Developing Source Water Protection Plans For Public Drinking Water Systems Using Inland Surface Waters

Hands Across the Watershed

A Cooperative Venture

Division of Surface Water
And
Division of Drinking and Ground Waters

October 2009

Acknowledgements

Ohio EPA wishes to thank all the individuals, including watershed coordinators and public water system operators, who reviewed this document and provided advice. Thanks also go to Ohio EPA staff who reviewed drafts and provided comments. A special thanks goes to Lauren McEleney (Division of Surface Water, Ohio EPA), who read an early draft and provided valuable edits and suggestions and Cathryn Allen, of Ohio EPA's Public Interest Center, who carefully edited and reformatted the entire document for consistency.

The authors also wish to acknowledge the support and guidance of Ohio EPA managers Michael Eggert (Division of Drinking and Ground Waters) and Gail Hesse (Division of Surface Water) throughout the development of this document.

Finally, the Agency recognizes the efforts of Linda Merchant-Masonbrink (Division of Surface Water) and Barbara Lubberger (Division of Drinking and Ground Waters), who were the principal writers and editors. Individual chapters, graphics and maps also were provided by Kristy Hunt, AmyJo Klei, Heather Raymond, and Craig Smith, Division of Drinking and Ground Waters.

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1.0 INTRODUCTION

Protecting drinking water is a top priority in Ohio. A 1995 statewide survey of citizens indicated that Ohioans rank drinking water quality as one of the top three environmental concerns facing Ohio (Ohio EPA, 1995). Another statewide survey conducted in 1998 indicated that 90 percent of Ohioans consider the quality of drinking water to be a "very important" water resource issue (Ohio Water Resources Council, 1998). This was the highest ranking of any water resource issue rated in the survey. Beginning in the 1970s, the federal government passed environmental laws to address the need for reliable supplies of safe drinking water, primarily by cleaning up contaminated air, soil, and water. In 1986, the Safe Drinking Water Act established health and treatment standards for public drinking water systems. Environmental goals at the national, state, and local levels are now shifting to protecting resources from potential *future* damage.

Because safe drinking water is a necessity to everyone, Ohio EPA considers protecting this valuable resource to be a primary goal. Thanks in part to drinking water treatment, design of treatment systems, certification of plant operators, and regulations on contaminants, public water systems in this country have set very high standards for providing safe drinking water to the public. However, even these efforts may not prevent serious outbreaks of waterborne disease or address all chemical threats to source water. In addition to the concern for public health, the economic costs incurred by a public water system when its drinking water source becomes contaminated can overwhelm a small community (refer to Appendix C - Costs and Benefits of Source Water Protection).

As a result, protecting drinking water *at its source* has become a top priority. The 1996 Amendments to the Safe Drinking Water Act established the **Source Water Assessment and Protection Program**[1] to help public water systems develop plans for protecting their drinking water resources. Federal funding from this program enabled Ohio EPA to complete Drinking Water Source Assessments (Figure 1.1) for all of Ohio's public water systems, which provided each system with information needed to develop effective strategies for protecting its source of drinking water.

1.1 PURPOSE OF THIS GUIDANCE

This guidance provides guidelines for developing a written **drinking water source protection plan** (protection plan), using a system's Drinking Water Source Assessment report as a starting point. This guidance is designed specifically for surface water based public water suppliers serving cities, villages, or other large populations (such as school districts or industrial facilities). It will be most useful for inland surface water systems. Portions of this guidance may also apply to Lake Erie systems and Ohio River systems, which were assessed differently from inland systems (Figure 1.1).

[1] **Items in bold are defined in the Glossary (Appendix B)**

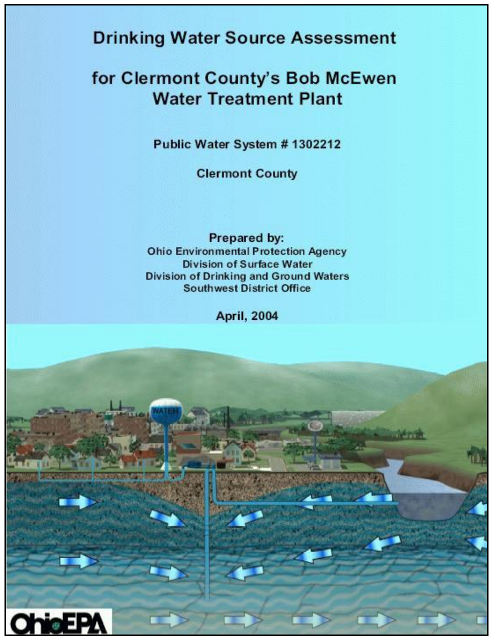

Figure 1.1 - Drinking Water Source Assessment Report

Drinking Water Source Assessment reports for surface water systems document Ohio EPA's efforts to (1) determine a reasonable area in which to focus protective efforts; and (2) locate potential contaminant sources within that area. Maps of the protection area, with the identified potential contaminant sources, are provided.

The procedure used for delineating the protection area varied, depending on whether a system's intake was:

- located on an inland stream (approximately 65 percent);
- located in the Ohio River (approximately 5 percent); and
- located in Lake Erie (approximately 30 percent).

Inland Streams - The *source water protection area* is that portion of the watershed upstream of the intake. However, the area of focus for protective efforts is the *corridor management zone (CMZ)*, which extends ten miles upstream of the intake, and 1,000 feet laterally from each bank of the main stream and 500 feet laterally from each bank of tributaries to the main stream. (Procedure developed by a statewide technical advisory committee which included Ohio EPA)

Ohio River - The *source water area* is the entire drainage basin upstream from an intake (which covers several states). The area of focus for protective efforts is the *zone of critical concern*, which is 1/4 mile wide on each bank and extends 25 miles upstream of the intake or to within 1/4 mile of the next upstream intake, whichever comes first. (Procedure developed by an interstate team led by the Ohio River Valley Water Sanitation Commission "ORSANCO")

Lake Erie - A circular area (*critical assessment zone*) is delineated around the intake, with a radius of 1,000 to 3,000 feet. The radius is based on the sensitivity of the intake, as determined by the depth of the intake below the lake's surface and distance from shore. Protective efforts are focused on this area and also may include a nearby section of shoreline designated a *potential influence zone*. (Procedure developed by the Great Lakes States Workgroup, August 17, 2000).

1.2 HOW TO USE THIS GUIDANCE

This guidance consists of eight chapters organized to follow the 'flow' of source water protection planning. The appendices contain additional background information (benefits and costs, types of contaminant sources, and case studies). For individuals just initiating protection planning, Chapters One and Two will be most useful. Once a team is formed, various individuals will want to read certain chapters carefully. Appendix A is a checklist of the items that should be in a protection plan for a surface water system. This checklist will be the most important portion of this guidance once a team begins writing the plan.

1.2.1 Incorporating protection planning into a watershed action plan

a number of watershed action plans are under development or beginning implementation (ftp://ftp.dnr.state.oh.us/Soil_&_Water_Conservation/WatershedActionPlans/EndorsedPlans/) to address **point source** and **nonpoint sources** of pollution. The 2003 Appendix 8, *Outline of a watershed action plan*[2] and the 1997 *Guide to Developing Local Watershed Action Plans in Ohio*[3] describe the necessary elements of a watershed action plan (WAP). For public water systems that draw water from a stream segment that is being addressed by a WAP, Ohio EPA strongly recommends trying to incorporate drinking water protection activities into the WAP. In many cases, the actions necessary to address impacted water quality will also protect sources of drinking water.

To determine whether an existing watershed action plan adequately addresses source water protection, source water protection planners should review the document against the checklist located in Appendix A. This may quickly identify items that are inadequately addressed by the watershed action plan. Reviewers should bear in mind, however, that a watershed action plan and a source water protection plan can appear similar on the surface but differ significantly on a more detailed level. For example,

- Any watershed action plan will address some level of public education/outreach but the materials may not emphasize the importance of the stream as a source of drinking water.

- Most watershed action plans will address monitoring the surface water but the sampling sites may be too sparse, or too distant from the public water system's intake or storage reservoirs. The sampling plan may not include contaminants that are a concern primarily for drinking water (such as nitrate and pesticides).

Therefore, in addition to comparing the watershed action plan to the checklist, planners should read the watershed action plan critically, constantly questioning whether the plan adequately considers the specific needs of a drinking water protection plan. If not, protection planners should try to work with the local watershed group to determine whether they are willing to amend the plan to address drinking water concerns.

If a local watershed group is *currently* developing a WAP, protection planners should request that a drinking water subcommittee be formed to ensure that drinking water concerns are adequately incorporated into the WAP and all elements in Appendix A are addressed.

If collaboration is not possible, a stand-alone drinking water source protection plan may be developed by a team organized for this purpose. Figure 1.2 illustrates these options.

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[2] Accessible at http://www.epa.ohio.gov/portals/35/nps/NPS_WAP_APP8.pdf

[3] Accessible at http://www.epa.ohio.gov/portals/35/nps/wsguide.pdf

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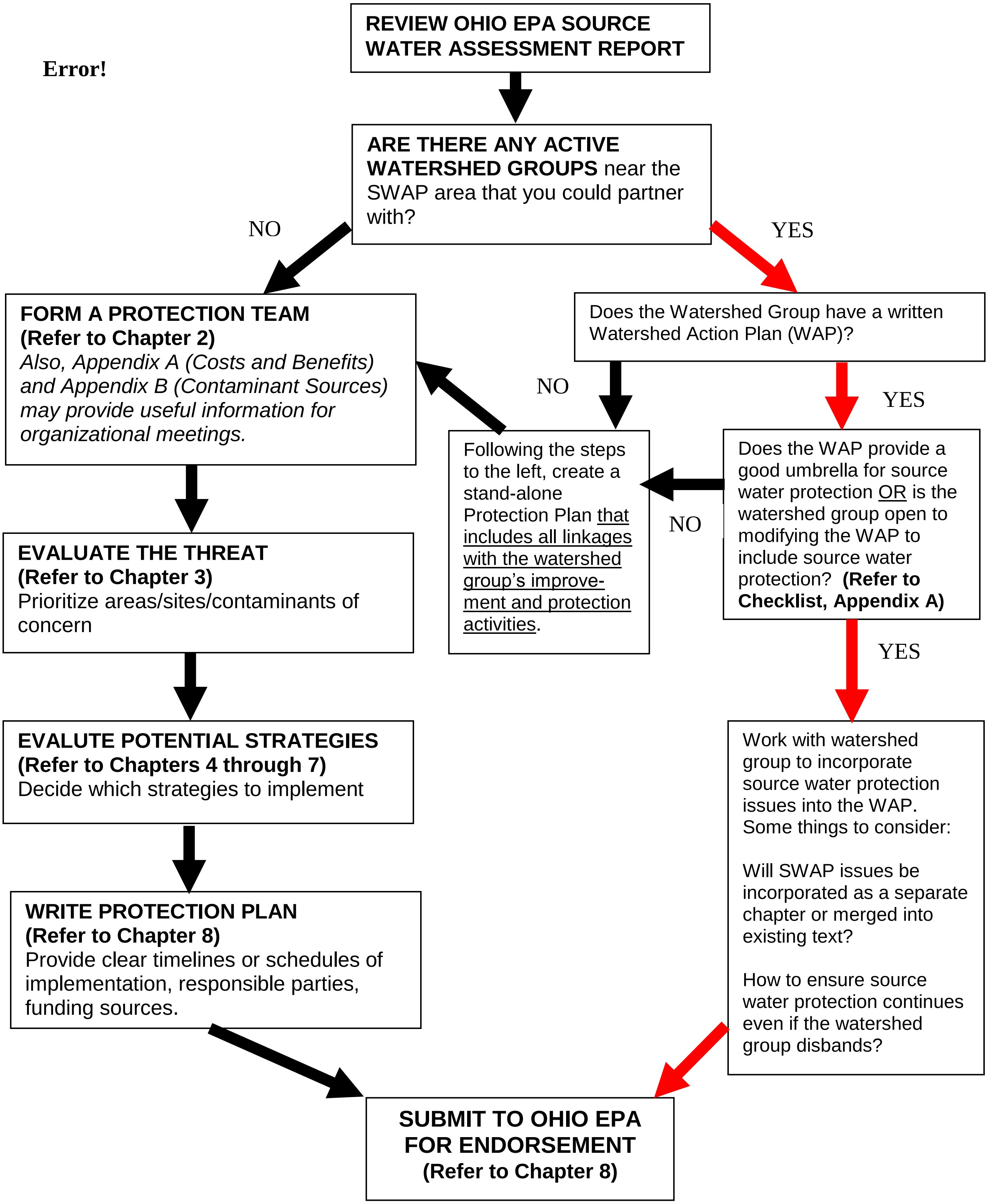

Figure 1-2 – Flow Chart for Creating a Source Water Protection Plan

1.3 SUBMITTING THE PLAN TO OHIO EPA

Whether packaged as part of a watershed action plan or as a stand-alone document, when the source water protection plan is completed, it is recommended that the plan be submitted to Ohio EPA for review and endorsement. Incentives are increasingly tied to having an endorsed protection plan. Currently, a public water system with an endorsed protection plan automatically receives a higher priority for low-interest loans from Ohio EPA's Drinking Water Assistance Fund.

Source water protection planners may feel overwhelmed at the prospect of creating a plan that is potentially very complex, addressing technical issues in areas that may lie outside the jurisdiction of the city, village, or region. Assistance is available from various state and local agencies and private consultants and from Ohio EPA. For general guidance or for more dedicated one-on-one assistance, please contact Ohio EPA Source Water Protection staff at the contact addresses and numbers shown on the last page of this document.

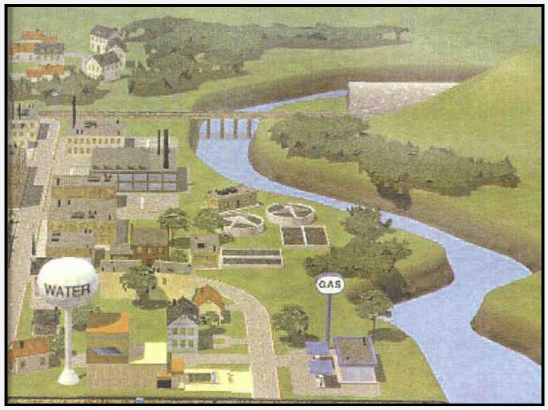

Figure 1.3 - Hypothetical Example:
"Anytown" Creates a Source Water protection plan

NOTE: This hypothetical example is intended to provide a sense of how a protection plan might be developed. It should not be regarded as a template or an ideal, because it does not include all of the numerous strategies and options available for protecting source water. Each water system has its own unique issues and resources.

The public water system for the city of "Anytown", Ohio (population 60,000) has an intake in "Buckeye River", an inland stream of moderate size. The public water system treats the water by adding alum to settle the solids, then sends the water through sand filters to remove any remaining particles, and then chlorine and fluoride are added before pumping it into the distribution system. Rapid development in the upper watershed has involved extensive earth moving, and heavy rains wash tons of silt into the stream.

As a result, the source water tends to be very turbid after rain events, and trihalomethanes exceed maximum contaminant levels. At such times, the system must pump the water through charcoal filters–a very costly process. In spring, testing detects high levels of nitrates and atrazine in the source water, presumably from application of agricultural chemicals in the cornfields that cover much of the watershed.

The city uses carbon treatment to address the atrazine levels, but there is no effective treatment in place for nitrates. City Council discussed building a reservoir to set aside large amounts of water when the water quality was high, but the cost was prohibitive. The public water system operator (Bill) and his manager agreed it was time to initiate source water protection, before it was too late.

Bill called Ohio EPA for their guidance document. Armed with some information about costs and benefits of source water protection, he gave a short presentation to Anytown's City Council. They officially agreed to move forward with the project.

Ohio EPA staff helped Bill locate the only watershed group operating upstream from the intake. However, their stretch of river was over 75 miles upstream and the all-volunteer group had a limited focus, lack of experience, few resources, and an uncertain future. Based on these facts, Bill and the people he consulted decided it would serve Anytown's interests better to create their own source water protection plan.

Bill assigned his administrative assistant, Angie, to help organize a **protection team**. Angie contacted the fire chief, city health department, a city planner, a local high school science teacher, the local Emergency Management Agency (EMA), the county agricultural extension agent and Soil and Water Conservation District staff, and a reporter from the local newspaper. In the end, about ten people expressed interest.

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Bill invited Ohio EPA staff to give a presentation at the protection team's kick-off meeting. During this meeting, the group established time and frequency of meetings, and a general timeline for accomplishing tasks. They agreed that their focus would be to conduct additional research, evaluate the threats, and propose strategies. Then they would begin an education campaign to share their findings with the community, and recruit support for strategies that might prove unpopular with certain groups. They discussed possibly forming a larger advisory group that would provide input and act as a sounding board.

Over the following weeks and months, the protection team reviewed the Ohio EPA source water assessment report, as well as surface water quality data on some upstream segments of Buckeye River (obtained from Ohio EPA's Division of Surface Water) and some data collected by the watershed group.

Since the assessment report was already several years old, several members updated the inventory of potential pollution sources in the corridor management zone. In the process, they found a number of new potential contaminant sources, as well as a number that were no longer active. They collected additional information about some contaminant sources, such as the amounts and types of chemicals used, the facility's compliance history, etc. Some other members obtained more current land-use information for the entire protection area. When they felt comfortable with their knowledge of the area, they began to evaluate the threat posed by various contaminant sources and land uses, and discussed some options for reducing the most significant threats.

For example, within Anytown's Corridor Management Zone, they found a number of bridge crossings, including one small bridge with a high accident rate. They discussed closing the bridge or lobbying to have it rebuilt. For the time being, they agreed to route commercial trucks transporting toxic materials to a safer bridge located farther upstream.

They also reviewed the EMA's contingency plans, and found some missing items. For example, there were provisions to notify the public water supplier of any spills into the river, but no warnings when a village upstream bypassed its wastewater treatment system and released raw sewage into the stream. One member said this was not a threat because the treatment plant was equipped to handle bacteria. Bill reminded him that certain viruses and protozoa, such as *Cryptosporidium*, are more difficult and expensive to treat. They agreed to set up an early-warning notification system with the wastewater treatment plant upstream of their intake, so that Anytown could avoid pumping from Buckeye River during these incidents.

In the Emergency Management Zone there was a combined sewer outlet (CSO). Any spill into the storm water system served by that outlet could make its way quickly to the drinking water intake, and during heavy rains, there was a potential for release of untreated wastes through this outlet. Anytown already was drawing up plans and working out financing to replace the existing lines with dedicated storm water and sanitary sewer lines. The protection team decided to approach the City Engineer about prioritizing the area that drained into the CSO upstream from the intake. They also decided to stencil "drains to drinking water source" on all storm drains in the protection area.

The team found it harder to deal with the nonpoint sources of contamination, which lay mostly outside and beyond the CMZ, but which were already impacting drinking water quality. They knew that variable turbidity levels were a concern, and at least one source of turbidity was the active development in an upstream community, outside Anytown's jurisdiction. For historical reasons, relations with that community were strained.

The team agreed that this problem was not likely to be resolved in the near future; meanwhile, they could ensure the developers were following the state storm water regulations with regard to sediment control measures. In addition, they agreed that the County should be encouraged to move forward with County planning that would identify river corridors as natural resource areas with a high priority for protection.

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The most worrisome threat was the periodic high levels of nitrate and atrazine, presumably related to applications of agricultural chemicals on the croplands surrounding Buckeye River. The Extension agent noted that most farmers in the area believed they were applying agronomic rates, and considered themselves stewards of the land. The team agreed that an education effort was in order, to pave the way for a cooperative partnership.

The team discussed incentives for farmers to take highly erodible land out of production (such as the Conservation Reserve Program and other programs administered by the Natural Resources Conservation Service). They discussed incentives to apply lower levels of agricultural chemicals (such as insurance programs that guaranteed the expected return on the acreage subject to lower levels of chemicals). They also discussed the potential need for additional monitoring and data collection in the subwatersheds to better define priority areas. Finally, they formed a workgroup, headed by the Extension Agent, to focus on developing a partnership with the farming community.

After developing strategies to address the potential threats to the water supply, the city planner volunteered to draft a Source Water protection plan that documented the strategies they had agreed to implement. After review by the entire team and some revisions, Bill submitted the plan to Ohio EPA for review and endorsement. The plan included an implementation timeline that specified who was responsible for completing each action item. (Bill wrote into the job duties of his administrative assistant responsibility for coordinating and tracking ongoing activities such as periodic educational outreach efforts and maintaining the team’s records.)

The protection plan included provisions for review and update at least every five years or whenever a significant change in land use occurred within the corridor management zone. Finally, it included measures to determine the effectiveness of the plan, based on improvements in water quality and the community’s heightened awareness of how to protect their source of drinking water.

Chapter Two
Getting Started

2.0 GETTING STARTED

In Ohio, public water system officials are responsible for initiating protective strategies for the drinking water they provide. They are, however, encouraged to collaborate with appropriate organizations. A realistic understanding of what this will involve will be essential.

This chapter provides a roadmap for the initial step of setting up a “protection team” - that is, the group of people who will evaluate the available information, collect more information if necessary, decide which protective strategies will be implemented, and document these decisions in writing. Guidance in this chapter may be helpful in organizing an effective team.

Helpful tips on getting started and developing a protection plan are outlined in the *Developing a Drinking Water Source Protection Plan* CD available from the Ohio EPA Division of Drinking and Ground Waters by calling (614) 644-2752, or by sending a request to Ohio EPA, DDAGW, Source Water Protection, P.O. Box 1049, Columbus, Ohio 43216-1049, or emailing whp@epa.state.oh.us. This CD has information pertinent to both ground water and surface water systems.

Getting Started

- ❑ Obtain support of local officials
- ❑ Identify existing watershed groups
- ❑ Recruit protection team members
- ❑ Organize the protection team
- ❑ Publicize the effort

Evaluate the threat and prioritize the contaminant sources

Evaluate protective strategy options and decide which to implement

Write the plan

2.1 OBTAIN SUPPORT OF LOCAL OFFICIALS

Before initiating drinking water source protection, a public water system operator will need the support of the public water system’s governing body, such as a city council, a homeowners association, the board of directors, or the county commissioners. This will involve discussing the project with supervisors, and arranging to put the issue on the agenda for a future meeting. To prepare for this meeting, the operator should review this guidance document, and plan to discuss the source water assessment data, benefits and costs, any local source water quality concerns, and what the planning effort will involve. Information provided in Appendices C, D, E and F of this document may be helpful in persuading the governing body.

