select an evaluation method or methods for your watershed

Chapter Product

❑ An evaluation process based on the goals, objectives, and tasks of the watershed plan

Introduction

Evaluation is an important part of watershed planning. It can tell you whether or not your efforts are successful and provide a feedback loop for improving project implementation.

Why should you conduct an evaluation?

A well-planned evaluation process will provide measures of the effectiveness of implementing the watershed management plan. If you are able to show results, you will gain more support from the community and increase the likelihood of project sustainability. Evaluation can show:

- Changes in knowledge or awareness of water quality issues
- Changes in attitudes or behavior
- Which best management practices were adopted and which were not
- Changes in the condition of the watershed
- Improvements in water quality

What methods are available?

There are several evaluation methods to consider, each with pros and cons. Some methods are more complex or costly to use, while others require special expertise to be effectively implemented. Evaluation methods include:

- Physical water quality monitoring, such as temperature, streamflow
- Chemical water quality monitoring, such as metals, nutrients

- Biological life measurements, such as insects, habitat, fish
- Photographic or visual evidence, such as before and after photos
- Compilation of the number and location of BMPs implemented
- Pollutant loading reduction measurements
- Stakeholder surveys, such as baseline and follow-up surveys, to evaluate changes in knowledge or behavior
- Focus groups, to determine effectiveness of project activities

How do you select your evaluation methods?

Evaluation methods should be selected as you are developing your plan. The appropriate methods depend on the objectives and tasks you are evaluating. For each objective or task selected, ask the following questions:

- How can effectiveness be measured?
- If it can't be measured directly, are there other indicators that can be measured?

For each task, answer the questions above, and then review the evaluation methods used by Michigan watershed projects to select the best method. For example, if you are evaluating the effectiveness of certain BMPs installed in the watershed, then methods for calculating, modeling, or monitoring reductions in pollutant load may be appropriate.

For evaluating reduction of pollutants, contact the DEQ Nonpoint Source Unit (see Appendix A) for a copy of *Pollutants Controlled Calculation and Documentation for Section 319 Watersheds*.

If you are evaluating changes in attitudes and behaviors to determine the effectiveness of your education program, then before and after implementation surveys, interviews, and focus groups may be the preferred methods. Because watershed plans contain a mix of activities, you will probably need more than one evaluation method.

When do you conduct the evaluation(s)?

Once you know what you are evaluating and what methods will be used, the next step is to determine a timeline for each of the evaluation methods you identified. Generally, there are two times to evaluate. One is during the implementation of project activities. The purpose of this evaluation is to provide feedback on project activities so that changes can be made if needed to increase their effectiveness. The

other time to evaluate is after the project activities have been completed. The purpose of this evaluation is to provide some measures of project effectiveness. For each evaluation method, determine an appropriate timeline.

What do you need to conduct the evaluation and who should do it?

The final step in developing the evaluation process is identifying the specific information needed to conduct the evaluation. For example, if you wish to do any before-and-after comparisons, you must have baseline information with which to compare the final results. If you wish to provide feedback during the project, you should ask about the barriers that are being encountered and whether tasks are effectively being implemented. Determine the information you need for each of your evaluation methods.

In some cases, the evaluation can be completed by the steering committee or a subcommittee. For complicated evaluation methods, you may wish to seek technical assistance from your local MSU Extension office, university, or consultants with expertise in the evaluation method selected.

How do you package this evaluation information?

To have a DEQ-approvable watershed plan, you must have a description of the process that will be used to evaluate the effectiveness of implementing your plan. You may do this in the form of a narrative that describes the evaluation plan, or to better ensure that evaluation occurs, you can add it to the table of objectives, tasks, responsible party, milestones, timeline, and estimated costs.

What resources are available to assist in developing an evaluation plan?

Resources are available to assist in developing an evaluation plan. See the agency and DEQ watershed project contacts in Appendix A.

Evaluation Methods Used by Michigan Watershed Projects

Methods	MI Example(s)*	Measures	Pros and Cons	Mode
Survey	Huron River Watershed, Little Rabbit Watershed, Allegan County	Opinions, attitudes, beliefs, behaviors	Moderate cost, relative ease of implementation	Mail, telephone, or group setting (meeting)
Focus Group	Davis Creek Watershed, Kalamazoo County	Perceptions, feelings, opinions, thoughts	Moderate cost, fast way to get public opinions	Small groups of 7–10, represent community
Interviews	North Branch Chippewa River, Isabella County	Opinions, beliefs, attitudes	Hear individual opinions; some may be more open to a one-on-one than in a group setting, more costly in time and resources	One-on-one meeting
Photographic	Bear Creek, Macomb and Oakland counties Boardman River, Grand Traverse County, Au Sable River	Before and after results	Easy to do, moderate costs	Visual evidence with photos
Calculations or models	Higgins Lake	Physical outcomes (e.g., erosion rates)	Moderate costs, relative ease of implementation	Manual calculations, computer models
Monitoring	York Creek, Kent County	Environmental impacts	Measures change but is more costly and longer term, requires expertise and extensive planning, monitoring may not show results for five to seven years after project completion	Physical sampling and lab analysis using accepted protocols
Water sampling	Donnell Lake, Cass County Sycamore Creek, Ingham County Willow Creek, Ingham County	Dissolved oxygen, pH, metals, nutrients		
Biological or aquatic life	Pine Creek, Dickinson County; Nottawa Creek, Calhoun County	Insects, habitat, fish		

* *See Appendix A for list of DEQ watershed project contacts.*

At a minimum your watershed plan should include a midcourse or annual evaluation to provide feedback to the steering committee and stakeholders. This will allow you to adjust or modify the watershed plan as it is being implemented to ensure that the goals will be achieved.

At this point you should have a description of the process that will be used to evaluate the effectiveness of implementing the plan and achieving its goals.

Chapter 11: Assembling Your Watershed Plan

Chapter Objectives

- Add any missing tasks
- Refine the water quality summary
- Assemble the watershed plan

Chapter Product

❑ The watershed management plan document, including the final water quality summary

Introduction

In this chapter you will complete your plan by integrating the chapter products developed throughout the planning process and adding a few more tasks. You will also finalize your water quality summary.

What information is needed to complete your watershed management plan?

By this point you should have a table of tasks, responsible parties, milestones, timeline, and estimated costs for all objectives for all of your goals. You may want to combine your tables from Chapters 7–10 into one table.

To complete your table add the following, as appropriate for your watershed:

- Tasks for verifying any remaining suspected pollutants, sources, and causes (see Chapter 4)
- Tasks for achieving desired use goals
- Tasks related to project coordination and administration

At this point you should add tasks needed to institutionalize watershed protection

What is included in the final water quality summary?

Using the information gathered in the previous chapters, you should modify and finalize the initial water quality summary written in Chapter 2. The final summary provides an accurate picture of the watershed and a clear link between the goals and conditions in the watershed. It includes the designated and desired uses, and detailed information about the pollutants, sources, and causes, and the goals of the watershed plan. An example of a final water quality summary is provided on the following page.

Assembling the Plan

In addition to the products that have been developed throughout the previous chapters, a watershed management plan should present a complete picture of the watershed. As you assemble your plan, keep in mind that a person with limited knowledge of the watershed should be able to read the plan and understand the needs and proposed solutions for effectively managing and restoring all designated uses in the watershed.

The ultimate outcome of your plan is an action-oriented approach for addressing water quality in the watershed. Use your plan to seek funding sources for implementation. Remember that your plan is not static and may change as implementation proceeds. Work with your steering committee to review the watershed management plan periodically to ensure that tasks are being implemented and that the plan is updated.

Example Water Quality Summary (Final)

The Example Watershed waterbody has three designated uses that are impaired: (1) partial body contact recreation, (2) aquatic life/wildlife, and (3) warmwater fishery. The designated use public water supply is threatened.

Project Goals

Restore the partial body contact recreation use by: (1) excluding 75 percent of the livestock from uncontrolled access, (2) instituting a residential nutrient lawn care program that properly manages fertilizer application and reduces the total amount of fertilizer used by 25 percent.

Additional goals based on the remaining impaired or threatened designated uses should also be stated.

Recreation

The designated use of partial body contact recreation is impaired due to undesirable algae and *E. coli* levels. The sources of nutrients include: (1) livestock in the stream, (2) residential fertilizer, and possibly (3) failing septic systems. The sources of *E. coli* bacteria include: (1) livestock in the stream, and possibly (2) failing septic systems.

There are 42 livestock operations in the watershed, but only 17 are located within the critical area. Of those, 12 livestock operations allow uncontrolled access to the waterbody. These are significant sources of both *E. coli* bacteria and nutrients.

There are 1,200 acres of residential lawn area within the critical area that receive intensive lawn management. Approximately 625,000 pounds of 25-5-5 (N-P-K) fertilizer or equivalent is applied annually to these lawns. Frequently, fertilizer is misapplied and/or overapplied so that runoff carries nutrients to the waterbody. These nutrients contribute to increased enrichment of the water.

Although not confirmed as a pollution source of *E. coli* bacteria and nutrients in the waterbody, failing septic systems are of concern to the public health department. The number of improperly operating septic systems is not known. However, there are three areas totaling 23 acres within the critical area where it is suspected that septic systems fail.