Sometimes, a governing body chooses to pass a Resolution of Intent to develop a drinking water source protection program, to document its support and lend added authority to the operator’s efforts. Ohio EPA staff members are available to assist with the presentation and answer questions (refer to Appendix G for contact information).

2.2 IDENTIFY CURRENT WATERSHED PROTECTION EFFORTS

Public water systems that draw water from a stream with an established watershed group are encouraged to work directly with the group. In this case, the protection team may be a subcommittee of the existing watershed group. Otherwise, the public water supplier will need to reach out to the community and take more responsibility for recruiting and organizing the team.

Watershed groups are operating on stream segments throughout Ohio. Figure 2.1 is a map of watershed groups and areas where Watershed Action Plans were developed. This information is current through July, 2005. For updated information on Watershed Groups, see this link: http://ohiowatersheds.osu.edu/groups-huc/. Some of these groups are relatively informal and modestly funded. Others chartered as not-for-profit organizations may be partially funded by various grants.

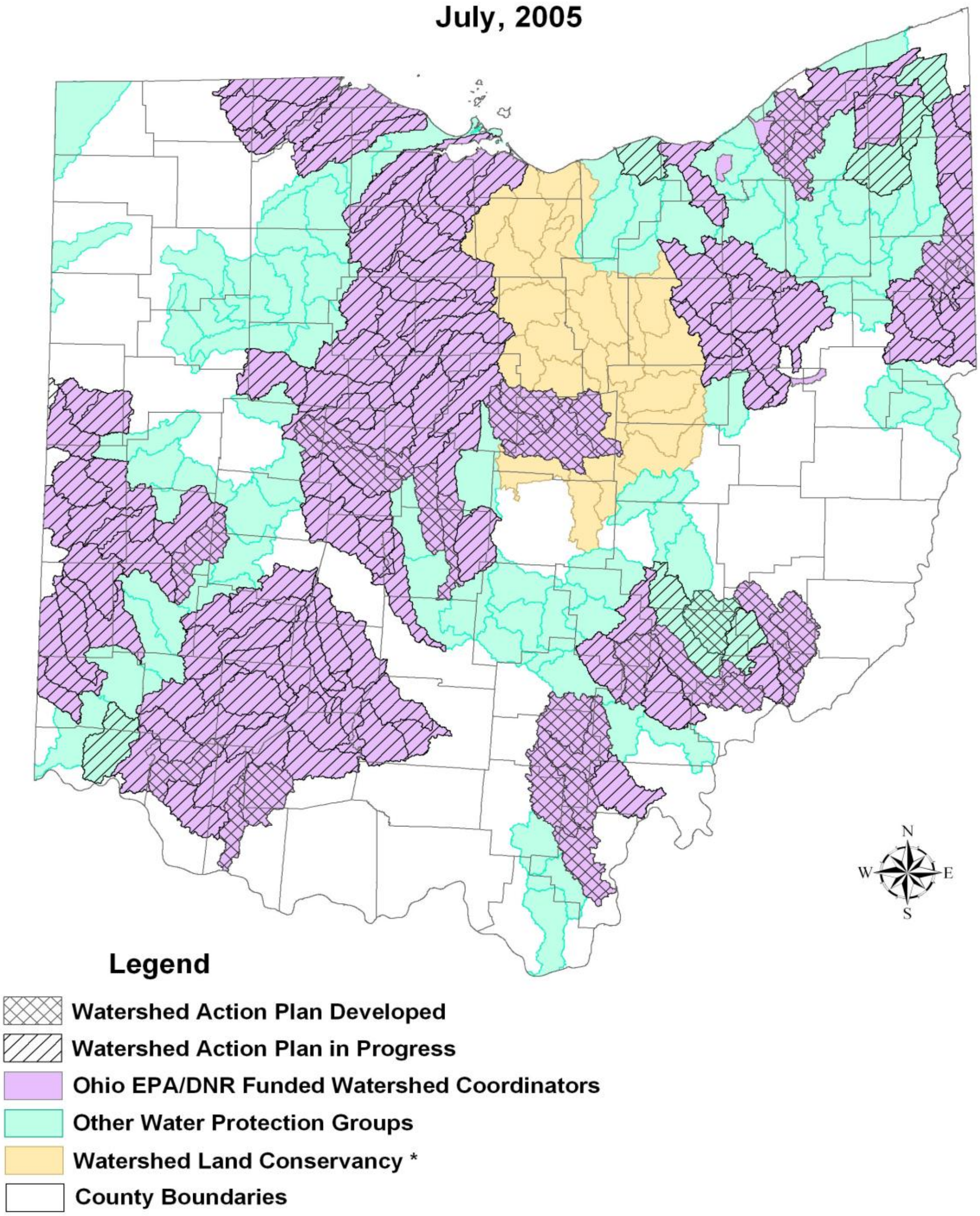
Watershed groups funded by the State of Ohio are required to develop a watershed action plan. A list of watersheds with endorsed and conditionally endorsed watershed action plans is available at ftp://ftp.dnr.state.oh.us/Soil_&_Water_Conservation/WatershedActionPlans/EndorsedPlans/.

If a watershed action plan covers all or part of a drinking water source protection area, the public water system operator should coordinate with the watershed group and determine whether priority actions/locations identified in the plan adequately protect the drinking water source. Chapter 3 of this guidance discusses how to evaluate the threat to drinking water. Chapters 4 through 7 discuss the various types of strategies available for source water protection. Chapter 8 discusses how to document the decisions and submit them to Ohio EPA for endorsement.

2.3 RECRUIT PROTECTION TEAM MEMBERS

Protection team members should include individuals who will play a role in implementing protective strategies, as well as those most likely affected by any decisions made. To some extent, the size of the group should reflect the size of the watershed and the resources of the public water system. At a minimum, the team should include local decision makers, public water system staff and preferably someone with knowledge of emergency response and/or environmental compliance. A public relations specialist ensures frequent and accurate publicity of the team’s efforts. Members drawn from groups such as the Natural Resources Conservation Service, Ohio Department of Natural Resources Soil and Water Conservation Districts, the Farm Bureau, or a local watershed planning organization, ensure coordination of their respective organizations. A large and well-organized watershed group may already include a sufficiently diverse number of volunteers to form a subcommittee. However, even in these cases the public water supplier may wish to recruit additional members.

Figure 2.1 – Watershed Groups in Ohio



* Often extends beyond area depicted to overlap some existing watershed groups
(Conservation Action Plan in NW Ohio not organized by watershed boundaries)

The public water system operator should consider the following steps for recruiting volunteers.

Step 1) Schedule a volunteer solicitation meeting

Contact the public library, school, fire hall, county extension, county conservation district, or other government agencies for a meeting place. The availability of an adequate meeting place may drive the meeting date. Allow about six weeks to plan and publicize the meeting. The best meeting time is usually around 7 p.m. in the middle of the week.

Be sure to consider other community events so that you can schedule a meeting date/time that does not conflict. For instance, planting/harvest season, local festivals, and school sporting events can make many potential volunteers unavailable at certain times of the year. Schedule the meeting with this in mind.

Step 2) Publicize the initial meeting

To recruit volunteers, issue a public service announcement on local radio or TV and post notices at the post office, city hall, courthouse, public library, senior center, state/federal agency buildings, and any other public bulletin boards. You may also post a notice in the local newspaper.

The most effective way to recruit volunteers, however, is through a personal appeal. Mail a meeting notice to any citizens who have expressed interest or have qualifications with water supply issues. Good target organizations include:

- Local offices of resource organizations such as Ohio EPA, Department of Agriculture, Natural Resources Conservation Service, Forest Service, Geological Survey, Department of Natural Resources, Emergency Management Agency, Soil and Water Conservation District, Local Emergency Planning Committee, Department of Health (County or municipal) and the local Extension office.
- Chamber of Commerce (especially important in urban watersheds with industrial/commercial uses in the critical areas).
- Local planning office.
- Service groups such as Kiwanis, Lions or Rotary clubs.
- Environmental consulting firms (see Yellow Pages under “Environmental”).
- Follow each mailing with a phone call to confirm receipt and encourage participation. Recruiting solely by letter is not productive.

Step 3) Hold the meeting

It is important to be well prepared and to have handouts available so potential volunteers can learn more about drinking water source protection after the meeting and at their own pace. It will also be helpful to display general information about intakes, maps of the watershed, and a sample drinking water source protection timeline so potential volunteers can ascertain just what might be expected of them. Materials are available from Ohio’s Source Water Protection Program. Ohio Rural Water Association staff members are available to assist with this meeting and answer questions.

Toward the end of the meeting, have potential volunteers identify strengths they may contribute to the effort. Give each person a sheet of paper and ask them to write their name, contact information and a brief summary of their knowledge or experience. Ask them to identify any particular skill they may possess that might be useful to the group. Give examples such as good writing skills; the ability to deal with all kinds of people or sales ability; technical training in geology, engineering, planning or geography; leadership skills or personnel management skills. It can be difficult for potential volunteers to respond so you will need to encourage them. Allow five to ten minutes before collecting the information sheets.

You should pass a sign up sheet around before closing the meeting. This will allow potential volunteers to make a positive decision and will identify those persons most committed to the process. Let everyone know that you will be making follow-up calls over the next few days. The benefit of performing these follow-up calls is that people who did not sign up initially may change their minds or provide details as to why they did not sign up.

Step 4) Make follow-up calls

It is important to make all follow-up calls to potential volunteers within a few days of the meeting. Allowing too much time to pass before contacting volunteers causes enthusiasm to diminish, resulting in a lower recruitment rate. If more citizens volunteer than you have room for, increase the community planning team size somewhat or select those that best represent the diversity of experience and skills needed for drinking water source protection planning. At a minimum, you should call everyone to thank them for their interest. Remember, you may need replacements later in the process and these folks have already expressed an interest in drinking water source protection.

If potential volunteers do not come to the first meeting, you will need to try to find out why and either address the problem or form a community planning team in some other way.

Occasionally, you may have to weigh the benefits or disadvantages of including a member who is considered difficult or strongly opposed to the protection team's goals. When you believe the individual may be influential enough to single-handedly derail the project, this is especially worrisome. On one hand, including such people can be the best way to neutralize their opposition, by winning them over or by compromise. The resulting plan may be much more robust than it would have been otherwise. On the other hand, such individuals can make the effort frustrating and exhausting, and may drive the other participants away. In the end, it is a judgment call, but the individual who is putting the team together should be aware that including the opposition might be worth the extra effort.

2.4 ORGANIZE THE PROTECTION TEAM

After selecting team members, hold a kick-off meeting to select a leader and secretary, and possibly a publicity specialist. Set up a timetable and establish regular meeting times and locations. Keep in mind that for larger systems, it is reasonable to expect that the project planning and plan development phase could take about two years. For small systems with very few potential contaminant sources, the process could be as short as six months. The team will probably meet once a month at first and perhaps every other month later. However, a project that relies on volunteers will take longer than one turned over to professional consultants. If the protection team is a subcommittee of a watershed group, the watershed action plan development timeline may drive the pace of the protection team.

The numbers and types of contaminant sources in the watershed, and the presence or absence of impacted areas will tend to drive the decisions about protective strategies. Therefore, if the team wishes to accomplish certain goals regardless of these factors, it is important to establish these goals at the outset. In terms of water quality, the overriding goal could be to improve water quality, or simply to maintain it at current levels. Secondary goals may be established, such as open-space preservation; education of watershed residents about the cumulative effects of a particular activity; controlled recreation around reservoirs; limits on impervious surfaces; and limits on specific pollutant discharges to name a few.

2.5 PUBLICIZE THE EFFORT

The solid support of the community may be critical to the success of the team's efforts. Drinking water protection is a "good news" story and reflects favorably upon the public water system sponsoring it. Therefore, managing publicity is an important role that will require a dedicated and energetic person with good writing and speaking skills. This person should contact the local newspaper and offer to meet with the editor to discuss a quarterly column of approximately 500 words. (They should be prepared to submit a couple of example articles about team efforts). If it is not possible to arrange a regular column, the publicity specialist might want to request a reporter-written article based on suggested topics or the regular committee meetings.

Some of the topics may be sensitive. For example, the farming community may feel unfairly targeted as the source of agricultural chemicals in surface water, or certain facilities may object to the label of “potential contaminant source.” It is important to keep the tone of the article(s) informational and positive, to give credit where it is due and to avoid singling out any particular facilities or individuals as culprits.

Authors should follow good journalistic practice, keeping the piece relatively brief while focusing on a few main points. Make sure to check facts and provide accurate quotes. While it is fine to contact and quote state officials, local readers are probably more interested in what is happening in the immediate area and in what local experts have to say about it.

The articles should begin very early in the team’s planning process. The most successful drinking water protection efforts are those publicized early and often and presented as a community source of pride.

Figure 2.2 - Suggested Checklist for Creating a “Protection Team”

- ❑ Meet with supervisor.
- ❑ Schedule meeting with governing body.
- ❑ Prepare for meeting (contact Ohio EPA, if desired, for assistance).
- ❑ Meet with governing body and if possible, obtain Resolution of Intent to create a drinking water source protection plan.

- ❑ Schedule volunteer solicitation meeting.
- ❑ Develop list of individuals to invite directly (by letter AND phone call).
- ❑ Publicize meeting.
- ❑ Prepare for meeting (contact Ohio EPA, if desired, for assistance).
- ❑ Hold volunteer solicitation meeting.
- ❑ Select team members.
- ❑ Call all meeting attendees to thank them for their interest. Invite chosen team members to kick-off meeting.

- ❑ Schedule kick-off meeting.
- ❑ Prepare for kick-off meeting (contact Ohio EPA, if desired, for assistance).
- ❑ Hold meeting. Designate a leader, secretary and publicity specialist.
- ❑ Develop goals, meeting schedule, timeline.
- ❑ Designate subcommittees, if desired.
- ❑ Begin review of protection areas (refer to Chapter 3).

Chapter Three
Evaluating the Threat

3.0 EVALUATING THE THREAT

Municipal officials and conservation agencies are routinely required to prioritize conservation and restoration projects. Which forested parcels should receive the highest priority for conservation? Which area is in need of restoration using riparian forest buffers? Where will agricultural best management practices likely yield the greatest improvements in water quality? It is critical to identify high-priority land for protection and restoration, as funding is always limited and multiple demands often are made on a valuable piece of land.

For drinking water protection, the highest priority is to protect the source water from those facilities and land use activities that noticeably impact the source water quality. The second priority is to protect the source water from those facilities/activities that have a high likelihood of impacting it in the future. This chapter provides guidance on evaluating existing water quality data, identifying the critical areas for drinking water source protection, and evaluating the potential contaminant sources that lie within critical areas.

Evaluating the Threat

Evaluate the threat and prioritize the contaminant sources

- ❑ Review existing water quality data
- ❑ Identify critical areas
- ❑ Identify potential contaminant sources in critical areas
  - ○ Review assessment report and verify listed sources
  - ○ Locate new sources
- ❑ Determine actual threat posed and prioritize

Evaluate protective strategy options and decide which to implement

Write the plan

3.1 EXISTING WATER QUALITY DATA

The first step for the protection team is to evaluate the water quality data in the Drinking Water Source Assessment Report and additional water quality data collected within the watershed. The data will help identify the major causes of impairment to the drinking water source and help to prioritize critical areas for both protection and restoration activities. Ohio EPA is a primary source for existing water quality data; however, the team should also contact the United States Geological Survey (USGS), regional planning agencies such as the Miami Conservancy District, local watershed groups and universities. Assign a member of the protection team to research additional sources of information.

3.1.1 Ohio EPA Surface Water Monitoring Data

Ohio EPA collects water quality data to support a variety of environmental programs and assist with environmental decision-making. A large portion of the data Ohio EPA collects is available in Technical Support Documents (TSDs). These documents (also known as "Biological and Water Quality studies") are available for most Ohio watersheds at http://www.epa.ohio.gov/dsw/document_index/psdindx.aspx or via an interactive GIS site at http://www.epa.ohio.gov/dsw/gis/index.aspx.

The Division of Surface Water at Ohio EPA has a monitoring schedule that includes the collection of water quality data for the TMDL program. In addition, Ohio EPA collects data based on a five-year basin approach, which provides the framework for the monitoring schedule because retaining the basin approach is important for balancing work and supporting other programs within Ohio EPA (refer to Figure 3.1 on the following page). The technical support documents contain information on sampling locations and provide summary data. All of the individual sampling results are available in U.S. EPA's STORET database. The database is available online at http://www.epa.gov/STORET.

Users can download data for entire counties or drainage basins and query the database using sampling date ranges and other data attributes. The STORET database also contains data collected from various universities and watershed groups.

Ohio EPA summarizes the data in technical support documents into an Integrated Water Quality Monitoring and Assessment Report. This report discusses general trends in water quality and identifies watersheds with water quality impairments. This general overview of your watershed's water quality may help you identify some of the sources of water quality impairment. The report is available online at http://www.epa.ohio.gov/dsw/tmdl/OhioIntegratedReport.aspx.

Ohio EPA is collecting additional water quality data in impaired watersheds that require a Total Maximum Daily Load (TMDL). A TMDL is a quantitative assessment of a watershed's water quality problems and contributing sources of pollution. It specifies the amount of pollution reduction needed to meet Ohio's water quality standards, allocates pollutant load reductions, and provides the basis for taking actions needed to restore the watershed. More information about this program and a list of watersheds with completed TMDLs is available online at http://www.epa.ohio.gov/dsw/tmdl/index.aspx.

Finally, the team may be able to collect some water quality data through Clean Water Act Section 319 grant projects and Ohio EPA's wastewater permit programs. The grant project data is usually not available in an electronic format, but hard copies are available by contacting Ohio EPA's Nonpoint Source Unit (614) 644-2020. Permit data is from effluent samples and samples collected upstream and downstream of wastewater discharge locations. This data is available by contacting Ohio EPA's Division of Surface Water at (614) 644-2884.

Figure 3.1 - The Five-Year Basin Approach
(*In fond memory of Bernie Counts, Ohio EPA, Division of Surface Water*)

In 1990, Ohio EPA initiated an organized, sequential approach to monitoring and assessment called the five-year basin approach.

One of the principal objectives of this approach was to better coordinate the collection of ambient monitoring data so that information and reports would be available in time to support water quality management activities such as the reissuance of discharge permits and periodic revision of the Ohio Water Quality Standards.

The initial step in this process was to section the state into 25 different hydrologic units, which represented aggregations of sub basins within the 23 major river basins previously delineated by Ohio EPA.

Each of Ohio EPA's five districts handles five of these hydrologic units. Each year each district office monitors one of its five units, so five years are required to complete one monitoring cycle of all 25 hydrologic units.

This approach ensures that data is collected for each of Ohio's watersheds at least once every five years.

3.1.2 Other Sources of Data

Additional sources of data include the United States Geologic Survey (USGS), universities, watershed groups, regional planning agencies, scenic river coordinators, and county soil and water conservation districts. The team should make every effort to contact these organizations to collect any pertinent water quality data.

Figure 3.2 - Wastewater Sampling

The USGS has water quality data available through a variety of programs available online at http://water.usgs.gov/data.html. The USGS Web site contains links for the National Water Information System Web site, which contains data for approximately 1.5 million sites across the United States, and other water quality Web sites. The USGS has additional information for the Lake Erie basin and Great and Little Miami River basins through its National Ambient Water Quality Program. Water Quality data for these basins are available on the Web at http://water.usgs.gov/nawqa/nawqamap.html.

Many local Soil and Water Conservation Districts (SWCD) are very active in watershed restoration and they may have water quality data. The following Ohio Department of Natural Resources Web site contains a link to all of the local SWCD offices: http://ohiodnr.com/tabid/8637/Default.aspx.

Information on the scenic river program and a list of scenic river coordinators is available on the Ohio Department of Natural Resources' Web site at http://ohiodnr.com/dnap/sr/tabid/985/Default.aspx .

3.2 IDENTIFY CRITICAL AREAS

After evaluating the existing water quality data, the protection team will need to identify the "critical area(s)" for protective efforts, based on the following factors.

- The area of focus provided in the system's drinking water source assessment report.
- Sub watersheds with drinking water quality impacts.
- Undeveloped areas under intense development pressure.

3.2.1 Area of Focus

The area of focus provided by a drinking water source assessment report will be the **Corridor Management Zone** and **Emergency Management Zone** for systems using an inland stream and the Zone of Critical Concern for Ohio River systems. For Lake Erie systems, it is the Critical Assessment Zone, along with the Potential Influence Zone, if one has been delineated (refer to Figure 1.1 on page 1-2).

3.2.2 Impacted Subwatersheds

Water quality data may suggest that a particular contaminant is impacting the watershed. For example, high turbidity levels at a monitoring point may suggest erosion upstream. Further investigation may indicate the source is a new development, road-building, plowed fields without stream buffers, etc. High nitrates in a tributary may lead investigators to an agricultural area upstream that is tilled all the way to the stream bank, or to a line of old vacation homes with discharging septic systems.

The protection team should evaluate all existing water quality data to identify critical sub-watersheds or stream segments within a watershed. In some cases, data may not be available for your watershed and the protection team should consider developing a Monitoring Plan and collecting additional water quality data before moving too far ahead with protection strategies. Chapter 7.0 describes how to develop a monitoring plan.