Your water quality summary should include a narrative for each designated use that is impaired or threatened, describing the relationships between the designated use, pollutants, sources, and causes. Your summary should also quantify the sources based on the inventory and priority they received.

Appendix A: Resources

State Agencies	*Contact Information / Websites*	*Information and Assistance*
DEQ Surface Water Quality Division	Phone: 517/373-1949 Nonpoint Source Pollution Program Unit 517/373-2867 Michigan Watershed Homepage NPDES Permits Unit 517/373-8088 I/E Coordinator 517/241-7733	Designated uses, nonpoint source pollution, Best Management Practices, CWA 305B Report, CWA 303D report, monitoring data, water quality standards and assessments, NPDES discharge **permits**, storm water management, investigation of complaints, and response to accidental releases.
DEQ Land and Water Management Division	Phone: 517/373-1170 Hydrologic Studies Unit 517/373-1170 Inland Lakes Management 517/373-8000 Wetlands Unit 517/373-8000 Soil Erosion Unit 517/335-3178 Coastal Programs 517/373-1950	Hydrology studies, lake management and monitoring, wetlands, cooperative lake monitoring program, coastal zone program
DEQ Drinking Water & Radiological Protection Division	Phone: 517/335-9218	Public water supply systems, local health department directory, non-community water supply systems, Wellhead Protection Program information
DEQ Waste Management Division	Phone: 517/373-2730	Regulation of large and small quantity generators of hazardous waste, facilities discharging to groundwater, and solid waste landfills and facilities
DEQ Geological Survey Division	Phone: 517/334-6907	Topographic and geologic maps
DEQ Environmental Assistance Division Assistance Center	Phone: 800/662-9278	Pollution prevention, regulations, permit information, Community Right to Know
DEQ Environmental Response Division	Phone: 517/373-9837	Environmental clean up programs
DNR Land and Mineral Services Division	Phone: 517/241-2438	Resource Mapping and Aerial Photography (RMAP)—GIS data and aerial photography information
DNR Wildlife Division	Phone: 517/373-1263	Endangered species, Michigan public lands maps, private lands program

State Agencies	Contact Information / Websites	Information and Assistance
DNR Fisheries Division	Phone: 517/373-1280	Aquatic life studies
DNR Forest Management Division	Phone: 517/373-1275	Natural rivers program, forest stewardship
MDA Environmental Stewardship Division	Phone: 517/241-0236	Pollution prevention, soil and water conservation districts and inter-county drain programs, local programs for proper use of pesticides and fertilizers: Farm*A*Syst, Home*A*Syst, and Field*A*Syst
MI Department of Transportation	Phone: 517/373-2090 www.michigan.gov/mdot/	Maps, facts and figures, transportation projects
MI Department of Management and Budget, Michigan Information Center	Phone: 517/373-7910 www.michigan.gov/dtmb/	Michigan census data, geographic, economic and demographic information

Federal Agencies	Contact Information / Websites	Information and Assistance
US Environmental Protection Agency	https://www.epa.gov/	Data bases, software, maps, information
US Environmental Protection Agency, Region 5, Water Division	Phone: 312/353-2147 www.epa.gov/aboutepa/epa-region-5	Watershed data and information, BMPs, information and education
United States Geological Survey	Phone: 800/627-0039 www.usgs.gov/	Topographic maps, other maps, stream flow data water use
Michigan USGS Water Resources Division	Phone: 517/887-8903 mi.water.usgs.gov/	Michigan USGS site information
US Army Corps of Engineers, Great Lakes Regional Office	Phone: 312/353-6354 www.lrd.usace.army.mil/ (Regional Headquarters)	Navigation, flood control, coastal wetlands
US Army Corps of Engineers, Detroit District	Phone: 313/226-6412 www.lre.usace.army.mil/	Water resources planning, shore protection
USDA Natural Resources Conservation Service Michigan State Office	Phone: 517/324-5266 3001 Coolidge Road, Suite 250 East Lansing, MI 48823-6123 www.nrcs.usda.gov/wps/portal/nrcs/site/mi/home/ or check phone book listings for your county office	Soils maps, technical assistance, agricultural BMPs cost estimate assistance, EQIP, CRP, WRP, native plants
USDA Farm Service Agency, Michigan State Office	Phone: 517/324-5110	Aerial photos

Federal Agencies	*Contact Information / Websites*	*Information and Assistance*
US Fish and Wildlife Service Region 3 Office	http://www.fws.gov/endangered/	Endangered species by region/state photo archive, national wetland inventory, habitat and wildlife, wetlands
Federal Emergency Management Agency	To speak with a map specialist toll-free, call 877/336-2627 (FEMAMAP). https://msc.fema.gov/portal/home	Floodplain mapping
US Census Bureau	www.census.gov/	Population, economic, demographic data and information, TIGER line files for GIS applications

Local Agencies	*Contact Information / Websites*	*Information and Assistance*
Local Health Departments	See county government listing in local phone book or https://www.naccho.org/membership/lhd-directory	Well records, septic system information, and permitting
County Conservation Districts	See county government listing in local phone book or https://www.macd.org	Agricultural BMPs, soil conservation technical assistance, soil survey books
County Planning Agencies	See county government listing in local phone book	Zoning information and ordinances, GIS information
County Drain Commissioner	See county government listing in local phone book	County drain development and maintenance, storm water management
County Road Commission	See county government listing in local phone book	County road maintenance and improvements
City and/or Village Public Works Department	See local government listing in local phone book	Public water supply, waste water treatment, storm water management, and infrastructure information
Park and Recreation Department	See local government listing in local phone book	Master recreation plan, park improvement plans

Planning Agencies	*Contact Information / Websites*	*Information and Assistance*
Northeast Michigan Council of Governments (NEMCOG)	P.O. Box 457 123 West Main Street Old Kent Bank Prof. Bldg. Gaylord, MI 49735 517/732-3551	Technical assistance, historical maps and information, assistance with planning, coordination with other communities, education materials
Northwest Michigan Council of Governments (NWMCOG)	c/o Traverse City Board of Realtors 852 South Garfield Avenue Traverse City, MI 49684 231/947-2050	see above
Southeast Michigan Council of Governments (SEMCOG)	660 Plaza Drive Suite 1900 Detroit, MI 48226 313/961-4266 www.semcog.org/	see above

Universities	*Contact Information / Websites*	*Information and Assistance*
Michigan State University MSU Extension	Water Quality Area of Expertise Team Phone: 517/353-9222 or 355-0224 http://msue.anr.msu.edu/topic/info/water_quality or check phone listing for your local county office	Educational materials, outreach assistance
Institute of Water Research	115 Manly Miles Building 1405 S. Harrison Rd. East Lansing, MI 48823 517/353-3742 www.iwr.msu.edu	Data, maps, outreach assistance
Center for Remote Sensing and Geographic Information Sciences	308 Manly Miles Building 1405 S. Harrison Rd. East Lansing, MI 48823 517/353-7195 www.rsgis.msu.edu/	Maps, data, aerial photos
Grand Valley State University Robert B. Annis Water Resources Institute	One Campus Drive Allendale, MI 49401 616/ 895-3749 www4.gvsu.edu/wri/	Water resources data and information

DEQ Watershed Project	*Nonpoint Source Grantee*	*Phone*
Acme and Yuba Creeks (Grand Traverse County)	Grand Traverse County Drain Commissioner	231/922-4728
Allen Drain (Tuscola County)	Tuscola County Soil Conservation District	517/673-8174
Animal Waste Management System (statewide)	Natural Resources Conservation District	517/337-6701
Au Sable River (Otsego, Roscommon, Crawford Montmorency, Oscoda Counties)	Huron Pines RC&D Council	517/348-9319
Bark River (Delta County)	Delta County Soil Conservation District	906/428-4076
Bear Creek (Kent County)	Cannon Township	616/874-6966
Bear Creek (Macomb and Oakland Counties)	Clinton River Watershed Council	248/853-9580
Betsie River (Benzie County)	Conservation Resource Alliance	231/946-6817
Better Backroads (Northern Lower Peninsula)	Huron Pines Resource Conservation and Development Council	517/348-9319
Big Creek (Arenac County)	Arenac County Soil Conservation District	517/846-4566
Black Lake (Cheboygan and Presque Isle Counties)	Northeast Michigan Council of Governments	517/732-3551
Boardman River (Grand Traverse and Kalkaska Counties)	Grand Traverse Soil & Water Conservation District	231/941-0960