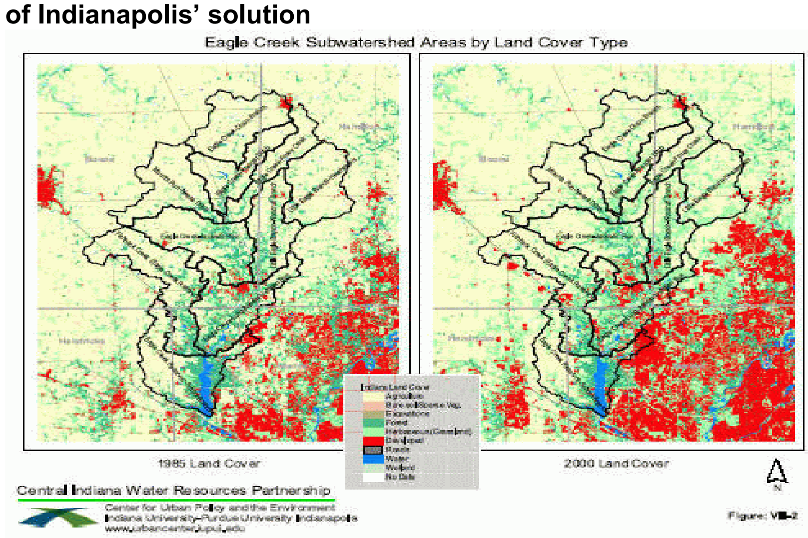
Protection teams that are a subcommittee of a watershed group with a completed watershed action plan should review the plan to make sure it has addressed drinking water concerns. For example, atrazine levels can be a major concern for public water systems in agricultural watersheds, but often watershed groups are addressing sediment, dissolved oxygen levels, and may not have watershed-wide data for atrazine concentrations. Therefore, “critical areas” identified in the watershed action plan may or may not be the same critical areas for source water protection.

3.2.3 Undeveloped Areas Under Development Pressure

Watershed action plans typically focus on areas that are already impaired and need restoration. Similarly, drinking water source protection plans tend to focus on protecting the water source from existing contaminant sources. However, in undeveloped areas, a protection plan can have even greater effect if it protects the water body from future contamination. For example, the City of Indianapolis has purchased portions of land on the mostly undeveloped west bank of its reservoir and converted it to parkland to reduce the risk of contamination (Figure 3.3).

The more compelling the potential threat to the water body, the more likely pre-emptive measures such as these will be locally acceptable. Therefore, the planning team should include in this category widely recognized high-development-pressure areas that are near the intake, but may not be part of the Corridor Management Zone. The team may wish to narrow its focus even further to portions of this area that are sensitive, such as areas with steep slopes, highly erodible soils, unforested or disturbed areas, soils with high clay content, etc. The team can obtain information on these characteristics from a variety of local, state and federal agencies.

Figure 3.3 - Protecting undeveloped land for the future: the City of Indianapolis’ solution



Eagle Creek Reservoir, located due west of the City of Indianapolis, is one of three reservoirs providing water to the City. Encroaching urbanization (indicated in red on maps above) has nearly consumed all land use east of the reservoir. Without intervention, the west bank was projected to follow suit by 2040.

The Central Indiana Water Resources Partnership (including the City’s water company and Indiana University’s Center for Earth and Environmental Science) recently studied the area in detail and reconstructed wetlands in a former marsh that had been drained and converted to agriculture. Extensive parklands have been created around the lake to help prevent total urbanization along the water’s edge.

3.2.4 Tools for Analyzing and Mapping Critical Areas

U.S. EPA has developed free water quality modeling software to help assess point source and nonpoint source water quality impacts. The team can download models from the following U.S. EPA Web site: http://www.epa.gov/waterscience/models/.

Geographic Information Systems (GIS) are tools for analyzing data spatially by displaying it on an electronic map. Many agencies, including county offices, are now used these tools, which are invaluable for public education as well as information analysis (refer to Figure 3.4 on the following page).

Figure 3.4 - Using Geographic Information Systems to Identify Critical Areas

Geographic Information System (GIS) software can be very helpful in identifying critical parcels and showing where protection or restoration will have the greatest benefit for water quality. GIS software can be used to identify high-priority lands in a number of different ways, including:

- Identifying land use and features (such as streams or slopes), or locating parcels of land or contaminants using existing data sources. Ohio EPA, Division of Drinking and Ground Waters or Division of Surface Water can provide the GIS data used in a Drinking Water Source Assessment report.

- Creating ranking systems and operational models that rank parcels based on a set of characteristics. These models require digitized data layers for the characteristics of greatest interest, such as slope, land cover, and distance to stream.

- Developing quantitative models that can predict potential impacts from land use on water quality, such as pesticide concentration, nutrient loading, or total suspended solids in stream water. These models require long-term, weather, stream flow, water quality, and other watershed data for development, testing and validation.

For more information on how to create such a tool, see Charles L. Convis Jr. *Conservation Geography. Case Studies in GIS Computer Mapping and Activism* (Redlands, CA: ESRI Press, 2001).

3.3 IDENTIFY POTENTIAL CONTAMINANT SOURCES WITHIN CRITICAL AREA(S)

Once the planning team has identified the critical area(s), it should identify the potential contaminant sources located within them. For the purposes of drinking water source protection, a **potential contaminant source** is any facility or activity that has the potential to release a drinking water contaminant, based on the kinds or amounts of chemicals typically associated with that type of facility or activity.

The drinking water source assessment reports completed by Ohio EPA identify potential contaminant sources located with in a public water system's focus area. However, the assessment does not determine whether any specific potential source is actually releasing (or has released) a contaminant. In addition, the assessment report emphasizes point sources, such as industrial sites and gas stations, but nonnpoint sources may be an even greater concern. Team members can use land use maps and aerial photos to estimate potential nonpoint sources of contamination (presence of agricultural areas, unsewered residential areas, etc.).

Protection team members should consider reevaluating the focus area, to check for new potential contaminant sources, including nonpoint sources, that may not appear on the map and to verify that sites shown on the map still exist and are correctly located. Where a particular source is large enough to pose a significant threat, the team should make an effort to obtain information about the amounts and types of chemicals used. When possible, the team should also obtain information on the management of such sites. If the site is regulated, a history of its regulatory compliance should be available from the regulating agency.

Since Drinking Water Source Assessment reports do not identify potential contaminant sources outside the CMZ and EMZ, it may be necessary to develop an inventory for the additional critical areas identified by the protection team. If the team is working with a watershed group, seek assistance from members who will already be familiar with this effort. Otherwise, guidance on how to develop an inventory can be found in Chapter 2 of the *Ohio EPA Guide to Developing Local Watershed Action Plans in Ohio* (1997), available online at http://www.epa.ohio.gov/portals/35/nps/wsguide.pdf; and Section 4 of the *2/7/03 Update, Appendix 8, "Outline of a Watershed Action Plan"* available online at http://www.epa.ohio.gov/portals/35/nps/NPS_WAP_APP8.pdf.

Appendix D of this document describes some of the more common potential contaminant sources in some detail, including associated contaminants and existing regulatory controls.

3.4 PRIORITIZING CONTAMINANT SOURCES

After locating and collecting sufficient information about potential contaminant sources, the planning team is ready to decide which of contaminant sources pose the greatest threat. The following list shows some of the items the team should weigh heavily when prioritizing the sources.

- The contaminant source handles chemicals or pathogens that are present in the drinking water or source water in elevated concentrations - these are the most critical sources.
- Presence of direct routes (such as direct discharge outlets, storm water drains or field tiles) to the water body.
- Proximity to the water body.
- Impervious surfaces (parking lots, streets, etc.) between the site and the water body.
- Large amounts of contaminants handled at the site.
- Highly toxic contaminants handled at the site (including pathogens).
- Lack of environmental regulations over the site.
- Lack of containerization or proper containment of the contaminant.
- A history of poor environmental management at the site.
- Steep topography that encourages rapid flow to the water body.

Of the above-listed factors, the most important one is the presence of contaminants handled by that facility in the source water body. The team should consider any site within a critical area that is potentially contributing to existing water quality impacts a top priority for protective strategies. Proximity to the water body also ranks highly. The other factors affect the ranking of a site based on how many are present, or how they combine. The lowest priority should go to sites initially identified as potential contaminant sources but subsequently found not to handle any contaminants of concern. The rationale for deprioritizing these sources should be included in the protection plan submitted to Ohio EPA for endorsement.

Once the main contaminant source or sources are determined, the team can consider other factors including political and financial considerations. A planning team may choose to prioritize the one issue they can reasonably do something about in the near-term, if it appears politically or financially impossible to take action on other issues. A type of site may receive higher priority because there are so many of them in the critical area (for example failing/discharging home sewage treatment systems, storage tanks) and dealing with them collectively could offer a better cost-benefit ratio. Finally, if the public water system has off-stream reservoirs or advanced treatment capacity, it may be less concerned about certain source water quality problems. The team should place emphasis on the potential sources of contamination that the water system has the most difficulty addressing.

Not all of the above-listed factors are relevant to prioritizing undeveloped areas under intense development pressure. Proximity to the water body remains important and topography may be relevant. However, the main factor will be the value the community places on protecting the water body as a drinking water source versus other potential uses. Waterfront land parcels are attractive to many users. Converting undeveloped land to parkland will be easier if the land is marshy, steep, unstable, subject to seasonal flooding, or valued as a habitat for rare species or as a historical site. Where there are numerous competing interests for land parcels adjacent to a water body, the team should attempt to develop creative compromises. The following chapters discuss land conservation and other types of protective strategies.

Chapter Four
Education and Outreach

4.0 EDUCATION AND OUTREACH

An effective public education and outreach component is critical for obtaining broad-based support and commitment to any program. Public commitment to protection planning can lead to support for additional funding as well as for the implementation of best management practices within homes and businesses in or near the drinking water source protection area.

Education and outreach will be an ongoing process. Some efforts must be repeated periodically to be successful. Others can be done once to meet their goals. Many organizations are already engaged in education and outreach projects that support source water protection.

Evaluate Protective Strategies

Evaluate the threat and prioritize the contaminant sources

Evaluate protective strategy options and decide which to implement

- ❑ Education and Outreach
- ❑ Contingency Planning
- ❑ Source Management
- ❑ Monitoring

Write the plan

4.1 OUTREACH

Public water systems can use many methods of outreach to inform their customers in the protection area, and the public about their source water protection efforts.

Brochures can cover general topics for all public water consumers or they can cover specific topics for a portion of the population, such as those who live or work in the protection area. Several Ohio communities include a brochure describing the source of the community's drinking water with their water bills. A template for such a brochure is available on Ohio EPA's Web page at http://www.epa.ohio.gov/ddagw/swap.aspx. Other systems have had their brochures hand delivered by a city official, protection team member, or members of local youth organizations such as scout troops (who could make this work a merit badge opportunity).

Community public water systems are required to prepare a Consumer Confidence Report (CCR) each year. This report must contain information about the drinking water source and its susceptibility to contamination. The team can add information to this section to provide details on drinking water source protection efforts or tips on what customers can do to help in these efforts.

Ohio public water systems have used many other means to build awareness through outreach. Articles in the local newspaper can be very effective. Placing posters and fact sheets in workplaces and public areas such as libraries and municipal buildings is a good way to reach a wide variety of citizens.

The team may want to give presentations to the local council and service groups such as Kiwanis and Rotary Clubs. For communities with their own broadcasting facilities, radio and cable TV are another outlet.

Many communities have their own Web pages, which can include links to documents and other resources. A booth at local festivals and county fairs is another outreach tool; these are particularly successful when they feature educational hands-on displays. Road signs at stream crossings (Figure 4.1) increase motorist awareness about the watershed.

Figure 4.1 – Road Sign

Finally, local water resources partners such as watershed coordinators, Soil and Water Conservation Districts, local health districts, the Natural Resource Conservation Service, and OSU-Extension share the goal of protecting the local water resources and may be able to provide assistance with the development and implementation of outreach efforts.

Various public awareness resources focusing on the importance of source water protection are available online at http://www.epa.ohio.gov/ddagw/swap_protplan.aspx. Ohio EPA staff members are also available to provide presentations.

Other outreach information includes:

- *Developing a Drinking Water Source Protection Plan* interactive CD-ROM from Ohio EPA, DDAGW
- *Protecting Your Environment: An Interactive CD-ROM* from Ohio EPA, Office of Environmental Education
- *Water Supply Operation: Source Protection* video from American Waterworks Association
- *Tools for Drinking Water Protection - Community Outreach Kit* includes a video from the League of Women Voters
- *Ground Water and the Ohio Wellhead Protection Program* video from Ohio EPA, Division of Drinking and Ground Waters (DDAGW)

4.2 EDUCATION

4.2.1 Educating the Public

Informed and engaged citizens are aware of the consequences of their actions in the workplace, at home, and as consumers. They make informed choices that will protect their health and the environment. The goal of source water education is to make individuals who live or work in the protection area aware that their actions have the potential to negatively impact their community's source of drinking water.

Studies indicate that the greater the interaction with a learner, the greater percentage of information the learner retains and uses. Ohio's water resources educators have found that interactive teaching tools such as an EnviroScape Model are very effective in demonstrating the impacts of point and nonpoint source pollution on Ohio's water resources. An EnviroScape Model demonstrates how water` and contaminants migrate through the surface environment and make their way into lakes, streams, and the ground (Figure 4.2).

Figure 4.2 - Both students and adults can learn about surface water flow and the pollutants that threaten surface water through an EnviroScape model.

Similarly, a model can be used to show how ground water contamination occurs and the impact on surface water. Several Soil and Water Conservation Districts have EnviroScape models and ground water flow models, and may be able to assist with a presentation.

Businesses located within the protection area can provide training to their employees to make them aware of the protection area, the location of the business within the protection area, and the importance of using management practices to protect the community's drinking water. Many occupations have annual education requirements to retain professional certification. Businesses and organizations may be able to include training on source water protection in their list of approved courses.

Ohio Source Water Environmental Education Teams (SWEETs), available within 58 participating Ohio counties, are providing Ohioans with source water education and guidance about protecting their sources of drinking water. Each team, mostly organized by county soil and water conservation district educator staff, consists of three to five local water resource partners such as local health department staff, watershed coordinators, and public water system operators. The teams are quickly becoming an important component of source water protection education efforts across the state. Each SWEET is equipped with a user-friendly ground water simulator, and some also have the new EnviroScape© table top models that show drinking water sources (surface and ground water), and drinking water and waste water treatment processes.

A ground water simulator demonstration is also applicable to surface water public water systems because it has the ability to demonstrate the interconnection between the surface and ground water environments. Clean surface water resources rely on both clean storm water runoff and clean ground water recharge.

SWEET members have considerable expertise in environmental education as well as professional experience in natural resources protection. Public water systems are encouraged to consider inviting SWEET members to participate on their drinking water source protection planning team.

For more information on SWEET teams or finding a local educator, go to http://wwwapp.epa.ohio.gov/ddagw/SWEET/index.html.

4.2.2 Educating K-12 in the Classroom

The origin and flow of surface water, and how it can become polluted, should be part of elementary and high school science courses. Materials available from environmental organizations can complement many textbooks and most teachers are open to incorporating this information into their plans. You can get much of this material for free or at a minimal cost.

Ohio Project Wet (http://www.dnr.state.oh.us/educate/owep/wetmain/tabid/3501/Default.aspx)
Through the Ohio Project Wet program, the Ohio Department of Natural Resources' Division of Water offers teachers training on source water concepts. To receive a copy, write to the Ohio Department of Natural Resources, Division of Water, 2045 Morse Rd., Bldg. B-2, Columbus, OH 43229-6605 or call (614) 265-6717.

Project materials are aligned with the new Ohio education standards, so teachers can easily select activities that relate directly to their lesson plans. Training opportunities are scheduled at various times and locations throughout the state. A public water system may sponsor a training opportunity for the teachers from school districts in their protection area. In return, teachers can incorporate source water protection education that supports the local system's efforts into their classroom instructions.

Healthy Water, Healthy People (http://www.epa.ohio.gov/oeef/hwhpohconnect.aspx)
Healthy Water, Healthy People (HWHP) covers water quality monitoring through classroom and outdoor activities designed for grades 6-12. The HWHP Educators Guide has classroom activities introducing students to data collection and interpretation, sampling methodologies and the causes and consequences of water pollution. The HWHP Test Kit Manual provides background information on testing water for parameters such as alkalinity, conductivity, dissolved oxygen, nitrates and phosphates. You can order the books directly from the HWHP Web site (http://www.healthywater.org). It is not necessary to attend a workshop to order the materials.

Trainers for the Healthy Water, Healthy People program are located throughout the state. Ohio EPA's Office of Environmental Education posts a workshop schedule on the Web at http://www.epa.ohio.gov/oee.

World Water Monitoring Day (http://www.worldwatermonitoringday.org)
October 18th is World Water Monitoring Day. On this date people across the globe participate in a worldwide effort to positively impact the health of rivers, lakes, estuaries and other water bodies. Volunteer monitoring groups, water quality agencies, students, and the public will join in testing four key indicators of water quality: temperature, pH, dissolved oxygen, and turbidity. Public water systems can work with teachers, the public and other water resource partners to sponsor a World Water Monitoring Day event. Invite the local media to report Monitoring Day events in the regional newspaper or on the local news. World Water Monitoring Day is spearheaded by the Clean Water Foundation and the International Water Association.

K-12 educational materials on source water protection concepts can be found on the Internet. Links sponsored by Ohio EPA and the Ohio Department of Natural Resources include:

- http://www.epa.ohio.gov/ddagw/swap_protplan.aspx
- http://www.epa.ohio.gov/oee
- http://wwwapp.epa.ohio.gov/ddagw/SWEET/index.html
- http://www.dnr.state.oh.us/H_Nav1/EducationTraining/Education/tabid/8643/Default.aspx

Chapter Five
Contingency Planning

5.0 CONTINGENCY PLANNING

All community public water systems are required by Ohio Administrative Code 3745-85-01 to have a written contingency plan that meets the minimum criteria specified in the code. A plan written to meet these regulatory requirements typically addresses situations such as power failures, floods, and other accidents that may impact any aspect of the entire system, including the treatment plant and distribution system. However, these contingency plans sometimes fail to address source water. They may not include guidance for what to do if a catastrophic spill of chemicals occurs in the protection area (Figure 5.1).

Such plans also may not address planning for future water needs. Will a community have enough drinking water if population continues to grow? What if there is a drought? Communities should investigate potential new sources of drinking water in case any of those scenarios would occur. They should also plan on how they would protect the new source by determining what types of management techniques would be applicable.

Evaluate Protective Strategies

Evaluate the threat and prioritize the contaminant sources

Evaluate protective strategy options and decide which to implement

- ❑ Education and Outreach
- ☑ Contingency Planning
- ❑ Source Management
- ❑ Monitoring

Write the plan

Figure 5.1 - Contingencies

Fire and floods (above) are typical contingencies. Drinking water protection plans must also address catastrophic contamination of the source water and the resulting temporary or permanent inability to provide water from that source. For example, massive spills have occurred on the Ohio River (below), which is the source of drinking water for six Ohio communities.

If a public water system has already addressed source water contingency planning in its contingency plan, it may be enough to simply attach copies of the relevant pages to the drinking water source protection plan.

Source water contingency planning also may be addressed in a system's **vulnerability assessment**—a document required by the Public Health Security and Bioterrorism Preparedness and Response Act of 2002. Vulnerability assessments catalog and prioritize a public water system's assets, identify potential threats, and list changes needed to mitigate the most serious vulnerabilities for the most critical resources. These changes are then incorporated into the system's Emergency Response Plan, which is kept at the public water system with copies going to the local police, fire department and Emergency Management Agency.

Vulnerability assessments and Emergency Response Plans are <u>not</u> public documents. Vulnerability assessments are prepared by public water systems and delivered directly to U.S. EPA as confidential documents. If a system's source water has been identified as a major vulnerability, it will be addressed in the vulnerability assessment and the Emergency Response Plan; however, the public water supplier is not at liberty to include this information in a Drinking Water Source Protection Plan, which is a public document.

If this is the case, the planners should explain this in the drinking water source protection plan. Otherwise, the planners should address source water contingency planning in the protection plan, as described in the following sections.

Figure 5.2 – Collapsed above ground storage tank
In the mid-1990s there were several catastrophic failures of above ground storage tanks. The collapse of this tank in rural central Ohio released liquid fertilizer into streams above the City of Columbus.

5.1 EMERGENCY RESPONSE

Contingency planning is one of the most valuable parts of the drinking water source protection process. Answering "what if" questions can enable a public water system to react thoughtfully to a concern instead of a crisis. For example asking "What if a tanker spill or tank leak occurred today that caused a large amount of fuel to enter the stream within a mile upstream from the intake?" leads to other questions the contingency plan will need to address <u>before</u> an accident occurs:

- How will public water system staff determine if the intake is threatened?
- Is there an emergency response mechanism in place sufficient to contain a spill?
- Who has the authority to shut down the intake?
- Is an alternate supply of safe water available until the threat has passed?
- Is providing an alternative source of water an option?

5.1.1 Document Response Procedures and Chain of Command

Chemical spills and accidents affecting an intake should not catch a public water supplier unprepared. The water supplier should post the chain-of-command, notification, and response procedures and ensure that all water system employees are trained in the procedures. Procedures should be in place for the kinds of catastrophic spills that can reasonably be expected. If the protection area contains large holding tanks, for example, plan for just such a failure (Figure 5.2). If roads or railroads cross the protection area, anticipate tanker spills (Figure 5.3). Any facility in the protection area has the potential to burn. If it contains large amounts of chemicals, the source water could be contaminated, especially if the fire department applies large quantities of water to douse the fire, and there is no way to contain the water or channel it away from the source water body. The public water supplier should work with local

Figure 5.3 – Derailed tanker cars, Great Miami River
The 1986 CSX train derailment in Miamisburg released tanker contents directly into the Great Miami River.

emergency services to develop detailed, written procedures for handling spills and fires in the protection area, especially in the Emergency Management Zone (EMZ) where a swift and environmentally protective response is most critical.

All public water systems should have a solid relationship with the County Emergency Management Agency (EMA) and local police, to make sure the police and EMA know where a system's intake is located. In the event of an emergency, they will be better able to evaluate potential impact on the intake and to communicate their concerns to the water system.

Ohio EPA guidance on comprehensive contingency planning for public water systems is available in *Drinking Water Supply Emergency Plan - Volume 2 - Public Water Systems*. For systems serving less than 5,000 people, a contingency plan template is also available. Both of these documents are available on Ohio EPA's Web site at http://www.epa.ohio.gov/ddagw/security.aspx.

5.1.2 Early Warning Networks

For spills in the protection area outside the EMZ, an early warning network can be a major asset. When a release or bypass impacts a stream, network members warn their downstream partners, enabling them to activate the relevant sections of their contingency plans. At a minimum, downstream water suppliers will increase monitoring of the source water. Specialized treatment units may be ordered or brought out of storage. Tanks and reservoirs may be filled to capacity, in the event that the water supplier is obliged to shut off the intake while the plume passes by. Emergency back-up sources (such as stand-by wells) may be activated, or emergency connections with other water systems may be opened.