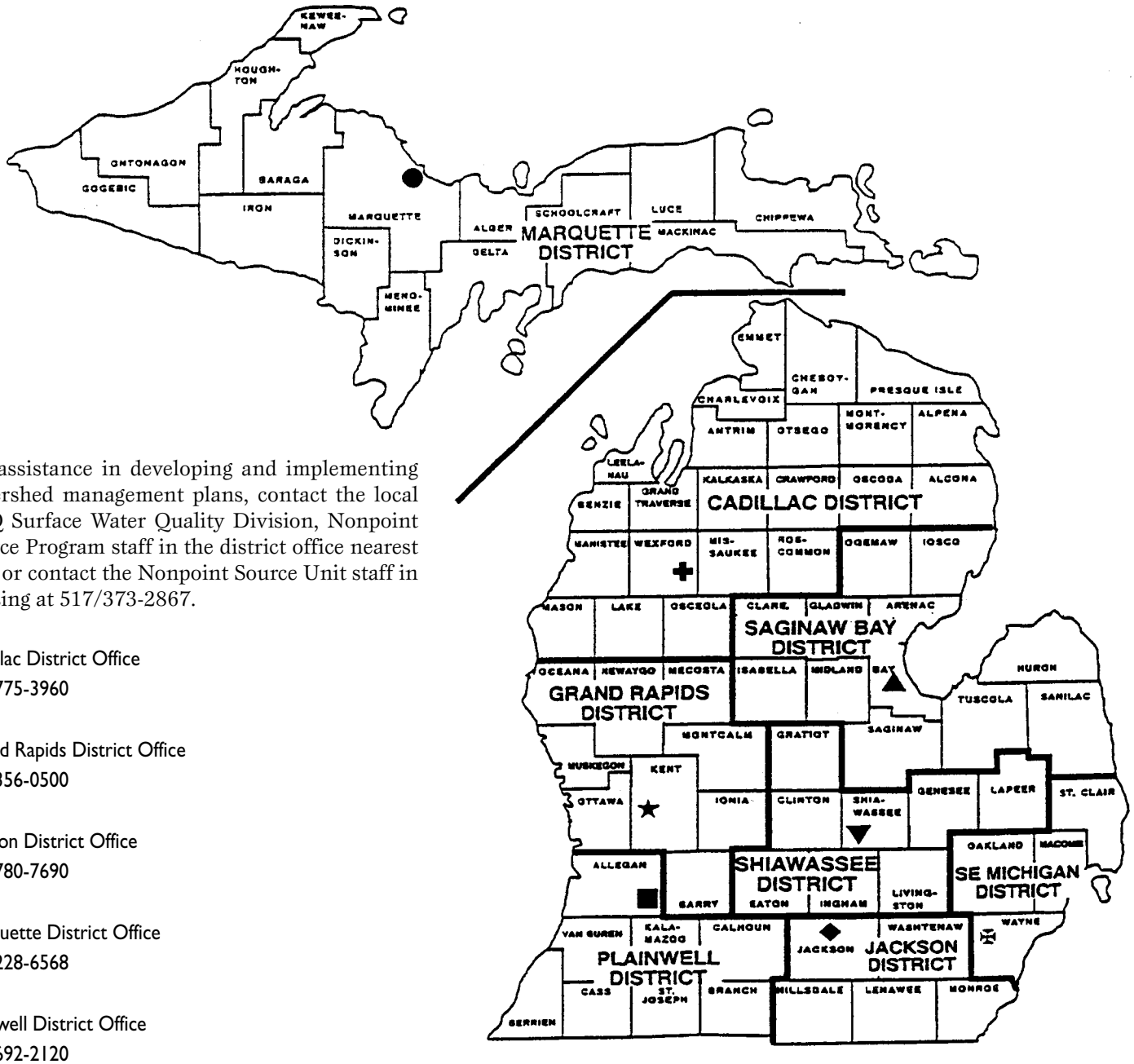
DEQ Watershed Project	*Nonpoint Source Grantee*	*Phone*
Brooks Creek (Newaygo County)	Newago County Conservation District	231/924-7131
Burt Lake (Cheboygan County)	Northeast Michigan Council of Governments	517/732-3551
Carlson Creek (Luce County)	Luce-West Mackinaw Soil Conservation District	906/341-5304
Carp River (Mackinac County)	Chippewa Soil Conservation District	906/632-7051
Cass River Watershed Livestock Exclusion (Sanilac County)	Sanilac Conservation District	810/648-2116
Chippewa River, North Branch (Isabella County)	Isabella Soil Conservation	517/772-9152
Chocolay River (Marquette County)	Marquette County Conservation District	906/226-9460
Christiana Creek (Cass County)	Cass County Soil Conservation District	616/445-8643
City of Grand Blanc Groundwater Planning Project (Genesee County)	City of Grand Blanc	810/694-1118
Clam River (Wexford County)	Wexford Soil and Water Conservation District	231/775-7681
Crockery Creek (Ottawa and Muskegon Counties)	Muskegon County Soil and Water Conservation District	231/924-7131
Davis Creek (Kalamazoo County)	Kalamazoo Conservation District and River Partners Program of the Forum of Kalamazoo County	616/327-1258 616/337-7002
Doe/Furlong Creek (Mackinac County)	Luce-West Mackinaw Soil Conservation District	906/341-8215
Donnell Lake -SCD (Cass County)	Cass County Soil and Water Conservation District	616/445-8643
Donnell Lake -MSU (Cass County)	Michigan State University Institute of Water Research	517/355-3742
Dowagiac River (Cass and Van Buren Counties)	Cass County Soil and Water Conservation District	616/445-8643
Dowagiac (MEANDRS) (Cass and Van Buren Counties)	Cass County Soil & Water Conservation District	616/685-0017
Duff Creek (Sanilac County)	Sanilac County Soil Conservation District	810/648-2116
Elk River (Antrim County)	Antrim Soil Conservation District	231/533-8709
Elk River Chain of Lakes (Antrim County)	Conservation Resource Alliance	231/946-6817
Farm Assessment System (Statewide)	Michigan State University Extension	517/355-2308
Fish Creek (Montcalm County)	Montcalm Soil and Water Conservation District	517/831-4606
Ford Lake (Washtenaw County)	Washtenaw County Environmental Health	734/971-4542