Currently, an effective early-warning system exists on the Ohio River. Managed by the Ohio River Valley Water Sanitation Commission (ORSANCO) (http://www.orsanco.org) it connects water users in all the states that border the Ohio River. Similar efforts could be made on other major Ohio inland rivers. While early warning systems typically focus on chemical spills, some water suppliers also would like to know when an upstream wastewater treatment plant activates a bypass. If the public water system's intake is downstream from a major urban center, an operator may want to know about any spills within the area drained by the storm sewer network. The direct involvement of public water system operators (or their designees) in creating the network will help ensure that it meets each public water system's needs.

An Important Note

For early warning networks to be most useful, a plant operator needs to be able to calculate the **time-of-travel** of a contaminant. Time-of-travel is the amount of time before the leading edge of the plume arrives at the water system intake from any given point in the watershed.

Time-of-travel curves generally are developed using data obtained through dye tests on the stream (Figure 5.4). The United States Geological Survey (USGS) (http://www.usgs.gov) has developed GIS-based software that also can provide projections based on data from USGS real-time on-stream monitoring points and the area of the upstream watershed.

As GIS becomes more widespread, methods for calculating time-of-travel will become more easily available and more sophisticated.

Protection team members who are interested in developing time-of-travel calculations for their watershed should contact the Source Water Protection Program at Ohio EPA's Central Office (refer to last page of this document for contact information).

Figure 5.4 - Walnut Creek dye test to determine contaminant transport flow rates.

5.2 DRINKING WATER SHORTAGE PLANNING

As with developing emergency response procedures, asking "What if?" helps a public water system develop its response if an intake or source is unavailable for a long time. The question "What if a drought caused the water level in the stream to fall below the level required to supply sufficient daily needs for the community?" leads to more specific questions:

- Is there a nearby back-up source available?
- Is a back-up well or wellfield an option?
- Should the system's storage capacity be increased?
- Where will the money come from?

Answering these questions helps a community plan for its future needs. A public water system needs to be prepared, not just for long-term water shortages but also for population growth and an increase in competing demands on the source of water.

Some factors increase the vulnerability of a surface water system to water shortages or loss of water source:

- Intake is located on a small water body (more vulnerable to drought, less capacity for dilution).
- Water body is located in a rapidly developing area (more vulnerable to being harnessed and depleted by competing users, and alternative sources may be under similar pressure; growing population may outstrip capacity).

A common short-term response to a total loss of drinking water supply is providing bottled water or water purchased from another community and brought by water trucks to a central distribution point.

The protection plan should provide details, such as indicating from whom the water would be purchased, how it would be transported, and how it would be distributed. Long-term measures may include tying into a neighboring community's water system, installing intakes on a different stream or in a different watershed, or developing a new wellfield so that ground water can supplement (or replace) the surface water.

A public water system should consider any options available to it and research and document the financial alternatives for funding them. A community needs to plan for such major expenditures, and may need to acquire options on or secure relatively undeveloped land many years in advance.

Chapter Six
Source Management

6.0 SOURCE MANAGEMENT

In this document, “source management” refers to protective activities that address specific sources of surface water contamination. They are the most direct and measurable type of protective strategies, sometimes involving new infrastructure or land uses, and often involving new practices. However, because they tend to involve change in the way things are currently done, they have more potential to meet resistance. Because they may involve encouraging landowners to make voluntarily changes, they can be the most time consuming to implement. Finally, because they may involve infrastructure improvements or land purchases, they tend to be more expensive to implement than contingency planning or education.

Evaluate Protective Strategies

Evaluate the threat and prioritize the contaminant sources

Evaluate protective strategy options and decide which to implement

- ☐ Education and Outreach
- ☐ Contingency Planning
- ☑ Source Management
- ☐ Monitoring

Write the plan

Management practices help restore impacted sources of drinking water and/or protect the water source from future quality impacts. Whether a management practice is considered restoration or preservation depends on the current condition of the water body and whether the practice is intended to be temporary or permanent. Restoration practices are designed to minimize the pollutants available, or inhibit their transport to a water body, or remediate pollutants before or after they enter the water body. Preservation focuses on identifying high quality water resources and protecting them from future degradation.

Management strategies that can be used to address point sources are often distinct from those that can be used to address nonpoint sources. Some strategies may be effective in addressing both types of sources. Management strategies for point and nonpoint sources are discussed in the following sections.

6.1 MANAGEMENT PRACTICES FOR POINT SOURCES

point sources are a drinking water concern mostly if they are located in the Emergency Management Zone (EMZ) or near the Corridor Management Zone (CMZ), and may be less of a concern elsewhere in the protection area due to dilution and assimilation of contaminants. They may impact water quality only when there is major accident that results in a release. As a result, current water quality impacts may not point to these facilities as a concern. In addition, many point sources are already regulated. For these reasons, point sources may receive less attention. However, the protection team should be concerned about any point sources located near the drinking water intake. The following strategies may be appropriate for point sources.

6.1.1 Prohibitions/Restrictions

For source water protection purposes, these prohibit or restrict specified activities or land uses within specified areas. For example, a community may agree to prohibit spreading manure, applying pesticides, or siting a tank farm or industrial park within the EMZ or a portion of the CMZ. A variation is to identify chemicals of concern and encourage the prohibition or restriction their use in areas that could impact water quality at the intake. Prohibitions and restrictions are usually achieved through zoning ordinances, but may also be implemented through the purchase of land or development rights, or by obtaining an easement, deed restriction, or restrictive covenant.

6.1.2 Voluntary chemical use reduction

Companies may agree to reduce the amounts of drinking water contaminants they handle. Providing incentives such as grants can be effective in initiating such efforts (Figure 6.1).

6.1.3 Design standards

Facilities can be required to meet certain environmental design standards, such as containment berms, overfill protection, leak detection systems, oil-water separators, or secondary containment systems. Many design standards are already required by existing state and local building codes or state and federal environmental regulations. For example, the Federal Oil Pollution Act requires many facilities to install and maintain secondary containment for above-ground storage tanks (Figure 6.2).

Figure 6.1 - Incentives
The City of Dayton's award-winning protection plan includes an innovative, incentive-based "Risk Point Buy Down" Program. Businesses may qualify for forgivable loans (conditional grants) if owners are willing to make a 97 percent reduction in their maximum daily inventory of regulated substances and sign a conservation easement agreeing to maintain this level. Businesses that implement measures to reduce the risk to ground water are eligible for zero percent interest loans, even if there is no decrease in their inventories of regulated substances. As of the spring of 2005, 17.3 million pounds of regulated substances have been reduced in the protection area. For more information, go to http://water.cityofdayton.org/Water/wellfield.asp.

6.1.4 Operating standards

Operators of public water supplies may be required to follow certain operating standards such as periodic inspection, testing and maintenance of equipment or storage tanks. A community may elect to pass local ordinances mandating such standards within the EMZ/CMZ.

6.1.5 Reporting requirements and documentation

Owner/operators may be required (by local ordinance) to report the types and quantities of chemicals used, stored and disposed on the property, and document source management efforts. Many activities and facilities are already subject to environmental regulations, and it may be enough simply to request copies of reports documenting a facility ongoing compliance record. Several Ohio cities, including the City of Lancaster, have such an ordinance.

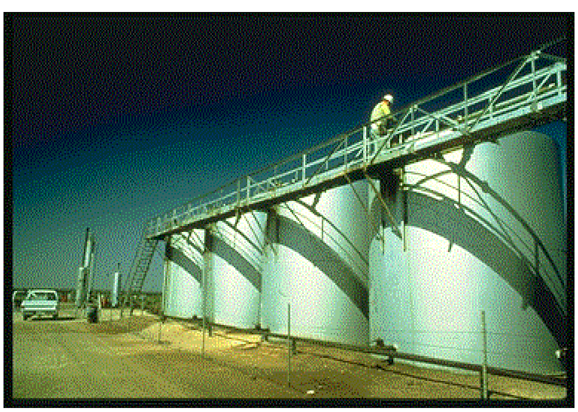


Figure 6.2 - Design standards
These above-ground storage tanks are surrounded by a dike to contain spills.

Point sources that are especially significant for surface water systems include **concentrated animal feeding operations (CAFOs)**, wastewater treatment plants, **combined sewer overflows (CSOs)**, sanitary sewer overflows (SSOs), and storm water systems. Most of these are already subject to some state regulations, as discussed in Appendix E of U.S. EPA's *Long Term 2 Enhanced Surface Water Treatment Rule Toolbox Guidance Manual* (Draft, June 2003), and summarized in the following paragraphs.

- **Concentrated Animal Feeding Operations.** Since 2003 federal laws have required large CAFOs to implement nutrient management plans that may include limiting manure land application rates, instituting buffer zones where manure is applied, and ensuring adequate manure and wastewater storage. The Ohio Department of Agriculture reviews nutrient management plans for compliance with standards. Many CAFOs also are regulated by Ohio EPA's Division of Surface Water, and are required to obtain a **NPDES permit** that sets wastewater discharge limits and requires implementation of a nutrient management plan. Public hearings can be requested as part of the permit renewal process (every five years). These hearings provide stakeholders with a regular opportunity to revise the permit, as needed, to better address specific water quality concerns.

- **Wastewater Treatment Plants.** Ohio EPA's Division of Surface Water regulates compliance based on sampling of effluent at the discharge pipe. All wastewater treatment plants are required to provide secondary treatment and most are required to disinfect effluent before discharging to a stream, but none of these measures is completely effective against *Cryptosporidium*. Wastewater treatment systems within 500 yards from a drinking water intake must provide treatment similar to that used for drinking water treatment. Public water systems should identify all wastewater treatment plants in their watersheds and determine what their permit effluent limits are, and whether the limits are being met. This information is available from Ohio EPA's Division of Surface Water.

- **Combined Sewer Overflows.** There are three major structural solutions to the problem of CSOs. The first is to separate combined sewers into sanitary sewer and storm sewer networks. However, since storm water will no longer be treated, this can actually lower the overall water quality in a stream. The second option is to increase the capacity of the wastewater treatment plant, and the third is to build retention basins for combined sewage during storm events. All of these options involve a major financial commitment from a municipality. See Appendix E, Case Study #2, for details on how the City of Toledo has addressed its CSOs and SSOs.

- **Sanitary Sewer Overflows.** SSOs typically are created by poorly designed or malfunctioning infrastructure (leaking or broken service lines, bad connections, hook-ups to roof drains that should have drained to storm water, etc.) SSOs can be reduced by cleaning and maintaining the sewer system, increasing holding capacity (in the service line network itself as well as the treatment plant), and constructing storage basins for excess wastewater.

- **Municipal Storm Water Systems.** NPDES permits and management plans may be required for municipal separate storm sewer systems (MS4s), certain industrial facilities, and construction sites. These compel the permitee to prevent pollutants (including untreated sewage and sediment) from being carried into surface water bodies by storm water. At construction sites, sediment is the main concern, and runoff may be controlled by such practices as land grading, diversion channels and dikes, and preserving natural vegetation. On a municipal scale, retention ponds are a common engineered solution to storm water pollution. However, temporary holding ponds may do little to remove contaminants, and infiltration ponds may become a ground water contamination concern, especially if ground water passing beneath the pond is being used for drinking water. Constructed wetlands are another possibility for reducing sediment, nutrients, and some toxics, as well as moderating floodwaters. However, in urban areas lack of undeveloped land may make this option difficult to implement. Less costly are educational efforts instructing residents to avoid pouring pollutants (such as used motor oil) into storm drains or culverts. More information on storm water management practices is available at http://www.epa.ohio.gov/dsw/storm/index.aspx.

6.2 MANAGEMENT PRACTICES FOR NONPOINT SOURCES

Releases from **nonpoint sources** may be constant or seasonal, and are usually spread over a large area. Nonpoint sources will likely be the main concern in areas that have been designated "critical areas" based on water quality impacts, and they may also be a concern within the EMZ/CMZ. Because nonpoint sources are typically widespread, a combination of management practices may be required and numerous landowners and organizations may be involved.

Management practices for nonpoint sources fall into two primary categories, overland transport management practices and stream integrity management practices. Overland transport management practices commonly used to address agricultural runoff include contour farming; grassy or forested "buffer strips" between tilled fields and streams; windbreaks; wetland creation or restoration (Figure 6.3); and reforestation. Stream integrity management practices include habitat restoration and hydro modification remediation practices. Other management practices address highways, chemical application to lawns, mineral extraction, sewage and wastewater, and storm water.

The most effective and widely recommended approach to managing nonpoint source pollutants is a combination of integrated practices, or **management practice system**. Protection of a stream segment in an agricultural area may involve integrated pesticide, nutrient, grazing, and animal waste management. A comprehensive list of nonpoint source management practices and measures was compiled by a multi-agency workgroup and is included in the *Ohio Nonpoint Source Management Plan* (http://wwwapp.epa.ohio.gov/dsw/nps/NPSMP/index.html). The protection team may find this Web site a good place to start reviewing potential management practices and electronic links are provided to documents that describe most of the management practices in more detail. The U.S. Natural Resources Conservation Service (formerly the U.S. Soil Conservation Service) developed many of these documents. The types of contaminants that are addressed by each management practice are indicated.

Figure 6.3
Bokes Creek Water Quality Enhancement Project
Powderlick Run Sub-Watershed

Powderlick Run
Before Project Completion

Powderlick Run
After Project Completion

The Bokes Creek project, initiated in 2003, restored 3,900 lineal feet of Powderlick Run from an agricultural petition ditch to a meandering natural channel flowing within an active floodplain with 10,200 newly planted seedlings and shrubs. Located in Union County, Powderlick Run is a 3.84-mile long tributary to Bokes Creek, which is a tributary of the Upper Scioto River-a significant source of raw drinking water for the City of Columbus.

Powderlick Run's impairments have had a significant impact on Bokes Creek. These impairments include low dissolved oxygen levels, siltation, and severe habitat degradation, as well as seasonally high levels of atrazine and nitrates and a history of fish kills associated with manure management problems by a concentrated animal feeding operation along Powderlick Run.

The diverse partnership formed to address these problems included DayLay egg farm, the City of Columbus, the Scioto River Federation, the Union County Soil and Water Conservation District and the Oxbow Stream Restoration. To finance the project, the group obtained a Clean Water Act 319 grant of $189,000 and funds from the Water Resources Restoration Sponsor Program.

Combined with a system of voluntary and regulatory actions within the watershed, the group anticipates restoring all of Powderlick Run to achieve measurable water quality impacts up to four miles downstream from the confluence of Powderlick Run and Bokes Creek. In the first year after restoration, nitrogen loads were reduced by 1,530 pounds per year and sediment loads were reduced by 760 tons per year.

6.2.1 *"Trading Spaces" Mitigation and Water Quality Credit Trading Programs*

In certain areas, the pressures to develop undeveloped land may prove insurmountable, or the costs to improve water quality may be too high. In such cases, local planners may promote protection or improvements in another part of the same watershed–preferably as close as possible to the original site--which can result in a similar water quality improvement or level of protection. If, in one area, a wetland will be drained and filled for construction, an equivalent wetland should be restored or enhanced in another area. This is called **mitigation**.

Ohio EPA is offering a Web-based tool, called the Mitigation Clearinghouse, to connect people required to restore surface waters with those who have an area available for creation, restoration or enhancement. A site may be listed if Ohio EPA has received sufficient information to post it, but use of the site as a given mitigation project is subject to review and approval by Ohio EPA's Division of Surface Water as part of a Section 401 Certification or Isolated Wetland Permit application. The Mitigation Clearinghouse is available at: http://www.epa.ohio.gov/dsw/swerp/index.aspx.

Similarly, water quality trading programs facilitate an overall improvement in surface water quality by enabling wastewater treatment plants to fund upstream nutrient-reducing programs in place of marginal (but costly) treatment upgrades at the plant itself (Figure 6.4).

Mitigation and water quality trading programs are usually beneficial for all sources of drinking water. Depending on where the "traded sites" are located, it would be appropriate for a drinking water protection-planning group to participate as a stakeholder in a trading program. If a wastewater treatment outfall is located within the CMZ of a public water system intake and the mitigation sites are many miles beyond the CMZ, that public water system may be more concerned about impacts from the wastewater treatment plant.

Figure 6.4 - Water Quality Trading Program in Southwest Ohio

In 2006, a Water Quality Credit Trading Program was launched in the Great Miami River Watershed. Soil and water conservation district staff, working with local farmers who agree to change voluntarily their farming practices, draw up projects that will reduce phosphorus and nitrogen runoff. Participating wastewater plants provide funding for the projects to generate "credits" that they can use to meet regulatory requirements.

Wastewater treatment plants operated by Butler County and six cities along the Miami River provided more than $1 million for agricultural projects during the program's first three years. The Miami Conservancy District (MCD) manages the credits generated and allocates them to the participating wastewater plants. MCD also monitors water quality to measure the program's success, and analyzes costs and benefits. It is estimated that this program will save participating communities $300 million over the next 20 years, while significantly improving water quality in the Great Miami River.

–*the Deed*, 2006, Miami Conservancy District Annual Report to the Miami Valley.

6.3 SELECTING MANAGEMENT PRACTICES AND MEASURES

When considering a management measure, the protection team should address questions such as:

- Does it address the major pollutant of concern?
- Does it target the primary source of the pollutant runoff?
- How effective is it in reducing pollutant load?
- Can it apply to several contaminant sources or just one?
- Can it be used for both point and nonpoint sources?
- Is it compatible with existing laws, regulations, ordinances, or programs?
- Is it practical for local environmental conditions, such as climate, soils, or geology?
- Are staffing and expertise available from existing resources?
- Are other local groups engaged in similar efforts?
- Do other initiatives complement or enhance the strategy?
- Is cost a factor in implementing this strategy?
- If so, are funding sources available to cover these costs?
- Is there community/stakeholder support for the strategy?
- Are landowners willing to implement and maintain the practices?

6.3.1 Long Term-2 Enhanced Surface Water Treatment Rule

If the water system(s) plan to obtain credit for drinking water protection efforts available through the Long Term 2 Enhanced Surface Water Treatment Rule, then the protection plan needs to clearly address the relative effectiveness of the protection strategies at reducing *Cryptosporidium* and other pathogens in the source water, along with the sustainability of each measure (40 CFR 141.725(a)(3)(ii)).

Protection strategies may include:

1. the elimination, reduction, or treatment of wastewater or storm water discharges,
2. treatment of *Cryptosporidium* contamination at the sites of the waste generation or storage,
3. prevention of *Cryptosporidium* migration from sources, or
4. any other measures that are effective, sustainable, and likely to reduce *Cryptosporidium* contamination of source water.

   If the water system does not own or otherwise have authority over the *Cryptosporidium* sources in the watershed, it may need to develop and maintain partnerships with landowners within the watersheds. These could include other municipal governments, farmers, wastewater treatment plant operators, regional planning agencies, and others. Further detail is available at: http://www.epa.gov/safewater/disinfection/lt2/

6.3.2 Evaluating the Effectiveness of Management Measures

From a technical standpoint, determining the effectiveness of a given management measure may be the most difficult part of the selection process. Several contaminant load reduction estimation tools are available from the Ohio Department of Natural Resources, Division of Soil and Water Conservation. These tools will estimate the benefit from implementing various urban and agricultural best management practices. The tools can be downloaded from: http://www.dnr.state.oh.us/H_Nav2/ProgramsProjects/AGPollutionAbatementProgram/tabid/8856/Default.aspx.

U.S.EPA's Spreadsheet Tool for Estimating Pollutant Load (STEPL) employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). STEPL provides a user-friendly interface to create a customized spreadsheet-based model in Microsoft (MS) Excel. It computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. STEPL and additional information is available at http://bering.tetratech-ffx.com/stepl/.

WATERSHEDSS (Water, Soil, and Hydro- Environmental Decision Support System) is a software-based decision-making tool designed to help identify water quality problems and select appropriate management practices. It has three components: The watershed assessment and evaluation, which includes a pollutant budget spreadsheet (estimates pollutant loads) and an agricultural best management practice (BMP) database (with information on effectiveness); an educational component, containing detailed information and references on pollutants and sources; and an annotated bibliography.

More information is available on the WATERSHEDSS Web site: http://www.water.ncsu.edu/watershedss/.

Research on the effectiveness of management practices is ongoing. The Conservation Effects Assessment Program is a recent program that may help organizations better understand what practices are most effective. Information on this program is available at: http://www.nrcs.usda.gov/technical/nri/ceap/ . For more information about the effectiveness of some agricultural management practices, go to the Ohio State University's Ohioline Web site: http://ohioline.osu.edu/aex-fact/0464.html .

Conflicting Management Measures

When a combination of management measures is being considered, it is important to consider the potential for conflicts. A protection team that is affiliated with a watershed group may find that the larger watershed group is interested in implementing a strategy that improves wildlife habitat but may have no impact or a neutral impact on drinking water quality. For example, no-till farming can reduce erosion but this typically requires more vigorous pest management, which farmers often address by increasing pesticide application. Drainage tiles may prevent overland runoff by increasing infiltration at the expense of channeling drainage to the ditches where the tiles discharge. In general, drain tiles and storm sewers can be easily overlooked as networks for channeling contaminants from distant areas to streams (Figure 6.5).

Figure 6.5 - Drainage Tiles
Some years ago, a surface water-based public water system in northwest Ohio detected components of petroleum in the water entering the water treatment plant. A nearby oil line was checked for leaks, but none was found. Finally, investigators learned of a tanker accident on a highway miles away. They finally concluded that petroleum from the spill had entered agricultural drainage tiles beneath the tilled soil at the spill site, and had then been transported to ditches that emptied into the city's drinking water reservoir.

6.4 IMPLEMENTATION STRATEGIES

The most direct way to ensure that protective strategies are implemented is to own or control the land to be protected. Where this is impossible, there are two basic approaches to compel others to protect the surface water: regulation or persuasion. These approaches are discussed in more detail below.

6.4.1 Land Acquisition Approach

Acquisition of critical areas by the utility or its affiliated jurisdiction is often the most effective approach to protecting the water source. Several organizations exist that can help systems purchase watershed land to protect drinking water quality, especially when government agencies are unable to move quickly enough to buy land when it becomes available. The Trust for Public Land (http://www.tpl.org) and small local land trusts and conservancies can facilitate the land acquisition process. Trusts can buy and hold land from multiple landowners on behalf of a water system until the system can assemble funding to purchase it from the trust. Trusts may also maintain land ownership themselves. The Trust for Public Land also can assist with development of financing strategies for land purchases.

Trusts also can work with landowners to buy or have landowners donate conservation easements. An easement is a legal document that permanently limits the development of a piece of land, even after the land is sold or otherwise changes ownership. The landowner selling or donating the easement specifies the development restrictions to apply to the land. Other government agencies, such as the U.S. Forest Service or the Ohio Department of Natural Resources may also be able to buy parcels in a watershed. Easements donated to government agencies or to land trusts may be eligible for tax deductions. See http://www.landtrustalliance.org/policy/taxincentives/how-to-use/guidance for frequently asked questions about easements. The Land Trust Alliance (http://www.lta.org), a trade organization for land trusts, has published handbooks on designing and managing conservation easement programs. Another good source of information is the Nature Conservancy (http://www.nature.org).

6.4.2 Deed Restrictions

A standard method of ensuring that a parcel of land continues to be used as a former owner intended is to insert a restriction into the deed. However, deed restrictions are based on common law and may not be upheld in court if there is a dispute. The owner who inserted the restriction is responsible for making sure it is upheld. It is also possible to have the responsibility assigned to an institution.

6.4.3 Regulatory Approach

For systems in watersheds where most of the land is privately owned, land use regulations may be the surest way to control pollution, especially in heavily developed or growing areas. Where watersheds cross multiple jurisdictions, public water systems should consider signing memoranda of agreement or understanding with other entities in the watershed, in which each entity agrees to meet certain standards or implement certain practices. In Ohio, municipalities and townships can enact their own zoning ordinances, and the standards and practices agreed to can be codified as a local ordinance, as was done by the Hamilton-New Baltimore Consortium in southwestern Ohio (described in Appendix E, Case Study #1).

Ordinances typically apply within an area defined clearly within the ordinance, called an “overlay district”. For surface water protection, the overlay district might be that portion of the CMZ that lies within the jurisdiction of the city or township, or it might be an identified critical area. Within the overlay district, all existing zoning and land use regulations apply, as well as the conditions specified by the new ordinance. Some ordinance types include:

- **Large-lot or low-density zoning**. Large-lot zoning may be inefficient, as it increases costs for sewer, water, and road development, and it may work against affordable housing requirements. However, it may be useful in agricultural areas for preserving rural character and preventing subdivision of farms.

- **Special permits**. Ordinances may specify limits on certain types of land use except by special permit. Such ordinances should specify criteria for granting special permits and designate an authority that may grant permits. The permit follows the lot, and not the lot's owner.

- **Impact fees**. In Ohio, impact fees typically are fees assessed against developers (and usually passed on to homebuyers) for the local government's projected expenses for maintaining the development's infrastructure (roads, sanitary and storm sewers, water lines, and sometimes parks, community centers, etc.). Impact fees also can be used to pay for mitigation of pollution caused by development, e.g., for preventing runoff or buying land elsewhere in the watershed.

- **Impact studies**. Ordinances may require the submission and approval of a watershed protection plan or impact study as a condition for development.

- **Performance standards**. A performance standard permits development but limits impact of the development. For example, a regulation could specify that permits require that the pollutant-loading rate of a development be no more than a certain percentage of the pre-development loading rate.

Most zoning ordinances have "grandfather clauses" that allow a nonconforming land use to continue until it has been out of business for a specified amount of time. As a result, a new overlay ordinance in a highly developed area (with numerous grandfathered sites) may take a long time to become effective. Most ordinances also specify conditions for a variance.

Land-use ordinances must be constructed to withstand a takings lawsuit (AWWA 1999). The Fifth Amendment to the U.S. Constitution states that private property may not be taken for public use without just compensation. Even where no land has literally changed hands, an ordinance may be viewed as a taking if it "fails to advance a legitimate government interest" or "denies a landowner economically viable use of his land". The first criterion means that there should be a need for the ordinance, and it is the government's responsibility to meet it (for example, public health or safety). Under the second criterion, if the ordinance causes property values to decrease but still retain some value, the ordinance does not result in a taking; however, a regulation that caused property values to plummet could be ruled a taking.

To prevent takings claims, the proponents must explain the need for the regulation and a connection between the ordinance and the expected result (AWWA 1999). The area to be protected should be mapped and the scientific basis for the boundary delineation should be presented. The current pollutant load for the area and the projected pollutant load should be compared. Thus, if an area is currently pristine, the comparison will demonstrate the water quality deterioration that will occur unless the ordinance is enacted. If an area is currently impacted, the comparison will demonstrate the water quality improvements that should occur if the ordinance is enacted.

Finally, it is important to remember that any ordinance is only as effective as its enforcement, and provisions must be made in the ordinance for reliable and accountable oversight.

6.4.4 Voluntary Approach

Protective strategies advanced by voluntary compliance are attractive because this method is least divisive, but it requires constant attention and educational campaigns. It may be easier to initiate a voluntary source water protection program, but harder to keep it going.

Persuading landowners and the general public to support protective strategies is largely a matter of continuous education. Stories about what has happened to other communities who failed to protect their water sources can be very effective (some examples are highlighted in Appendix C "Benefits and Costs of Source Water Protection").

For landowners, incentives can be very effective. The Natural Resources Conservation Service administers numerous programs that pay landowners to preserve portions of their land in a less-developed state for a contracted number of years; these programs are discussed in detail in Section 6.5 below. Working with a partnership of stakeholders, the City of Columbus has successfully promoted several of these programs within its Big Walnut Creek Watershed and Scioto River Watershed, as described in Appendix E, Case Studies #3 and #4.

6.4.5 Ensuring Local Support for Implementation

However protective strategies are implemented, efforts need to be made to educate local stakeholders on the benefits of restoring and preserving the watershed and water quality, to gain their support. This is best achieved by involving local stakeholders in the drinking water protection planning process. Additional outreach and educational events may be needed to help gain local support. One or two prominent members of the community supporting the restoration and protection efforts may go a long way in convincing other residents of the project benefits. In some cases, implementation of management practices can be required through state laws, or a local ordinance. In these instances, care should be taken to involve affected parties in any planning and implementation meetings. Information about the benefits of the project should be distributed. Local concerns regarding implementation projects should be acknowledged, respected, and incorporated as much as possible. These actions will help to minimize and may even avoid local resentment of the projects.

6.5 FUNDING SOURCES FOR SOURCE MANAGEMENT IMPLEMENTATION

6.5.1 Watershed Planning and Restoration Grants (319 Grants)

The 1987 Amendments to the Clean Water Act (CWA) established the section 319 Nonpoint Source Management Program, which supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, implementation projects, and monitoring. Each year Ohio EPA announces a request for grant proposals for watershed planning and restoration activities in Ohio. Grants range from $20,000 to $500,000, depending on the size and scope of the project. More information about the 319 grant program is available on the following Ohio EPA Web site: http://www.epa.ohio.gov/dsw/nps/319Program.aspx.

More information about the following programs is available online at http://wwwapp.epa.ohio.gov/dsw/nps/NPSMP/FUND/Fundjumppage.html.

6.5.2 Water Resource Restoration Sponsor Program (Low-interest Loans)

The Water Resource Restoration Sponsor Program (WRRSP) provides funds to implement projects that will protect or restore surface water quality and aquatic habitat. Applicants to the Water Pollution Control Loan Fund for a direct loan can apply to carry out their own WRRSP project, or to sponsor a WRRSP project to be implemented by another organization. WRRSP implementers may include political subdivisions, park districts, and not-for-profit organizations. Eligible projects include restoration activities such as stream bank stabilization and riparian re-vegetation, or protection activities such as the purchase of land or easements for permanent conservation. For more information, call (614) 644-2798, or refer to the most recent WPCLF Program Management Plan at: http://www.epa.ohio.gov/defa/wpclf_new.aspx.

6.5.3 Funding for Agricultural Best Management Practices

The Farm Security and Rural Investment Act of 2002 (Farm Bill) provides funding for conservation and environmental improvements on agricultural lands. The conservation provisions, developed by the Natural Resources Conservation Service (NRCS), will assist farmers in meeting environmental challenges on their land. The Farm Service Agency (FSA) administers the following Farm Bill-funded programs,

6.5.4 Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that promotes agricultural production and environmental quality as compatible national goals. Through EQIP, farmers and ranchers may receive financial and technical help to install or implement structural and management conservation practices on eligible agricultural land.

6.5.5 Conservation Security Program

The Conservation Security Program is a voluntary program that provides financial and technical assistance for the conservation, protection, and improvement of soil, water, and related resources on Tribal and private lands. The program provides payments for producers who historically have practiced good stewardship on their agricultural lands, and incentives for those who want to do more.

6.5.6 Resource Conservation and Development Program

The Resource Conservation and Development Program (RC&D) encourages and improves the capability of civic leaders in designated RC&D areas to plan and carry out projects for resource conservation and community development. Program objectives focus on “quality of life” improvements achieved through natural resources conservation and community development. Such activities lead to sustainable communities, prudent land use, and the sound management and conservation of natural resources.

6.5.7 Wetlands Reserve Program

The Wetlands Reserve Program is a voluntary program that provides technical and financial assistance to eligible landowners to address wetland, wildlife habitat, soil, water, and related natural resource concerns on private land in an environmentally beneficial and cost effective manner. The program provides an opportunity for landowners to receive financial incentives to enhance wetlands in exchange for retiring marginal land from agriculture.

6.5.8 Conservation Reserve Enhancement Program (CREP)

The Conservation Reserve Enhancement Program (CREP) is a voluntary conservation program for agricultural landowners. Farmers can receive annual rental payments and cost-share assistance to establish long-term, agricultural best management practices on eligible land. In Ohio, CREP funds in Ohio are available for the Scioto and Big Walnut Creek Watersheds and select Western Lake Erie watersheds (Figure 6.6). More information on the CREPs is available on the following Web site: http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=cep.

6.5.9 Other Farm Bill Programs

Other Farm Bill programs include the Farmland Protection Program, which may be of interest in rapidly urbanizing watersheds, the Wildlife Habitat Incentive Program, and the National Natural Resources Conservation Foundation, which helps promote research and education on conservation efforts.

More information about these and other conservation programs can be obtained from any local USDA Service Center, listed in the telephone book under U.S. Department of Agriculture, or the local conservation district. A contact list of Ohio staff is also available on the following Web site: http://www.oh.nrcs.usda.gov/contact/directory/directories.html .

Information on Farm Bill programs is available online at: http://www.nrcs.usda.gov/programs/farmbill/2002.

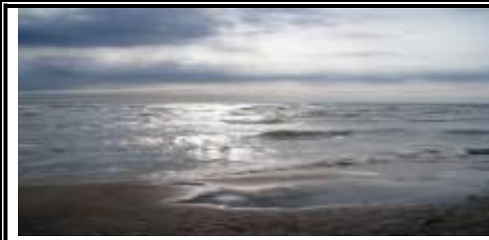


Figure 6.6 - The Lake Erie CREP

The Ohio Lake Erie CREP is designed to:

- reduce the amount of sediment entering Western Lake Erie by over 2,325,000 metric tons over the next 20 years;
- significantly reduce the amount of nutrients and pesticides that enter Western Lake Erie and its tributaries;
- protect over 5,000 linear miles of streams from sedimentation; and
- improve wildlife habitat in the project.

Similar goals are being developed for the Scioto and Big Walnut CREPs.

Links to these projects are found at http://wwwapp.epa.ohio.gov/dsw/nps/NPSMP/FUND/fundusda.html

Chapter Seven
Source Water Monitoring

7.0 SOURCE WATER MONITORING

Evaluate Protective Strategies

Evaluate the threat and prioritize the contaminant sources

Evaluate protective strategy options and decide which to implement

- ❑ Education and Outreach
- ❑ Contingency Planning
- ❑ Source Management
- ☑ Monitoring

Write the plan

Unlike other "protective strategies", monitoring the quality of a surface water source does not help prevent contamination. However, it may provide information that leads to other strategies or help focus resources on critical subwatersheds. The primary functions of monitoring are:

- **Early warning**. Well-chosen locations for surface water sampling can provide early warning of contaminants from specific sources. Chemical analysis can be tailored to the chemicals used at a specific potential contaminant source. If contaminants are detected, actions can be taken before the public water supply is affected.

- **Identify critical subwatersheds**. A water system may have elevated nitrates or other contaminants in its treated water, but it may not know where in the watershed the nitrates are coming from. Sampling subwatersheds upstream of the intake may reveal certain areas with higher nitrate loads to the stream. Knowing which subwatersheds are the primary source of the water system's nitrate problems will help focus protection strategies in these critical areas.

- **Tracking water quality trends**. Where nonpoint sources pose a threat, monitoring may warn of general trends in contaminant levels. If water quality changes are detected, corrective actions and measures that are more effective can be implemented and treatment protocols can be optimized.

- **Evaluating the effectiveness of selected protective practices**. Monitoring helps track the effectiveness of specific protective strategies.

- **Obtaining information to compel protective actions**. Most organizations with the resources and legal jurisdiction to address a source of contamination need solid proof that contamination is occurring before they can initiate action.

Not all public water systems need to develop a monitoring plan. The required compliance sampling and data collected by Ohio EPA and other organizations may be sufficient information to target critical areas and develop a protection plan. The need for additional monitoring depends on past water quality problems, the presence of significant potential contaminant sources, and the strategies selected to protect the drinking water source. It is up to the protection team to provide the rationale for why they believe additional monitoring and a monitoring plan is or is not necessary.

7.1 EVALUATING EXISTING SOURCES OF WATER QUALITY DATA

Before a monitoring plan is developed, the water system should evaluate existing sources of water quality data. The sampling conducted by Ohio EPA, watershed groups, and universities may provide all the necessary data or reduce the number of sampling locations. The water system can also use existing data to target areas for more intensive sampling. For example, samples collected near the mouths of tributaries may identify subwatersheds that have elevated contaminant concentrations. Future sampling efforts could target locations within these subwatersheds. If the local watershed group is collecting samples, the public water system may want to consider helping to share in the cost of sampling analysis. Be sure to review the sources of water quality data and information discussed in Section 3.1 prior to developing a monitoring plan.

7.2 DEVELOPING A MONITORING PLAN

If, after evaluating existing data, the protection team decides that it needs to create an additional monitoring program of its own, it may be helpful to follow some of the guidelines in U.S. EPA's document *Volunteer Stream Monitoring: A Methods Manual*. This document is available online at http://www.epa.gov/owow/monitoring/volunteer/stream/.

Figure 7.1 - Water quality monitoring.

U.S. EPA's guidance was not developed specifically for drinking water protection concerns, so some of the chapters may not apply. For example, Chapters 1 through 4 discuss elements of a stream study, watershed survey methods, and macro-invertebrates and habitat. Your Source Water Assessment report already contains much of the information that is recommended in the watershed survey methods chapter, and macroinvertebrates and habitat are generally not a drinking water quality concern. However, if sediment load and turbidity are a concern the chapter on habitat surveys may be useful to help assess areas of the watershed that are contributing to the stream's sediment load. In addition, the information on safety considerations and basic equipment that is included in Chapter 2 may be helpful for staff or volunteers that will be collecting water samples.

Chapter 5 of the U.S. EPA Guidance, Water Quality Conditions, contains very useful information on setting up a sampling program for nitrates, turbidity, and fecal bacteria, although it does not describe how to sample for pesticides or volatile organic compounds (VOC) (which may be a concern if there is a chemical spill or industrial sites). VOC sampling guidelines are available in the U.S.G.S. report, Field Guide for Collecting Samples for Analysis of Volatile Organic Compounds in Stream Water (Report 94-455), which is available on the following Web site: http://water.usgs.gov/nawqa/pnsp/pubs/ofr97-401/voc.html.

When collecting samples for nitrates and pesticides, timing should also be considered. This is especially true for pesticides, since sampling is relatively expensive and samples usually are not collected frequently. Efforts should be made to try to time the collection of pesticide data during agricultural application of pesticides, especially after a rain event. This will help demonstrate if buffers and other agricultural best management practices are effectively reducing the amounts of pesticides that enter the stream.

Figure 7.2 - Labeling stream samples taken for lab analysis.

Chapter 6 of the U.S. EPA Guidance, Managing and Presenting Data, describes how to organize your data for effective public dissemination. Water systems are not required to share the data they collect, but it is encouraged to help build support for water quality restoration and protection strategies.

Overall, a monitoring plan for drinking water source protection should answer the following questions:

1. What do you hope to find out by monitoring?
2. What parameters/conditions/contaminant sources will be monitored?
3. Where are the monitoring sites? (Show them on a map that also shows location of the public water supply intake(s) and the source water protection area)
4. Why were these locations selected for a monitoring site? (e.g., proximity to contaminant source, evidence of impacted water quality from previous sampling, access to stream, etc.)
5. When will monitoring occur? At what frequency?
6. What methods will be used for sampling?
7. Who will use the data?
8. How will they use the data? (e.g., as indicators, for adjusting water treatment, for regulatory purposes, etc.)
9. How good does the data need to be?
10. How will you assure that data are credible (see section 7.3)?
11. How will data be managed and presented?

Finally, a major factor in the design of any program is available resources. Limited staff and funding may limit the size and scope of the monitoring program. This is why partnering with other organizations that are interested in collecting water quality data is so important.

7.3 DATA QUALITY

If a protection team decides to set up a monitoring program, it will need to think very carefully about the data quality it hopes to achieve. Better quality data involves higher costs but may be necessary if the team hopes to use it for certain purposes, such as litigation. Similarly, if the protection team decides to seek existing monitoring data from other organizations (such as local watershed groups), the quality of the data should be a primary consideration. At a minimum, the monitoring plan should discuss the quality assurance procedures that will be used during data collection.

The phrase “quality assurance and quality control (QA/QC)” is commonly used but often misunder-stood. Quality assurance is the broad plan for maintaining quality in all aspects of a monitoring program. It guides the selection of parameters and methods, how data will be managed, analyzed and reported, and what steps will be used to determine validity of the selected procedures. Quality control procedures are the mechanisms established to reduce errors and make analyses more accurate and precise. Quality control procedures help discover a problem quickly, allowing timely action to be taken to remedy problems. A final term, quality assessment, refers to the process by which data is reviewed after it is collected. Quality assessment provides verification that sampling and analytical processes operated within analytical or operational limits and that enough data were collected to permit reasonable data interpretation. Quality assurance, control, and assessment procedures all help ensure that data collected through the monitoring program is reliable.

7.3.1 Federal Requirements

If sampling activities are funded through federal grants, such as the Clean Water Act Section 319 grant program, the group conducting the sampling may be required to develop a Quality Assurance Project Plan (QAPP). U.S. EPA's Volunteer Monitor's Guide to Quality Assurance Project Plans outlines the QAPP requirements. The document is available online at http://www.epa.gov/volunteer/qappcovr.htm .

7.3.2 State Guidelines

In 2003 the State of Ohio adopted House Bill 43 (Ohio Revised Code 6111.50 to 6111.56) creating the Ohio Credible Data Program. The law requires Ohio EPA to develop and administer a new surface water quality-monitoring program for three levels of credible data. As of December 2005, Ohio EPA is in the process of adopting rules that define the criteria for the three levels. The criteria for each level will include the training and experience necessary to submit credible data, requirements for sample collection, analytical methods, data assessment and quality assurance/quality control procedures. The statute and the rules do not address ground water or finished drinking water. Participation in the program is voluntary. Individuals or organizations interested in submitting surface water quality data under the program must apply and meet the requirements for their intended level of data to become Qualified Data Collectors (QDC). Other individuals may collect samples under the supervision of a QDC.

The three levels of credible data are based upon the purposes the data will be used. Level 3 data utilizes the most stringent methods and procedures as the data is intended for regulatory program purposes. Level 1 data is the least stringent. The three levels are defined below.

- Level 3 data will be used to address specific regulatory issues, setting use designations, developing statewide water quality inventories, or establishing a total maximum daily load (TMDL) for water bodies.

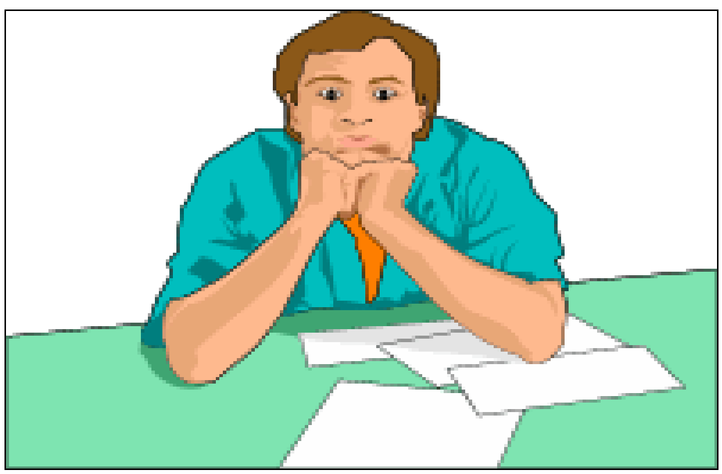
- Level 2 data can be used to evaluate the effectiveness of pollution controls or to conduct initial screening of water quality conditions.

- Level 1 data will be used to promote public awareness and education about surface waters of the state.

More information about these rules can be obtained from the Division of Surface Water's Web site: http://www.epa.ohio.gov/dsw/rules/index.aspx.

It is up to the water system to decide what level of data it needs. That decision should be based on the future intended uses for the data and any federal grant requirements.

Chapter Eight
Writing the Plan



8.0 WRITING THE PLAN

Writing the Plan

Evaluate the threat and prioritize the contaminant sources

Evaluate protective strategy options and decide which to implement

Write the plan

The best way to ensure that protective strategies are carried out is to prepare a written drinking water source protection plan (also referred to as a protection plan). This provides an opportunity to capture the decisions of the protection team. This plan documents what will be done, why those activities were selected, who will be responsible for which strategy, and when each strategy will be implemented. The plan should explain how the public water system will focus its efforts on the protection area, and how the various strategies proposed will work together to reduce the risk of contamination. Since public water system staff and community leadership changes over time, preparing a formal protection plan—either stand-alone or incorporated into a Watershed Action Plan-will help provide continuity in succeeding years.