DEQ Watershed Project	*Nonpoint Source Grantee*	*Phone*
Four Township (Barry County)	Four Township Water Resources Council, Inc	616/731-4259
Fox River (Schoolcraft County)	Schoolcraft Soil Conservation District	906/341-5304
Garden Peninsula Aquifer Protection Project (Delta County)	Delta-Menominee District Health Department	906/786-4111
Grand Traverse Bay (Grand Traverse, Leelanau, Kalkaska and Antrim Counties)	Grand Traverse Bay Watershed Initiative	231/935-1514
Higgins Lake (Roscommon County)	Crawford-Roscommon Soil and Water Conservation District	517/275-5231
Hoffmeyer Creek (Osceola County)	Osceola-Lake Soil Conservation District	231/832-5438
Homer Lake (Calhoun County)	Homer Lake Management Board c/o Calhoun County Drain Commission	616/780-0790
Huron River (Washtenaw County)	Washtenaw County Drain Commissioner	734/994-2525
Huron River's Model Mass Media Campaign Project (Washtenaw County)	Huron River Watershed Council	734/769-5123
Iron River (Iron County)	Iron River Soil and Water Conservation District	906/875-3765
Jordan River (Antrim County)	Antrim County Soil and Water Conservation District	231/533-8709
Kalamazoo County Groundwater Protection	Kalamazoo County Human Services Department	616/373-5200
Kalamazoo River Watershed Project (Kalamazoo County)	Western Michigan University, GIS Research Center	616/387-3405
Kalamazoo River Watershed Project (City of Kalamazoo)	City of Kalamazoo	616/337-8711
Kawkawlin River South Branch (Bay County)	Bay County Soil and Water Conservation District	517/686-0430
Lake Charlevoix (Charlevoix, Antrim, Emmet and Otsego Counties)	Charlevoix Soil and Water Conservation District	231/347-5255
Lake Erie Phosphorus Reduction (Monroe, Lenawee, Washtenaw and Wayne Counties)	USDA-Natural Resources Conservation Service	517/337-6701
Lake Macatawa (Ottawa County)	Macatawa Area Coordinating Council	616/395-2688
Little Rabbit River (Allegan County)	Allegan Soil Conservation District	616/673-8903
Long Lake (Grand Traverse County)	Grand Traverse County Drain Commissioner	231/922-4728
Manistee River	Conservation Resource Alliance	231/946-6817

DEQ Watershed Project	Nonpoint Source Grantee	Phone
Mitchell Creek (Grand Traverse County)	Grand Traverse County Drain Commissioner	231/922-4728
Mullet Lake (Cheboygan County)	Northeast Michigan Council of Governments	517/732-3551
North Branch of the Bad River (Gratiot and Saginaw Counties)	Gratiot Soil Conservation District	517/875-3401
Northern Michigan Road/Stream Crossing Initiative (Northern Lower Michigan Counties)	Huron Pines Resource Conservation and Development Area Council	517/348-9319
Nottawa Creek (Calhoun County)	Calhoun Conservation District	616/781-4263
No-Till Demonstration (Huron County)	Michigan State Extension	517/269-9949
Otter River (Houghton and Keweenaw Counties)	Houghton-Keweenaw Soil Conservation District	906/482-0360
Paint Creek (Oakland County)	Clinton River Watershed Council	248/853-9580
Paint Creek (Washtenaw County)	Washtenaw Soil Conservation District	734/761-6722
Paw Paw River (Van Buren County)	Van Buren Soil and Water Conservation District	616/657-4220
Pentwater River (Oceana County)	West Michigan Shoreline Regional Development Commission	231/722-7878
Pickerel/Crooked Lakes Watershed (Emmet County)	Northeast Michigan Council of Governments	517/732-3551
Pigeon River (Ottawa County)	Timberland Resource Conservation and Development Council	616/956-8019
Pine Creek (Dickinson County)	Dickinson Soil Conservation District	906/774-8441
Pine River (Wexford, Lake and Osceola Counties)	Conservation Resource Alliance	231/946-6817
Plaster Creek (Kent County)	Kent County Drain Commissioner	616/336-3688
Poplar Creek and North Branch Pine River (Wexford County)	Wexford County Road Commission	231/775-9731
Portage Creek (Kalamazoo County)	City of Portage	616/324-9256
Presque Isle County Groundwater Protection Project (Presque Isle and Alpena Counties)	Presque Isle Soil Conservation District	517/734-4000
Rifle River (Ogemaw and Arenac Counties)	Saginaw Bay RC&D	517/684-5650
River Raisin (Lenawee County)	Lenawee Soil Conservation District	517/263-7400