8.1 CONTENTS OF THE PLAN

Information that should be included in a drinking water source protection plan for inland surface water systems is summarized as a checklist in Appendix A of this document. Main headings include:

- Executive Summary
- Introduction
- Identification of Critical Areas
- Identification of Potential Contaminant Sources
- Prioritization of Contaminant Sources
- Strategies for Protecting Source Water from Prioritized Sources/Known Contaminants
- Educational Strategies
- Contingency Planning
- Source Water Monitoring
- Implementation

It may not be necessary for the Protection Team to have completed every bulleted item on the Appendix A checklist, but the writers should note items that were not completed and explain why. There may be very legitimate reasons for passing over certain items, but in most cases Ohio EPA reviewers will not know about them unless they are addressed in the document.

As noted in Appendix A, maps and text provided by Ohio EPA in the original SWAP report may be used, but they should be carefully reviewed by the Protection Team for accuracy, and any errors or changes should be noted on them. Ohio EPA does not plan to routinely edit or update SWAP reports, but Ohio EPA District staff may be able to provide local Protection Team members with the shapefiles so that any organization with the appropriate GIS software and training could update the maps themselves.

Because watershed groups consist primarily of volunteers, they may go through cycles of greater and lesser activity. If a public water system's protection plan is incorporated into a WAP, the system must consider and address within the WAP or within a separate letter how drinking water source protection will continue even if the watershed action group is not active.

8.1.1 Evaluating Effectiveness

Probably the most direct indicator of program effectiveness is a measurable improvement in source water quality measured over several years. Because surface water quality fluctuates significantly according to weather, season, and other factors, the case will be more compelling where there is a large amount of sampling data obtained throughout the year. Many systems detect seasonally higher levels of nitrate, which is a human health concern and very difficult to treat. A decrease in seasonal nitrate spikes over several years following implementation of strategies to control nitrate runoff within the upper watershed would be a powerful indicator of program effectiveness. Another good indicator would be a reduction in THMs in finished water after implementing measures upstream to control turbidity.

Treatment costs may provide another indicator. Some public water system operators are obliged to use costly charcoal filters and other special treatment techniques to treat for contaminants such as algae byproducts and pesticides. A reduction in the amount of treatment required each year after implementing strategies to control such contaminants would also be a good indicator of program effectiveness.

Success of the contingency plan can be demonstrated when new procedures put into place for source water protection prevent a major spill or release. Success of the educational efforts can be demonstrated when such efforts enable a local citizen to recognize a situation that poses an eminent threat to the source water, and to call the authorities. Some communities measure effectiveness of educational strategies by providing classes on source water protection that begin with a pre-test and end with a second test. The results of the two tests are then compared.

The “success” of any prevention program is not easy to prove. This is especially true where it appears that a community was never significantly threatened to begin with. On the other hand, the “failure” of a prevention program can be claimed whenever an accident occurs, in spite of everyone’s best efforts. Similarly, benefits are always more difficult to quantify than costs. The benefits of source water protection are often measured in terms of the costs of a spill not prevented (see Appendix C). A community could also take this approach in its discussion of program effectiveness. Despite the difficulties this subject frequently poses, all drinking water protection plans should address how the effectiveness of the drinking water protection plan will be evaluated.

8.2 SUBMITTING THE PLAN FOR ENDORSEMENT

For endorsement, two copies of the protection plan should be submitted to the Ohio EPA Central Office, Division of Drinking and Ground Waters. Staff in the Division of Drinking and Ground Waters and Division of Surface Water will review the plan. If the plan generally meets the Appendix A checklist criteria, it will be endorsed and a formal endorsement letter will be sent to the public water supplier, usually with some suggestions for improving the plan. If not, a letter will be sent explaining why the plan was not endorsed and what is needed to make it endorsable.

For systems that are incorporating elements of source water protection into an existing Watershed Action Plan (WAP), the structure of the WAP will likely dictate the order in which various elements are addressed. To assist Ohio EPA reviewers, it would be helpful to indicate which portions of the WAP target drinking water concerns (for example, tab relevant pages, or send a list of which pages are pertinent). This will help to expedite review of the plan and is greatly appreciated.

All drinking water source protection plans, whether stand-alone or incorporated into a WAP, must be accompanied by a letter from the public water system officials (or the company/city/county that owns the water system), stating that this document represents the public water system's drinking water source protection plan, and the public water system and its partners intend to implement this plan. Ohio EPA will not review any document sent by a third party (such as a consultant or even a watershed group) unless it is accompanied by such a letter.

8.3 UPDATING THE PLAN

Over time, conditions and land uses in the protection area will change and new water quality impacts may occur. Agricultural or wooded land may become residential or industrial. Some potential contaminant sources will disappear, but new potential contaminant sources will be introduced. Existing businesses can change their operations, eliminating their potential contaminants from the protection area and new developments may increase storm water or wastewater concerns. As these changes occur, changes may need to be made to the protection plan.

Any significant change in water quality that persists over time should trigger a review of the protection plan. The team will need to determine what land use changes or activities have caused the change in water quality and select new protective strategies to address it. In addition, it may be beneficial to periodically revisit the plan to gauge effectiveness of education and preventive strategies even if the water quality has not changed. As a rule of thumb, Ohio EPA recommends reviewing the drinking water source protection plan every five to ten years

8.4 FUNDING SOURCES AND FUNDING INFORMATION

U.S. EPA's Catalog of Federal Funding Sources for Watershed Protection:
http://cfpub.epa.gov/fedfund/

A State and Local Government Guide to Environmental Program Funding Alternatives:
http://www.epa.gov/owow/nps/MMGI/funding.html

River Network's list of watershed restoration funding sources:
http://www.rivernetwork.org/library/index.cfm?doc_id=114

Appendix A
Drinking Water Source Protection Plan Checklist

The following checklist is designed to help public water systems address all items needed for Ohio EPA endorsement of a drinking water source protection plan. For planners drafting a stand-alone plan, this checklist may serve as an outline for your plan.

For planners who are adding source water protection components to a watershed action plan (WAP), the structure of the WAP may dictate the order in which various components are addressed. If source water protection elements are integrated seamlessly into the text, please help Ohio EPA reviewers by noting the areas where each of the following items is addressed.

Executive Summary

- ❑ Describe main impetus for developing a Protection Plan, and implementation goals (i.e., what drinking water concerns do you hope to address with source water protection?)
- ❑ Describe how the Plan was developed
- ❑ List agencies and groups involved in developing the plan (a full list, including individuals' names and contact information, may be included in an appendix)
- ❑ Describe main elements of Plan

Introduction

The introduction and maps provided in your SWAP report may be used. If you use this information, please check to make sure it is still accurate and feel free to add information.

- ❑ Describe community location, service area, and population
- ❑ Describe treatment system and capacity
- ❑ Provide map of source water protection area

Identification of Critical Areas – see Section 3.2

NOTE: For systems drawing water from an inland waterway or reservoir, the Emergency Management Zone (EMZ) and portions or all of the CMZ should be considered a critical area due to proximity to the intake.

- ❑ If you decide to delineate additional critical areas, describe them* and why they are critical (e.g., proximity to intake, water quality results, historical spills or releases from contaminant sources, land use, high development pressure, etc)
- ❑ If you decide to delineate additional critical areas, include a map of critical areas (maps provided in SWAP report may be used as a base map, if applicable and accurate)
- ❑ Include in text or an appendix water sampling analyses or other data used to identify critical areas.

Identification of Potential Contaminant Sources – see Section 3.3

Critical areas should be reviewed by your team to determine whether they include any potential contaminant sources that were not identified in the SWAP report.

- ❑ If additional contaminant sources were located, indicate their locations on a map (again, maps from the SWAP report may be used, if applicable and accurate)

Prioritization of Contaminant Sources and/or Water Quality Impacts – see Section 3.4

- ❑ If there are known water quality impacts, but the source is unclear, list those impacts (e.g., seasonal high nitrates, turbidity, seasonal pesticides, algae, etc.)
- ❑ Provide a list of the prioritized contaminant sources, that is, the sources that your team truly believes could impact the quality of your drinking water. (You may have many or just a few). For each one, explain why it was prioritized. It would be helpful to highlight these on a map.

******Referring to a subwatershed in terms of its Hydrologic Unit Code ("HUC") is a very precise way to describe it and HUCs are well understood by entities involved with watersheds. A map showing the boundaries of Ohio HUCs is available at: http://www.oh.nrcs.usda.gov/technical/14-digit/county_map.html

Appendix A
Drinking Water Source Protection Plan Checklist

Strategies for Protecting Source Water from Prioritized Contaminant Sources/Known Contaminants – see Chapter Six

- ❑ For each prioritized contaminant source (or known contaminant, where a water quality impact is evident but the source is unknown), discuss strategy(ies) for protecting the source water from potential impacts from that source/contaminant. Strategies may include specific BMPs as well as more global efforts--such as educational efforts, contingency planning, land purchases/ easements, and ordinances--that will address the source/contaminant in question. Please provide as much detail as possible.
- ❑ Indicate timelines for implementation of each strategy. If the strategy is a one-time effort (like removing a contaminant source), the date of completion should be included. If the strategy is a periodic effort (like annual educational outreach to schools), indicate the planned frequency.
- ❑ Indicate how the public water system will be kept informed of progress with this strategy.

Education – see Chapter Four

- ❑ Describe planned educational activities
- ❑ Provide timelines for conducting each educational activity (one-time and on-going activities)
- ❑ Describe each educational activity's target audience
- ❑ Describe the process for ensuring continuity of the educational activities

Contingency Planning – see Chapter Five

If a public water system has already addressed source water contingency planning in its <u>contingency plan</u>, it may be enough to simply attach copies of the relevant pages to the drinking water source protection plan. If source water has been listed as a critical vulnerability in the system's <u>vulnerability assessment</u>, the system is prohibited from including this information in a drinking water source protection plan, which is a public document. In this case, this should be stated in the protection plan.

The following items should be addressed in at least one of the above-mentioned documents or in the contingency planning portion of the source water protection plan.

- ❑ Plans for how the community would deal with a major threat to source water quality at the intake
- ❑ Response protocol in the event of a hazardous substance spill or other emergency
- ❑ A discussion of back-up water supplies (bottled, bulk, etc.) for short-term emergencies involving source contamination
- ❑ A discussion of alternate sources of water, in the event the current source would become unusable for a long period of time
- ❑ A discussion of financial mechanisms that could be used to implement those alternatives
- ❑ A discussion of any water supply planning for future needs

Source Water Monitoring – see Chapter Seven

It is not necessary to conduct additional monitoring. However, the following items should be addressed in the protection plan:

- ❑ List existing sources of water quality data (any actual data used to decide implementation or monitoring strategies can be included as an appendix)
- ❑ Indicate whether sampling is being conducted or is planned to assess the quality of pretreatment drinking water. Explain why or why not.
- ❑ If sampling is being conducted or is planned, describe the monitoring program using the questions presented in Section 7.2 of this guidance (page 7-2) as a guide. The underlined items are most critical.

Appendix A
Drinking Water Source Protection Plan Checklist

Implementation

- ❑ Describe the short-term and long-term implementation schedule
- ❑ List the individuals, agencies, and groups with significant responsibilities for implementing the plan
- ❑ Describe any intergovernmental agreements, memoranda or ordinances that set forth procedures or responsibilities related to drinking water source protection
- ❑ Identify potential funding sources
- ❑ Indicate the proposed method for evaluating the effectiveness of the program – see Chapter Eight
- ❑ Designate the agency, person or team responsible for periodically updating the local drinking water source protection plan (or elements of watershed action plan
- ❑ Indicate how frequently the protection plan will be updated – see Chapter Eight

Appendix B
Glossary

agricultural petition ditch - A ditch constructed for the purposes of agricultural drainage (often involving the straightening and channelizing of a natural stream). Construction is initiated by a petition of one or more landowners, or by the drainage authority (such as the County Engineer, Conservancy District, SWCD or NRCS). Costs are paid by assessment on the existing benefitted area.

best management practices (BMPs) - practical, effective, affordable, and technically feasible actions intended to minimize adverse impacts to natural resources. Best management practices focus on managing the impacts caused by specific potential contaminant sources.

bypass - in the context of wastewater treatment practices, diverting untreated wastewater away from the treatment plant, typically into a nearby surface water body. This is an emergency measure undertaken only when the treatment plant is damaged or in danger of being damaged, such as when an influx of storm water (in combined sanitary/storm sewers) threatens to overwhelm the plant.

CAFOs (concentrated animal feeding operations) - Facilities where a large number of animals (typically, many hundreds or thousands) are confined for 45 days or more a year and where no vegetation grows in the area used for confinement. When manure is not managed adequately, runoff from CAFOs may be a significant source of microbial contaminant to surface water.

contaminant - any physical, chemical, biological or radiological substance in water that is present at levels high enough to have harmful or undesirable effects. For the purposes of this document, 'contaminant' generally refers to a substance that has a potential harmful impact on human health.

corridor management zone (CMZ) - the surface and subsurface area delineated or endorsed by the agency under Ohio's Source Water Assessment and Protection Program within a drinking water source protection area for a public water system using surface water where the potential for drinking water contamination warrants delineation, inventory, and management because of the area's proximity to a public water system intake. The width of the standard CMZ extends 1,000 feet from the top of each bank of the principal stream and extends 500 feet from the top of each bank of tributaries draining into the principal stream, except as modified due to local conditions. The CMZ extends 10 miles upstream of the intake, including the principal stream and all the tributaries that drain to it, except as modified due to local conditions.

critical areas - the areas within a watershed where the magnitude of NPS pollution and/or habitat/hydromodification results in water quality impairments or threats to full attainment.

critical area zone (CAZ) - a calculated area around a Lake Erie public water system intake, based upon its sensitivity determined by the intake's depth and distance from shore. This is generally a circular area around the intake that has a radius of 1,000 feet for less sensitive intakes, 2,000 feet for medium sensitive intakes, or 3,000 feet for highly sensitive intakes. The shape and extent of this area may be modified to take into account site specific conditions.

CSO (combined sewer overflow) - a discharge outlet into a surface water body that releases untreated wastewater combined with storm water from the sewer network. Combined sewers carry both sewage and storm water to wastewater treatment plants. During storms, the volume of water in combined sewers may become too great for wastewater plants to treat, so the excess is released untreated through CSOs. Combined sewers are most common in older cities, and can be a significant contributor of microbial contaminants to urban watersheds. Ohio communities with combined sewer networks are gradually replacing them with separate storm water and wastewater lines.

disinfection byproducts - compounds formed when disinfectants used in water treatment plants react with bromide and/or natural organic matter (i.e., decaying vegetation) present in the source water. Different disinfectants produce different types or amounts of disinfection byproducts. Regulations have been established for various disinfection byproducts including trihalomethanes, haloacetic acids, bromate, and chlorite.

drinking water source assessment - the 3-step process of (1) determining a protection area around a wellfield or surface water intake; (2) inventorying that area for potential contaminant sources; and (3) evaluating how susceptible the source waters are to contamination.

drinking water source protection plan - the written document describing the strategies to be implemented by a public water system and its partners to prevent, detect, and respond to ground water contamination within the drinking water source protection area. The protection plan is based on information in the public water system's Drinking Water Source Assessment Report and focuses on the potential contaminant sources identified in the protection area.

emergency management zone (EMZ) - the surface and subsurface area in the immediate vicinity of a public water system intake as delineated or endorsed by the agency under the Source Water Assessment and Protection Program within which the public water supply owner/operator has little or no time to respond to potential contamination from a spill, release, or weather-related event. The standard emergency management zone boundary consists of a semi-circle that extends 500 feet upstream of the intake and 100 feet downstream of the intake, except as modified due to local conditions.

endocrine disruptors - a group of chemicals that are widely believed to disrupt the endocrine systems of various wildlife and humans, resulting in developmental and reproductive problems. Laboratory studies and extensive anecdotal evidence suggest a compelling link between these chemicals and the health problems noted, but the relationship is poorly understood and still scientifically controversial.

ground water - subsurface water, located below the water table. Subsurface water above the water table, called soil water, flows differently.

haloacetic acids - a group of chemicals that are formed when chlorine or other disinfectants in drinking water react with naturally occurring organic and inorganic matter in water. The regulated haloacetic acids, known as HAA5, are: monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid. The MCL for HAA5, based on the average of detected levels over a year's time, is 60 parts per billion.

management practice systems - combinations of management practices that work together to achieve a management goal (such as reducing pollutant loads).

mitigation projects - 'mitigate' means to moderate an effect; however, in this document mitigation projects refers to projects that involve implementing water quality protection/improvement efforts in an accessible area rather than another area of the same watershed where they are needed but too costly to implement, for an overall equivalent or greater water quality benefit at lower cost.

nonpoint source - a diffuse potential contaminant source or group of potential contaminant sources such as agriculture, surface mines, forestry, home wastewater treatment systems, construction sites, and urban yards.

NPDES permit - National Pollutant Discharge Elimination System permits are permits for discharging wastewater to waters of the state. Wastewater treatment plants and many other facilities are required to obtain this permit from Ohio EPA's Division of Surface Water. More details are available online at http://www.epa.ohio.gov/dsw.

point source - a potential contaminant source with a concentrated origin, like an underground storage tank or a large registered feedlot with a specific point of discharge. Point sources are frequently registered and regulated by federal, state, and local laws.

pollution prevention - reducing the overall level of contaminants introduced into the environment by reducing the amounts of chemicals used, or by recycling in an environmentally sound manner. Pollution prevention avoids cross-media transfers of wastes and/or pollutants and is multimedia in scope.

potential contaminant source - a facility or activity that stores, uses, or produces chemicals, and has the potential to release contaminants in amounts that could significantly impact the source waters used by a public water system.

protection area - an area around a well or surface water intake targeted for special protective efforts to avoid contamination of an aquifer or surface water body that is used for public drinking water. Also called source water protection area, drinking water source protection area, and wellhead protection area.

protection team - a group of individuals representing organizations, businesses, and other participants in the drinking water source protection planning process and those most likely to be affected by decisions made.

protective strategies - actions taken to limit or eliminate the risk of contamination from a potential contaminant source or a type of source.

Source Water Assessment and Protection Program (SWAP) - a program designed to advance protection of aquifers and surface water bodies used as public drinking water sources (currently or in the future). The program was created by the 1996 amendments to the national Safe Drinking Water Act. In Ohio, the program is administered by Ohio EPA's Division of Drinking and Ground Waters, in accordance with the Ohio Source Water Assessment and Protection Program (approved by U.S. EPA in November 1999). Refer to http://www.epa.ohio.gov/ddagw/swap.aspx.

sewershed - the area that drains into a particular storm sewer system (and therefore capable of reaching the stream rapidly and in undiluted form through the storm sewers).

SSO (sanitary sewer overflow) - any accidental discharge of untreated sewage from a sewer system. SSOs occur when sewage backs up into basements, streets and surface water. Primarily due to insufficient maintenance, insufficient capacity, and illegal connections.

susceptibility - the likelihood for the source water(s) of a public water system to become contaminated at significant concentrations (in Ohio, designated as high, moderate or low).

time-of-travel - describes the distance a particle will move through an aquifer and/or surface water body in a specified amount of time, or the area that contributes ground water to a well within a specified period of time (e.g., five-year time-of-travel area).

trihalomethanes (THMs) - a group of four chemicals (chloroform, bromodichloromethane, dibromochloromethane, and bromoform) that are formed when chlorine or other disinfectants in drinking water react with naturally occurring organic and inorganic matter in water. The maximum contaminant level (based on detected levels averaged over a year's time) is 80 parts per billion.

volatile organic compounds (VOCs) - a group of chemicals that tend to volatilize (evaporate) very quickly when exposed to air. Many of these compounds are toxic to humans, but are found in everything from paints and coatings to deodorant and cleaning fluids. Because they are very miscible and persistent in ground water, they are among the most frequently detected. However, they are not frequently detected at levels of concern in surface water, except when associated with a spill.

vulnerability assessment—a document required by the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 for community public water systems. Vulnerability assessments catalog and prioritize a public water system's assets, identify potential threats, and list changes needed to mitigate the most serious vulnerabilities for the most critical resources.

wellfield - an area containing two or more wells that supply water to a public water system.

wellhead protection program (WHP) - a program designed to advance protection of aquifers that are or could be used as public drinking water sources. Created by the 1986 amendments to the national Safe Drinking Water Act, the program is administered as source water protection by Ohio EPA's Division of Drinking and Ground Waters, in accordance with the Ohio Source Water Assessment and Protection Program. For a discussion of the minor distinctions between wellhead protection and source water protection, go to http://www.epa.ohio.gov/ddagw/swap_faqs.aspx#diff.

zone of critical concern (ZCC) - pertains to public water system intakes located on the Ohio River and means an area that extends 1/4 mile below the intake to 25 miles upstream on the Ohio River and major tributaries. The lateral extent includes 1/4 miles on both sides of the Ohio River and tributaries.

Appendix C
Benefits and Costs of Source Water Protection

Source water protection is the oldest method of protecting drinking water. Long before Louis Pasteur's discovery of microorganisms and their role in illness, Europeans understood that maintaining a sanitary radius around a well kept the well water cleaner and safer to drink.

Today, source water protection is recognized as the first barrier in the multiple-barrier concept of providing safe drinking water. However, in the United States it tends to be the least implemented, especially by surface water systems. Some notable exceptions include New York City and the City of Seattle, both of which control most of the land around city reservoirs located near the upland boundaries of their watersheds and restrict public access to this land. Instead, public water suppliers tend to rely on treatment solutions to keep drinking water safe for human consumption.

There are a number of reasons for this. Engineered solutions are easier for a public water system operator to propose, cost out, and single-handedly maintain than source water protection. Most municipalities do not control all the land that drains into the water body providing their drinking water. Land use and protection decisions are often based on short-term (one to five years) revenue and expense projections for local governments. However, the impacts of development on water quality and treatment costs are realized over the long-term--five to ten years and longer--and are often ignored in land use planning processes. The short-term costs of protecting source lands can be high, and water suppliers, who understand the long-term cost and public health impacts of watershed development, are not usually involved in land use or land protection decisions.