DEQ Watershed Project	*Nonpoint Source Grantee*	*Phone*
Rogue River (Kent, Ottawa, Newaygo, Muskegon and Montcalm Counties)	Grand Valley Metro Council	616/895-3749
Rouge River (Wayne County)	Wayne County	313/224-3620
Sanilac County Abandoned Wells (Sanilac County)	Sanilac Soil and Water Conservation District	810/648-2116
Sauk-Coldwater Rivers (Branch County)	Branch Soil Conservation District	517/278-2725
Scales Creek (Houghton County)	Houghton-Keweenaw Soil Conservation District	906/482-0360
South Branch of the Big Salt River (Isabella County)	Isabella Soil Conservation District,	517/772-9152
South Branch of the River Raisin (Lenawee County)	Lenawee Soil Conservation District	517/263-7400
South Lake Leelanau (Leelanau County)	Conservation Resource Alliance	231/946-6817
Stewardship in Huron River (Washtenaw County)	Huron River Watershed Council	734/769-5123
Stony Creek (Clinton County)	Clinton Conservation District	517/224-4318
Sycamore Creek (Ingham County)	Ingham County Health Department	517/887-4300
Timber Box Culvert (Grand Traverse County)	Conservation Resource Alliance	231/946-6817
Tobacco River (Gladwin and Clare Counties)	Gladwin Soil and Water Conservation District	517/426-9621
Tollgate Drain Sand Peat Filter (Ingham County)	Ingham County Drain Commissioner,	517/676-8395
Total Nutrient Management (Huron County)	Michigan State University Extension	517/269-9949
Whetstone Brook (Marquette County)	Marquette Soil and Water Conservation District	906/226-9460
Willow Creek (Ingham County)	Ingham County Drain Commissioner	517/676-8395
York Creek (Kent County)	Alpine Township	616/784-1262

Michigan Department of Environmental Quality District Boundaries and Offices



For assistance in developing and implementing watershed management plans, contact the local DEQ Surface Water Quality Division, Nonpoint Source Program staff in the district office nearest you, or contact the Nonpoint Source Unit staff in Lansing at 517/373-2867.

Cadillac District Office
231/775-3960

Grand Rapids District Office
616/356-0500

Jackson District Office
517/780-7690

Marquette District Office
906/228-6568

Plainwell District Office
616/692-2120

Saginaw Bay District Office
517/686-8025 Ext. 8264 or 8261

Shiawassee District Office
517/625-5515

Southeast Michigan District Office
734/953-8905

John Engler, Governor, State of Michigan
Russell J. Harding, Director
Michigan Department of Environmental Quality
Surface Water Quality Division

Appendix B: Typical Nonpoint Source Pollutants Impacting Michigan Waters

Nonpoint source pollutants are any of the substances listed below that can degrade the water quality by impairing the designated use(s) of the water.

Animal manure—Manure is a source of nutrients, salts, and organic matter that can degrade water quality.

Depressed dissolved oxygen—When the oxygen dissolved in water and readily available to aquatic organisms (mg/l) is below optimal levels.

Hydrologic flow fluctuation—When the natural hydrology of the watershed changes due to increases in storm water runoff.

Metals—Toxic substances, such as mercury and lead, that come from urban runoff or atmospheric deposition.

Nitrogen—An element that at certain levels can cause excessive algae and aquatic weed growth.

Organic matter—Residue from plant or animal origin (including leaves and grass clippings). In excessive amounts organic matter can lower dissolved oxygen levels.

Pathogens—Human disease causing bacteria or viruses.