Above all, the benefits of source water protection are largely intangible. Good health, and a clean drinking water source tend to be taken for granted and to be valued most after they are lost. The willingness of a community to add source water protection to its list of on-going projects depends in large part on the community's perception of the likelihood of contamination. Today the City of Dayton has one of the most sophisticated source water protection programs in the country, but it took a near-catastrophe on the wellfield in 1987 to galvanize the community around the importance of source water protection (Figure C.1).

C.1 The Benefits Of Source Water Protection

This section presents the benefits of source water protection mostly in terms of the costs–direct and indirect--of an impaired source of drinking water. This information may be helpful to planners as they seek support for the program, recruit team members, and prepare informational material for the public.

Figure C.1 - An environmental nightmare. The Sherwin-Williams warehouse fire in 1987 threatened to destroy Dayton's source of drinking water. The reportedly fireproof facility, containing tons of solvents, was located in one of the city's wellfields, over an aquifer that is the sole source of drinking water for 1.5 million people. Clean-up and subsequent monitoring cost an estimated $12 million.

C.1.1 When Treatment Fails: The Costs of Contamination Events

No matter how well-engineered and well-run a water plant is, accidents can and do happen. When they do, the impacts on a community can be devastating. Acute microbial contamination events can have deadly impacts on public health. The outbreak of cryptosporidiosis in Milwaukee, Wisconsin in 1993, resulted in 370,000 illnesses and contributed to 100 deaths (Figure C.2).

Another recent case is the outbreak of *E. coli* in Walkerton, Ontario in 2000, which caused over 2,000 illnesses, and seven deaths. The costs of these incidents were high in strictly economic terms and there is no way to place a dollar amount on lives lost, or the pain and suffering inflicted.

Even when human health is not impaired, there are costs associated with the immediate response to the contamination, which may include:

- emergency provision of bottled water;
- cleanup and remediation costs;
- investigation costs;
- professional consulting fees; and
- costs of distributing information to public.

Following an incident like the one described above and in Figure C.3, a water supplier typically will be compelled to make costly upgrades to the plant, such as installing redundant emergency filters, expanding holding capacity, or constructing an emergency connection with another water system.

In the worst case, the community may need to find an alternative surface water source. The development of a new surface water source is a major project, requiring outlays for permits, biological and hydrogeological studies, treatment, and infrastructure development.

If the geology is suitable, a surface water source may be replaced by a wellfield, but this is also a costly multi-year project. Where the geology is not suitable, the community may have no other choice than to purchase water from another public water supplier.

Figure C.2 - When treatment fails
Milwaukee 1993 cryptosporidiosis outbreak.

In April 1993, spring floods washed cysts of a parasitic microorganism *Cryptosporidium parvum* into the rivers of Wisconsin and subsequently into the City of Milwaukee' water plant. Although the plant filters and disinfects its water, the tiny oocysts broke through the filters and proved resistant to disinfection. In all, 370,000 cases of cryptosporidiosis (a gastro-intestinal illness) were attributed to this event.

The *Milwaukee Journal* estimated that costs related to this incident exceeded $54 million. These costs included lost wages and productivity, hospitalization and clinical treatment, water utility expenses, emergency room treatment, statewide water testing, and City Health Department expenses. The loss of human lives was not factored into this estimate.

Figure C.3 - Emergency Response to an Ohio River Spill

Spills on rivers can cause serious disruptions to public water systems that draw water from the river. On June 3, 1994, a massive spill of ethylene dibromide (EDB) on the Ohio River created serious difficulties for the public water systems that were located downstream. The nearby cities of Ironton and Portsmouth were especially threatened. They shut off their water intakes immediately and notified their consumers to conserve water.

Despite this, the storage tanks and reservoirs quickly dropped to alarming levels. At the eleventh hour, the first of several barges filled with water arrived at Ironton, and the water was pumped into the city's treatment plant.

Special treatment materials were supplied to the Portsmouth treatment plant. Round-the-clock sampling of raw and treated water continued for a week, and the emergency was not declared officially "over" until almost a month later.

Finally, there may be long-term and/or indirect costs associated with the event, such as:

- increased monitoring costs;
- real estate devaluation;
- lost jobs (if industry relocates due to water costs or new industry declines to locate);
- decline of consumer confidence in water supply; and
- potential lawsuits from actual or alleged consumption of contaminated water.

C.1.2 The Costs of Treating Low Quality Surface Water

The State of Ohio is heavily populated, heavily industrialized, and extensively farmed. Undeveloped land is relatively scarce. The pressure on less-developed areas is intense and destined only to increase with time. As a result, without protective efforts, the quality of Ohio's water bodies will decline over time. Even without a major contamination event, long-term environmental degradation imposes a cost on society.

The costs associated with operation and maintenance (O&M) can be substantial for systems that require use of chemicals or frequent filter back washing due to poor source water quality. Low-quality source water not only requires sophisticated filtration technology with increased O&M costs, but it can also influence biofilm growth and result in elevated disinfection byproducts. Water with excessive nutrients will support algae and weed growth and lead to high levels of total organic carbon (TOC), a food source for bacterial growth and a precursor substance for the formation of disinfection byproducts (i.e. **THMs** and **haloacetic acids**).

Bacterial regrowth in distribution lines often causes violations of the Total Coliform Rule. With such violations, suppliers are required to increase monitoring (at increased operation and maintenance costs) to prove that the violations are caused by biofilm and not by fecal contamination.

Algae and weed overgrowth in poor quality sources of water often cause taste and odor problems leading to significant increases in treatment costs (Figure C.4).

Fig. C.4 - Dealing with Unexpected "Natural" Contaminants: The City of Akron's Struggle with 'MIB'

The City of Akron's source water is surface water piped in from nearby Lake Rockwell, which was created by constructing a dam on the middle reaches of the Cuyahoga River. In December 2005, residents began complaining of a pungent odor and foul taste to their drinking water.

After considering lake turnover and surface runoff as culprits, city officials pinpointed two naturally-occurring compounds released from algae and soil bacteria: 2-methylisoborneol (MIB) and Geosmin. These compounds are not toxic to humans, but are very powerful taste and odor-causing compounds that can be detected by humans at levels of less than 10 parts per trillion (ppt).

The levels of MIB in Akron's finished water peaked at 260 ppt before treatment with powdered activated carbon began to take effect. In December the City used 100 tons of carbon, costing $50,000; normally it uses about 20 tons of carbon *a year*.

Surface water treatment plants frequently treat their reservoirs with copper sulfate in the summer to control algae. However, algae is rarely a problem in the winter. Officials suspect Akron's problem was related to heavy precipitation throughout the Cuyahoga River watershed during late November.

A similar situation occurred in Wichita, Kansas' Cheney Reservoir in the winter of 2002-03, producing taste and odor problems that did not resolve until the Spring, despite vigorous treatment. In that case, the cause was traced to heavy rains that washed phosphorus from farm fertilizers into the reservoir. Wichita's long-term solution was to add a $7.5 million ozone-injection system to its water plant.

Some species of algae are notorious for clogging filter beds, thus requiring higher expenditures for operation and maintenance. In addition to producing taste and odors, several blue-green algae species may produce neurotoxins and hepatotoxins which have been responsible for numerous animal (Carmichael 1981) and human deaths (Jochimsen et. Al 1998). Dead algal cells can provide a food source for microbes in deep waters, causing oxygen depletion. The low dissolved oxygen levels cause the release of iron, manganese, and hydrogen sulfide from sediments, a condition that requires further treatment in order to meet regulatory standards.

Surface water quality fluctuations tend to be seasonal. Operators of public water systems using Lake Erie water know that lake turnover in the spring and autumn causes turbidity that may make additional treatment necessary. Operators of systems with intakes on streams that run through agricultural land know that the heavy rains of spring, coupled with fertilizer and pesticide application, can result in high concentrations of nitrate and pesticides in the water system.

For public water systems with an on-stream reservoir, these seasonal influxes require careful monitoring and treatment. The Village of Monroeville supplemented an on-stream reservoir with an upground reservoir to increase storage capacity and decrease the water supply's vulnerability to nonpoint source pollutants (Figure C.5). In general, increasing holding capacity in reservoirs and water towers can be an alternative to treatment, but construction costs are significant, and acquiring the land for a reservoir will become increasingly difficult with time. This option is effective only when water quality degradation remains a transient seasonal problem.

Figure C.5 - The Village of Monroeville's Solution to Seasonal Water Quality Problems

Persistent exceedances of nitrate and atrazine MCLs persuaded the Village of Monroeville (in northern Ohio) to construct an upground reservoir in 2000. Water quality in the upper reaches of the Huron River is often problematic in the spring, when heavy rains wash agricultural chemicals into the stream. At such times, the Village can now turn off its intake and still have sufficient water to meet its needs for an extended period of time, until flood waters recede and water quality improves. Total cost of the reservoir and associated infrastructure was $2.6 million dollars, a heavy burden for a small village.

C.1.3 Incalculable Costs of Contamination

Proponents of engineered solutions to water quality issues tend to overlook the fact that there are many thousands of synthetic chemicals whose human health impacts have not yet been studied. In addition to concerns about possible carcinogens that have not yet been discovered, concerns have been voiced about endocrine disruptors– chemicals that can derail the prenatal development (especially sexual development) of aquatic life and humans.

A number of so-called wastewater chemicals are widely present in drinking water sources, and for that reason alone may warrant concern. For example, a USGS study of Colorado streams in 2001-2003 revealed the presence of detergent metabolites, disinfectants, fire retardants, fragrances/ flavors, plasticizers, solvents and steroids. Detections were especially significant of caffeine, DEET (found in insect repellents), nonylphenol (a detergent degradation product and potential hormone disruptor) and triclosan (a disinfectant found in many liquid soaps). Levels were significantly higher in urban streams than in forested streams (USGS, 2005). To date, drinking water is not routinely monitored or treated for these wastewater chemicals.

Another often-overlooked concern is the potential for the appearance of 'new' microorganisms (via natural mutation or biological engineering) that may be lethal to humans. Microbiologists suggest that this is more common than is generally acknowledged. (One example that has received international attention is the bird flu virus, which public health officials fear may mutate to a more contagious variant.) Public water system operators cannot realistically be expected to treat source water for such undefined possibilities. Source water protection is a more inclusive barrier to contamination that may succeed where more focused barriers would fail.

C.1.4 Calculable Benefits of Source Water Protection

The benefits of source water protection can be directly quantified, using the value of incentive and waiver programs. Communities with state endorsed source water plans in place may receive higher priority for low-cost loans and grants related to drinking water programs or watershed control programs. In recent years, Ohio EPA, working with USEPA Region V, has made 319 grant funds available for public water systems to develop and implement Protection Plans and to conduct management practices to restore source water quality. Section 319 of the Clean Water Act established these grants, which are intended to address nonpoint sources of pollution (see Appendix D of this guidance for a discussion of nonpoint sources).

Also, as part of the Long Term 2 Enhanced Surface Water Treatment Rule (40 CFR 141.722), USEPA has proposed awarding a 0.5 log credit toward *Cryptosporidium* treatment requirements for public water systems that have a State endorsed Protection Plan specifically addressing *Cryptosporidium* (refer to Chapter 8).

C.2 The Costs of Source Water Protection

The costs of source water protection implementation can vary widely, from very high (for an extensive land purchase) to almost nothing (for a minimal program run by volunteers). The costs of developing the Protection Plan itself should be modest, and should consist primarily of staff time. One of the great benefits of partnering with an established local watershed group is that such groups typically attract committed and energetic volunteers.

Although turnover may be high, the structure remains in place to continue recruiting fresh volunteers. This is an invaluable resource to public water system officials. If the planning team members meet on their own time and a meeting room can be secured without a fee (for example, in a church, school or municipal building) the planning phase may involve minimal costs.

As noted, actual implementation costs depend on the methods selected. Many of the less costly methods are one-time and organizational in nature (such as developing a regional contingency plan) while others (such as monitoring) are ongoing and require more resources. Chapters 4 through 7 discuss various types of protective strategies in detail.

Appendix D
Potential Contaminant Sources

An ancient truth holds that the dose makes the poison - in other words, anything can be harmful to human health at sufficiently high levels. There are several classes of chemicals that are of special concern as drinking water constituents. This chapter contains some background information about the types of chemicals that are a concern in drinking water, and the types of activities or facilities that typically handle such chemicals. These activities or facilities are called potential contaminant sources.

The contaminants that concern public water suppliers may differ from those that are considered a threat to water quality by watershed groups. For example, primary indicators of the aquatic health of a stream include levels of dissolved oxygen and ammonia–neither of which are a major concern for human health. Levels of nitrates and volatile organics are a significant concern for drinking water, but may be less of a concern for watershed groups (although nitrate-nitrogen impacts on Gulf Coast hypoxia are a growing concern).

Sediment levels are a concern to both interest groups, but for different reasons. High sediment levels in a stream lead to low dissolved oxygen and a generally unhealthy habitat for fish and other biota. On the other hand, high levels of organic material in a public water system's source water can lead to the presence in drinking water of **trihalomethanes (THMs)**, potentially carcinogenic compounds that are produced when chlorine reacts with organic material. Public water system operators are required to monitor and control levels of THMs, so they are concerned with total organic carbon levels (which are associated with sediment levels) in surface water sources.

Despite these differences, the sources of various contaminants are frequently the same, and watershed groups and public water systems can combine their resources and influence to leverage clean-up and protective measures.

D.1 Drinking Water Contaminants

Microorganisms

Throughout history, microorganisms have been the most dangerous contaminant in drinking water. In developing countries, waterborne pathogens are responsible for approximately one-third of all deaths–many of them children (WorldWatch Paper #129, 1996). The diseases spread through contaminated drinking water include hepatitis A, typhoid fever, cholera, salmonella, Giardiosis and Cryptosporidiosis. Although the use of chlorine and other disinfectants has made major outbreaks relatively rare in developed countries, there are occasional incidents such as the *E.coli* outbreak in Walkerton, Ontario in May 2000, or the Cryptosporidiosis outbreak in Milwaukee, Wisconsin (refer to Figure C.2).

Cryptosporidium is a relatively new drinking water concern. A pathogenic protozoan associated with animal wastes, it has long been a veterinary problem, but was rarely reported in humans until 1982 (USDA, 2004). Water treatment plants may not remove all *Cryptosporidium* oocysts from drinking water, because the oocysts are resistant to chlorine, and are small enough to occasionally slip through conventional filters. U.S. EPA has set a standard of 99% removal of *Cryptosporidium* for public water systems using surface water or ground water under the direct influence of surface water. Operators may use watershed protection as one of their mechanisms for removal of this pathogen. More information on *Cryptosporidium* is available from the Center for Disease Control or the USDA Water Quality Program at http://waterquality.cce.cornell.edu/publications/CCEWQ-15-Cryptosporidium.pdf.

Nitrate

Nitrate violations of the maximum contaminant level (10mg/l) are the most common chemical contaminant violation for water systems. Human health impacts related to nitrate include a potentially fatal condition in infants called methemoglobinemia, or blue-baby syndrome. High nitrate levels in surface water may result from:

- agricultural activities (due to spreading of fertilizers, typically in the form of manure or anhydrous ammonia, urea, or ammonium sulfate);
- failing home sewage treatment systems - HSTS (generally found in rural areas, where sanitary sewer lines have not been installed); and
- sludge from wastewater treatment plants–commonly applied to fields as fertilizer.

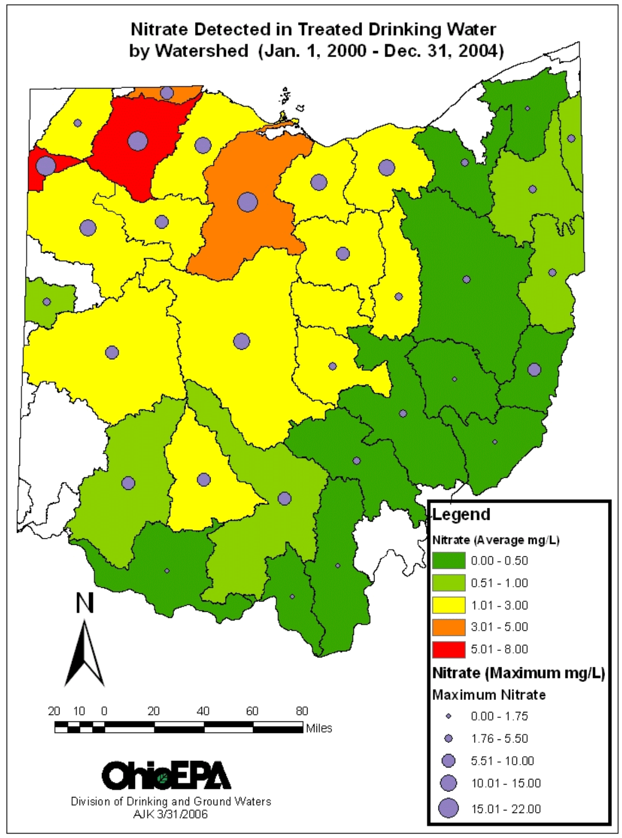


Figure D.1 - Nitrate Levels in Treated Drinking Water by Watershed (January 2000 to December 2004)

Figure D.1 shows that nitrate impacts on public drinking water tend to be highest in northwest Ohio, presumably due to the extensive agricultural land use. (Uncolored watersheds in this figure reflect no data, as there are no surface water-based public water systems located in these watersheds.)

Reverse osmosis and ion exchange are two treatment techniques that can be used to remove nitrate from drinking water; however, relatively few public water systems are equipped for this process (due to the expense and intensive operation and maintenance requirements). More information on nitrate impacts is available in Ohio's Nonpoint Source Management Plan, available online at http://wwwapp.epa.ohio.gov/dsw/nps/NPSMP/ET/nitrogenwq.html.

Volatile Organic Compounds (VOCs)

Volatile organic compounds are chemicals that vaporize rapidly when exposed to air. Because of this, they are detected more frequently in ground water than in surface water. Many VOCs are solvents and include such common chemicals as benzene, toluene, xylene, trichloroethylene (TCE), perchloroethylene (PCE), and methyl ethyl ketone (MEK). VOCs can cause acute reactions in humans when breathed at very high concentrations, causing headaches, impairment of the nervous system, nausea, and other symptoms. Also, a number of VOCs are believed to cause cancer. For this reason, even low-level exposure is a concern. In Ohio community public water systems that use surface water sources are required to monitor treated water annually for some VOCs. Watershed groups may not monitor for these chemicals due to the high expense of monitoring and relatively low priority as a threat to stream biota.

Pesticides

Pesticides include a variety of mostly synthetic chemicals that are used to control weeds or pests such as insects and rodents. Many of them are semi-volatile. They can cause acute reactions with symptoms similar to those caused by VOCs, and some of them are suspected of causing cancer.

Several Ohio public water systems have experienced elevated pesticide levels with significant short-term spikes, usually from April to August. Atrazine and simazine are the most commonly detected pesticides in treated drinking water in Ohio.

Statewide, atrazine detections are most prevalent in the western portion of the state, where land use is predominantly agricultural. Plotting the atrazine data (above detection limit only) from 1999-2004 shows the seasonal nature of its occurrence in Ohio's surface waters (Figure D.2). In some watersheds, U.S. EPA has restricted the use of atrazine due to drinking water contamination problems. For more information about pesticide impacts, refer to *Ohio's Nonpoint Source Management Plan*, available online at http://wwwapp.epa.ohio.gov/dsw/nps/NPSMP/ET/pesticideswq.html.

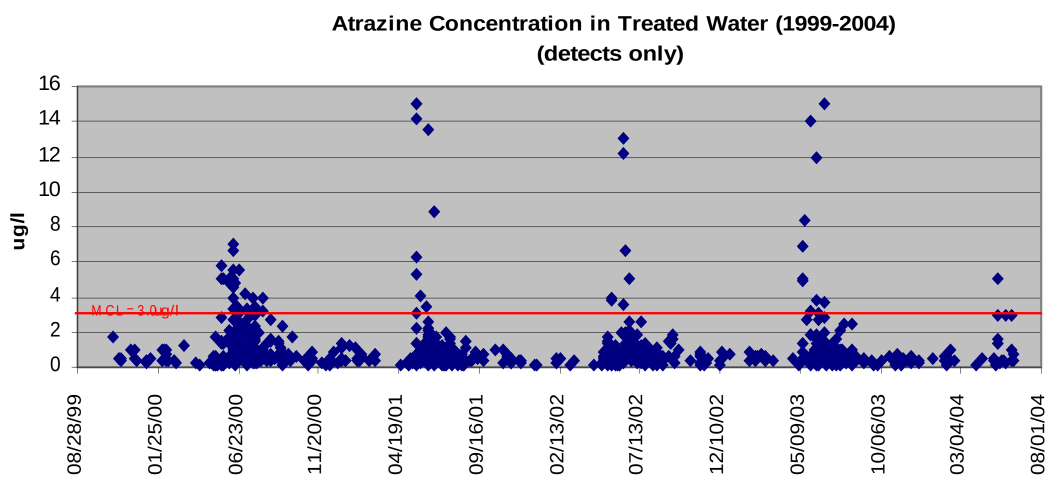


Figure D.2 – Atrazine Detections at Ohio Public Water Systems

Hormone Disruptors

In the 1990s, hormone disruptors came to the forefront as an environmental concern, for drinking water and for stream biota. These are chemicals that may disrupt hormonal development in a fetus. In aquatic animals they can cause birth defects and sexual changes. In humans they are believed to cause birth defects, learning problems, and predisposition to certain cancers. Identified hormone disruptors include a number of pesticides and polychlorinated biphenyls (PCBs).

More recently, U.S. EPA has begun to focus attention on pharmaceutical and personal care pollutants (PPCPs)–the thousands of chemicals used in medications, beauty aids, cleaners and foods, which survive in wastewater even after it is treated and disinfected. These include caffeine, cotinine (from tobacco products), antibiotics, antidepressants, contraceptives, painkillers, hormones, steroids, chemotherapy drugs, insect repellents, soaps, perfumes, plasticizers and fire retardants. The potential impacts on public health or on stream biota is currently unknown. Sewage plants do not screen for these chemicals and can remove only a portion of them. State and federal regulations generally don't address their disposal.

Trace Metals

Certain metals–including mercury, lead, cadmium, and chromium–can cause serious human health effects if ingested regularly at high enough levels. Most of these metals occur naturally in ground water, but they rarely occur naturally at high levels in surface waters. High levels of metals can be found in wastewater sludge, fly ash and bottom ash from coal-burning power plants, in run off from coal piles, and in road salt.