Pesticides—Chemical substances used to kill pests such as weeds, insects, algae, rodents, and other undesirable agents.

Petroleum and petroleum by-products (oil and grease)—Urban pollutants that are transported by rainfall from roads, parking lots, and improper storm drains.

Salts—Chemical compounds from winter road deicing, septic systems, and water softener outwash.

Sediment—Soil that is transported by air and water and deposited on the stream bottom.

Temperature—An elevation in water temperature that stresses fish and aquatic insects.

Appendix C: Glossary of Terms

Best Management Practices (BMP): Structural, vegatative and managerial practices implemented to control nonpoint source pollution.

Confluence: Point at which two or more watercourses intersect.

Critical area: That part of the watershed that is contributing a majority of the pollutants and is having the most significant impacts on the waterbody.

Culvert: A covered channel or a large diameter pipe that directs water flow below the ground level.

Designated uses: Recognized uses of water established by state and federal water quality programs

E. coli: Bacterium used as an indicator of the presence of waste from humans and other warm-blooded animals.

Erosion: Detachment and movement of rocks and soil particles by gravity, wind, and water.

Focus groups: Groups of individuals brought together to discuss a particular topic or situation.

GIS: Geographical Information System: A system that analyzes and models data in a spatial context and displays digitally recreated map layers.

GPS: Global Positioning System: A system capable of providing worldwide navigation and positioning by pinpointing locations.

Groundwater: The subsurface water supply in the saturated zone below the water table.

Headwaters: The origin and upper reaches of a river or stream.

Hydrologically distinct: Defined by drainage basins or watersheds rather than areas arbitrarily defined by political boundaries.

Impervious: A surface through which little or no water will move. Impervious areas include paved parking lots and roof tops.

Infiltration: The penetration of water through the ground surface into subsurface soil or the penetration of water from the soil into sewer or other pipes through defective joints, connections, or manhole walls.

Nonpoint source pollution: Pollution caused when rain, snowmelt, or wind carry pollutants off the land and into the waterbodies.

Permit: An authorization, license, or equivalent control document issued by EPA or an approved state agency to implement the requirements of an environmental regulation; e.g., a permit to operate a wastewater treatment plant or to operate a facility that may generate harmful emissions.

Point source: The release of an effluent from a pipe or discrete conveyance into a waterbody or a watercourse leading to a body of water.

Pollutant: Any substance of such character and in such quantities that when it reaches a body of water, soil, or air, it contributes to the degradation or impairment of its usefulness or renders it offensive.

Resource management system: A combination of best management practices that, when installed, will at a minimum protect the resource base by meeting acceptable soil losses; protect or improve water quality; and conserve plant, air, and animal resources.

Riparian: Person who lives along or holds title to the shore area of a lake or bank of a river or stream.

Riparian corridor: Areas bordering streams, lakes, rivers, and other watercourses. These areas have high water tables and support plants requiring saturated soils during all or part of the year.

Runoff: That portion of the precipitation or irrigation water that travels over the land surface and ends up in surface streams or water bodies.

Sediment: Soil, sand, and minerals which can take the form of bedload, suspended, or dissolved material.

Soil erosion: The wearing away of land surface by wind or water. Erosion occurs naturally from weather or runoff but can be intensified by land-clearing practices related to farming, residential or industrial development, road building, or timber cutting.

Spatially referenced data: Assigning specific geographic locations to data.

Stakeholder: Any organization, governmental entity, or individual that has a stake in or may be affected by a given approach to environmental regulation, pollution prevention, or energy conservation.

Storm drain (storm sewer): A slotted opening leading to an underground pipe or an open ditch that carries surface runoff.

Storm water: Runoff from a storm, snow melt runoff, and surface runoff and drainage.

Surface water: All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, wetlands impoundment, and seas).

Suspended solids: Sediment particles in the water column and carried with the flow of water.

Topographic maps: Land maps that display elevation along with natural and man-made features.

Topography: The physical features of a surface area including relative elevations and the position of natural and man-made features.

Tributary: A river or stream that flows into a larger river or stream.

Vegetative controls: Control measures or practices that usually involve the use of cropping systems, permanent grass, or other vegetative cover to reduce erosion and control.

Water quality: The biological, chemical, and physical conditions of a waterbody, often measured by its ability to support life.

Watershed: The geographic region within which water drains into a particular river, stream, or body of water. Watershed boundaries are defined by the ridges separating watersheds.

Wetland: An area that is regularly saturated by surface or groundwater and subsequently is characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions. Examples include swamps, bogs, fens, and marshes.

Windshield survey: Conducting an inventory of the watershed via a motorized vehicle.

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