Sediments and Organic Carbon - Trihalomethanes & Haloacetic acids

Sediments and other organic carbon sources can interact with the chlorine used to disinfect drinking water and create disinfection by-products (DBPs). These byproducts include **trihalomethanes (THMs)** and **haloacetic acids (HAAs)**. Trihalomethanes and other disinfection by-products pose a significant health risk as a number of DBPs, including chloroform and dichloroacetic acid, have been shown to be either carcinogenic or potentially carcinogenic. A number of DBPs, including dichloroacetic acid, have also been shown to have subchronic toxicity. In 2004, the drinking water for 39 Ohio public water systems exceeded the maximum contaminant level (MCL) for THMs and there were three MCL exceedances for HAAs.

D.2 Potential Contaminant Sources

Potential sources of surface water contamination can be classified as either a point source or a non-point source. Point sources typically are specific facilities. They store, apply or release contaminants within a constrained area that can be monitored and managed. Many point sources are already subject to environmental regulations. For example, most facilities that discharge wastewater to a stream are required to have a NPDES permit, which specifies the water quality requirements at the point where the pipe discharges into the stream.

Non-point sources typically are land use activities or disturbances that are often conducted by many different entities, making monitoring, management, and enforcement of existing regulations difficult. Releases from non-point sources may be constant or seasonal, and are usually spread over a large area.

Some potential contaminant sources can be considered both a point and nonpoint source. For example, home sewage treatment systems are discrete sites. However, when surface water is demonstrably impacted by failing home sewage treatment systems, it is usually related to an entire community of failing systems, not just one. Pipelines also have characteristics of both types of sources, in that they are typically managed by one entity and can be regulated, but may cover hundreds of miles, and could leak at any point along their length.

D.2.1 Nonpoint Sources

Pesticide and Fertilizer Use

Millions of tons of fertilizers and pesticides (including herbicides, insecticides, rodenticides, fungicides, and avicides) are used annually in the United States for crop production. In addition to farmers, homeowners, businesses (such as golf courses), utilities and municipalities also use these chemicals. Pesticides, nutrients, Cryptosporidium, and other contaminants from animal wastes can make their way into surface water bodies. There are a variety of management practices that can limit the impacts of pesticides and fertilizer on surface water. *Ohio's Nonpoint Source Management Plan*, available online at http://wwwapp.epa.ohio.gov/dsw/nps/NPSMP/MM/Mmjumppage.html, lists various management practices and measures.

Erosion, Stream Channel Alteration and Dam Removal

Turbidity caused by stream bank modification or in-stream or lake dredging or mining and processing delivers suspended sediment to the water column. This can be transported to the intake and require extra treatment to remove. Suspended sediments can also carry other associated contaminants through the water column and pose an additional treatment concern.

Dam removal can provide long-term water quality benefits, but in the short term a slug of sediments may be transported downstream during and immediately following the demolition of the dam. The public water supply should contact the Corps of Engineers to ask to be notified in the event an upstream dam will be removed, or any in-stream work will be conducted above the intake so the turbidity levels may be more closely monitored.

Highway Deicing

More than ten million tons of salt are applied annually to roads in the United States to remove ice (Transportation Research Board). Salt is usually added to sand (at approximately 3%). Oil field brines have, in the past, also been used as a road deicer. Rain and snow melt wash all of this material into roadside ditches, gutters, and sanitary sewers. Precipitation can also wash the salt from storage piles into the streams. High sodium levels in water pose a health risk and also damage vegetation, vehicles, and bridges.

Resource Extraction

Active and abandoned mines can contribute to surface water contamination. Precipitation can leach soluble minerals from the mine wastes (known as spoils or tailings) into surface water below. These wastes often contain metals, acids, and sulfides. Dissolution of sulfide minerals, which are commonly associated with coal mines, results in acid mine drainage (AMD). AMD can affect streams and is a leading source of nonpoint source pollution in the coal mining regions of the state. More information on AMD is available in *Ohio's Nonpoint Source Management Plan*, available online at http://wwwapp.epa.ohio.gov/dsw/nps/NPSMP/ET/amdjumppage.html.

Petroleum exploration and production are additional potential sources of contamination. The improper disposal or storage of wastes, such as brine generated during drilling, can adversely impact surface waters.

Sand and gravel, or aggregate, mining is also a potential source of contamination. Leaks and spills from equipment and above ground or underground storage tanks can impact surface water. Unused and unmonitored quarries can present tempting targets for illegal dumping of wastes. In-stream mining should be avoided.

Landfills

Solid waste is disposed of in municipal landfills throughout the state. Chemicals that should be disposed of in hazardous waste landfills sometimes end up in municipal landfills. In addition, the disposal of many household wastes is not regulated. Once in the landfill, chemicals can move into the surface water by means of precipitation.

New landfills are required to have clay or synthetic liners and leachate (liquid from a landfill containing contaminants) collection systems to protect waters of the state. However, older landfills may not have these safeguards. Abandoned landfills can continue to pose a surface water contamination threat, especially if they are not capped with an impermeable material, such as clay, before closure.

Surface Impoundments

Surface impoundments are relatively shallow ponds or lagoons used by industries and municipalities to store, treat, and dispose of liquid wastes. As many as 180,000 surface impoundments exist in the United States. Like landfills, new surface impoundments are usually required to have liners and monitoring wells for leak detection. If a leak should occur, or the impoundment overflows into a neighboring surface water body, the source water may be impacted.

Sewers and Other Pipelines

Sewer pipes carrying untreated wastes sometimes leak fluids into the surrounding soil and surface water. Untreated sewage consists of organic matter, inorganic salts, heavy metals, bacteria, viruses, nitrogen, and common household products and cleaners. Other pipelines carrying industrial chemicals and oil brine have also been known to leak, especially when the materials transported through the pipes are corrosive or under extreme pressure. Some contaminants are denser than water and can move through the joints in older sewer pipes and contaminate ground and surface water.

Natural Sources

Some substances found naturally in rocks or soils, such as iron, manganese, chloride, fluoride, sulfates, arsenic, or radionuclides, can become dissolved in streams. Naturally occurring substances, such as decaying organic matter, and algae, can be present in surface water. Whether any of these substances appear in water depends on local conditions. Some of these substances may pose a health threat if consumed in excessive quantities; others may produce an undesirable odor, taste or color. Water that contains these substances in relatively high concentrations may be treated to remove these substances.

D.2.2 Point Sources

Home Sewage Treatment Systems

The Ohio Department of Health estimates that there are at least one million home sewage treatment systems (HSTS) in Ohio. Although each individual system releases a relatively small amount of waste into the ground water (via leachfield) or surface water (via outflow pipe), the large number and widespread use of these systems makes them a potential contamination source. For this reason some programs consider HSTSs a nonpoint source of pollution.

Home sewage treatment systems that are improperly sited, designed, constructed, or maintained can contaminate ground and surface water with bacteria, viruses, nitrates, detergents, oils, and chemicals Commercially available septic system cleaners containing chemical solvents (such as 1,1,1-tricholoroethane or methylene chloride) can also contaminate surface and ground water. Septic tank additives also interfere with natural decomposition processes in home sewage treatment systems and therefore should not be used.

Ohio recently revised its home sewage treatment system rules and regulations to better protect water quality. House Bill 231, which addresses the regulation of household sewage treatment systems, was signed into law on February 1, 2005 (see Ohio Revised Code 3718). Under this authorization, the Ohio Department of Health developed home sewage treatment system rules that include provisions for routine inspections and maintenance of home sewage treatment systems.

Storm Water Discharges

Storm drains in parking lots and on roadways commonly discharge directly to streams and rivers and historically were combined with sanitary sewage and transported to a treatment facility. **Combined sewer overflows (CSOs)** occur during storm events when combined sewage and storm water discharge directly to a stream prior to treatment (see next section).

Runoff from impervious surfaces can carry dirt particles, oil, grease and any other substance lying on the paved surface. Household cleaning products, automotive, gardening, painting and other chemical supplies often make their way into storm drains when residents pour or wash these chemicals into storm drains for disposal. Under Ohio law, certain industrial facilities are required to obtain NPDES permits for storm drains in parking lots and other paved areas where chemicals and other substances may be stored and exposed to precipitation.

One of the difficulties in correlating water quality information with discharges from CSOs and storm drains is that the discharges are sporadic; they mostly occur during rain events or snowmelts. If monitoring is not done immediately following a heavy rainfall or snowmelt, water quality may not accurately reflect pollution surges. Similarly, if monitoring is done after a series of heavy precipitation events, results may not indicate the intensity of the initial pulse of contaminants discharged to a stream or river. Spot checking and monitoring by volunteers in identified areas of concern can help your group determine the degree to which storm water drains are impacting water quality.

Storm water discharges may be worse in areas where wetlands have been filled or reduced in size. Wetlands can reduce the rate and volume of runoff. If they are filled, their function in storm water runoff moderation is reduced or eliminated.

Combined Sewer Overflow Systems (CSO)

Combined sewers are built to collect sanitary and industrial wastewater as well as storm water runoff and transport this combined wastewater to treatment facilities. When it rains, the volume of storm water and wastewater may exceed the capacity of the combined sewers or of the treatment plant, and a portion of the combined wastewater may be allowed to overflow untreated into the nearest ditch, stream, river or lake. This is a combined sewer overflow, or CSO. Ohio has about 1,400 known CSOs in 87 communities (January 2005), ranging from small, rural villages to large metropolitan areas.

Because the wastes are untreated, discharges from CSOs can contain a variety of contaminants, such as pathogens, oxygen-demanding contaminants, suspended solids, nutrients, toxics, and floatable solids. As a result, they can impact streams and rivers suddenly after heavy rainfall or quick snow melts.

In 1994, U.S. EPA published the national CSO Control Policy. Working from the national policy, Ohio EPA issued its CSO Control Strategy in 1995. In 2000, Congress passed the Wet Weather Water Quality Act, which did two important things. It codified the 1994 national policy by making it part of the Clean Water Act (CWA), and it required that all actions taken to implement CSO controls be consistent with the provisions of the national policy.

The objectives of the national policy are: to ensure that if CSOs occur, they are only as a result of wet weather; to bring all wet weather CSO discharge points into compliance with the technology-based and water quality-based requirements of the CWA; and to minimize water quality, aquatic biota, and human health impacts from CSOs. Ohio EPA continues to implement CSO controls through provisions included in NPDES permits and using orders and consent agreements when appropriate.

Refer to Case Study #2 in Appendix E to review Toledo’s Plan for Combined Sanitary Sewer Overflows (CSOs/SSOs).

Wastewater Discharges

Wastewater treatment plants that treat residential, commercial and industrial waste are required to be permitted under the National Pollutant Discharge Elimination System. The effluent from wastewater treatment plants often contains nutrient levels that are higher than those of the stream or river. When examining water quality monitoring data, however, be aware that high nutrient levels observed in a stream may also be the result of runoff from agricultural fields. Often, it can be difficult to discern which is the greater source of nutrient loads. In these cases, innovative approaches to reducing or maintaining total nutrient loads to the stream or river may be required.

Wastewater treatment plants may also contribute to *Cryptosporidium* oocyst loads, depending on the amount of treatment provided. In the Netherlands, it is estimated that 85 percent of *Cryptosporidium* oocysts occurring in surface water are discharged in wastewater treatment plant effluent (Medema and Schijven 2001).

CAFOs

Large animal feeding operations, known as concentrated animal feeding operations (CAFOs), are regulated by the Ohio Department of Agriculture's Livestock Environmental Permitting Program. Ohio EPA, the Soil and Water Conservation Service, OSU Extension and the Natural Resource Conservation Service also work with animal feeding operations to ensure these facilities do not pollute Ohio's waters. Animal feeding operations can be a significant source of animal waste, which can contaminate source water in two ways. If not properly managed, waste can leak or overflow from waste storage lagoons, feedlots, or other facilities. In addition, waste applied as fertilizer to fields can run off into drinking water sources or source tributaries, especially if over-applied.

Industrial Discharges

The water that is discharged from industrial facilities to a stream or river is referred to as industrial effluent. Some facilities discharge directly to a stream or river, whereas others discharge to a pipe that goes to a wastewater treatment plant. Facilities directly discharging to surface waters are required to obtain an NPDES permit from Ohio EPA. The permit, if granted, specifically itemizes limits on each chemical parameter and the facility must conduct regular monitoring to demonstrate compliance with these limits. When a facility discharges to a municipality's (or regional) wastewater system, the wastewater treatment plant may require the industry to fulfill certain pretreatment steps to ensure that the industrial effluent does not cause the wastewater treatment plant to exceed its NPDES permit limits.

Disposal of Hazardous Materials

Hazardous waste should always be disposed of properly through a licensed hazardous waste handler or through municipal hazardous waste collection days. Many chemicals should not be disposed of in home sewage treatment systems, including oils (cooking oils or motor oils), lawn and garden chemicals, paints and paint thinners, disinfectants, medicines, photographic chemicals and swimming pool chemicals.

Similarly, many substances used in industrial processes should not be disposed of in drains at the workplace because they could contaminate a drinking water source. Companies should train employees in the proper use and disposal of all chemicals used on site and follow all local, state and federal regulations on the handling and management of hazardous substances. The many different types and the large quantities of chemicals used at industrial locations make proper disposal of wastes especially important for drinking water source protection.

Chemical Storage and Spills

Improper chemical storage and handling, and poor quality containers can be major threats to surface water. Tanker trucks and train cars pose another chemical hazard. Nationally, approximately 16,000 chemical spills occur each year from trucks, trains, and storage tanks, often when materials are being transferred. At the site of an accidental spill the chemicals are often diluted with water, washing the chemical into the soil or a stream and increasing the possibility of surface water contamination.

Underground Storage Tanks (USTs)

Underground storage tanks are commonly used for chemical storage. Some homes have underground tanks for heating oil. Many businesses and municipal highway departments also store fuel oil, diesel, gasoline, or other chemicals in onsite tanks. Industries may have storage tanks to hold chemicals used in industrial processes or to store hazardous wastes for pickup by a licensed hauler.

As underground storage tanks age and corrode, they commonly develop leaks. Here chemicals can migrate through the soil and reach the surface water. From 1986 to 2005, almost half a million leaking USTs have been discovered nationwide, and approximately 120,000 still require remediation (CRS Report for Congress, March 2006). Newer tanks are more corrosion resistant, but they may not be totally leak-proof. Abandoned underground tanks pose another problem because their location often is unknown. Many underground storage tanks must be registered with Ohio's Bureau of Underground Storage Tank Regulation (BUSTR). BUSTR may also oversee the cleanup of leaks or spills from these tanks. For more information, contact BUSTR at (614) 752-7938.

Above-ground Storage Tanks (ASTs)

Unlike underground storage tanks, there is no single comprehensive regulation governing above ground storage tanks. Federal laws that regulate aboveground tanks include the Clean Water Act (secondary containment and spills to surface water), the Oil Pollution Act (spill prevention and spill response), the Clean Air Act (venting of gases), and Resource Conservation and Recovery Act (hazardous waste storage) – depending on the substance contained in the tank. For example, the requirements of the Oil Pollution Act only apply to aboveground storage tanks containing 660 or more gallons of oil (or to a facility with a total of 1,320 gallons when all of the ASTs are considered). In Ohio, several state and local agencies regulate ASTs, including Ohio EPA (Oil Pollution Act requirements), the Ohio Department of Natural Resources (Oil Pollution Act requirements for oil wells) and the State Fire Marshal or local fire department (fire code requirements on siting and construction).

Appendix E
Case Studies

Case Study #1
Hamilton to New Baltimore Ground Water Consortium
Communities Working Together

FOCUS - It is important to work together to come up with solutions to complex issues that affect drinking water sources. This case study is a good example of communities working together toward source water protection.

The Hamilton to New Baltimore Ground Water Consortium is located along the Great Miami River north of Cincinnati. The consortium includes six public and industrial ground water producers/users serving more than 300,000 people. The systems all obtain their municipal supplies from ground water in glacial sand and gravel deposits. Cooperation in drinking water supply planning and protection has been an important issue for these water systems for more than 30 years. After determining the one-, five- and 10-year time-of-travel zones for the wells, the consortium conducted a potential contaminant source inventory. The consortium decided to include a 10-year time-of-travel zone because of the many potential contaminant sources located just outside the 5-year time of travel. The inventory identified more than 700 potential contaminant sources at 394 sites in their joint protection area, including numerous small and potentially unregulated used oil tanks.

Based on these figures, the consortium worked to establish an ordinance that prohibits certain activities throughout the protection area and requires the registration of facilities that store or use certain regulated materials. Because the consortium does not have the authority to enact the ordinance, it has had to work with the cities, townships, and county to enact it. Two municipalities in the consortium – the cities of Hamilton and Fairfield – have already enacted the ordinance. Although Ross and St. Clair Townships are not members of the consortium, they have recognized the importance of drinking water source protection and have enacted resolutions for their zoning that mirror the municipalities'. The consortium also has conducted an extensive education and outreach program, starting with the potential contaminant source inventory. The consortium has developed fact sheets and brochures, curricula for school teachers, maintains a web site (http://www.gwconsortium.org), and sponsors the Butler County Children's Water Festival.

The consortium's contingency plan has three main components: notification to the Wellhead Protection Coordinator, submission of release information, and incident assessment. The consortium's contingency plan addresses both hazardous materials releases associated with an accident and releases detected through ground water monitoring. The primary objective of the plan is to ensure that the consortium is informed of, and kept up to date on, the status of hazardous material releases in the protection areas. This allows evaluation of the nature of a release, clean up activities, and potential for long-term groundwater quality impacts from these releases. Secondary objectives include tracking the occurrence of regulated substance releases in the protection areas, spill prevention awareness, and general ground water education for area fire departments.

The consortium utilizes the strengths of each of its members. One entity oversees the monitoring program, another management. All participate in public education and all pay for the installation and sampling of the monitoring wells. The monitoring wells serve as an early warning system for the production wells. Eighteen monitoring wells around the consortium's well fields are monitored monthly for water levels and semi-annually for various water quality parameters. Installation of additional monitoring wells around the consortium's wellfields is planned in the future as the members prepare to re-delineate all the wellfields.

(For more information: http://www.gwconsortium.org)

Case Study #2
Toledo's Plan for Combined and Sanitary Sewer Overflows
Addressing Century-Old Infrastructure

FOCUS - We need to recognize that Combined and Sanitary Overflows are pollutant sources that adversely impact water quality. The following is an example of how Toledo is addressing this problem. Even though it may take a while to fix the problem, the first step followed by persistence is the key to success.

Reference:

- Donald M. Moline, Director
- Department of Public Utilities

Combined Sewer Overflows (CSOs)

The City of Toledo currently has 31 CSO Regulators that, during wet weather, discharge a little over 300 million gallons of combined sewage into area streams on an annual basis. Of the 31 overflows, six discharge into the Ottawa River.

Current U.S. EPA Policy and Ohio EPA Strategy require major control measures and construction commitments of all CSO communities. Toledo, however, started its CSO abatement program with the passage of the Clean Water Act in 1972. After completion of an extensive CSO Impact Study in 1978, the City proceeded with construction on projects that would reduce or eliminate combined sewer discharges in area streams. These projects included:

- the Ten Mile Creek relief sewers that reduced overflows to the Ottawa River;
- CSO Regulator renovations to maximize treatment of wet weather flows;
- tide gate installation to eliminate extraneous flows to the CSO system;
- construction of the Downtown and Swan Creek storage/treatment tunnels to reduce overflows and increase treatment capability; and
- elimination of four (4) CSO outfalls from the system.

The city completed this work over a 15-year period at a cost of over $75 million. Toledo is continuing to be proactive in reducing the impact of CSOs by systematically eliminating sources of flow that discharge into the combined sewer system. These projects are cost beneficial, and usually in the range of $500,000 to $2 million each.

Sanitary Sewer Overflows (SSOs)

To counteract wet weather problems with surcharged sanitary sewers, the city constructed three permanent pump stations - one at 129th Street and Edgewater Drive, one at 145th Street and Edgewater Drive, and the last at 290th Street and Ottawa River Road. The 129th Street station discharges to Maumee Bay, and the other two discharge to the Ottawa River.

Due to the magnitude of the problem (approximately 1,000 acres and 200,000 feet of sanitary sewers), the city began an extensive study of the Point Place sewer system in 1994.The study included flow monitoring to locate areas of excessive inflow and infiltration (I/I), followed by smoke and dye testing, and televising of selected sewers to determine sources of the I/I. The city completed the study in July 1997, and recommended a two-phase improvement program.

Case Study #3
City of Columbus
A Watershed Approach

FOCUS - The City of Columbus is taking great strides toward source water protection. They have used imagination and ingenuity to develop protective strategies.

Reference:
- City of Columbus
- City of Columbus SWAP Report

This section describes notable protective strategies currently used in the Columbus, Ohio source water protection areas.

Land Stewardship Program

The Division of Water has established a program to work with the nearly 1,200 residential landowners living contiguous to the Hoover, O'Shaughnessy and Griggs Reservoirs. Primary goals of this program include elimination of encroachments, implementation of best management practices along the waterways, and securing land stewardship agreements. Land stewardship agreements are personalized contracts with the contiguous landowners who give permission for limited landscape management on city-owned riparian land. This outreach program is succeeding through personal contact and landowner education on best management practices. Prior to this program, many landowners were maintaining mown lawns to the water's edge and erodible paths. Now, landowners are mowing less, establishing buffer zones of grasses and native plants to slow run-off, and minimizing impact to the riparian corridor. This program, established in 1996 is improving through the use of databases, documentation of land conditions and photographic records of land-use changes.

Watershed Ranger Staff

The Division of Water, Watershed Management Section employs eleven Water Protection Specialists, commonly known as Watershed Rangers. Two shifts of Rangers patrol the watershed areas using boats, vehicles, and foot patrol to identify potential sources of contamination. They maintain and secure the city-owned land and facilities surrounding the reservoirs and serve as contact points for the public. Duties include regular and special water sampling, various educational efforts, monitoring of contiguous properties, and cooperation with law enforcement, and other agencies to respond to violations of park and reservoir rules and regulations.

Public Outreach at Special Events

All three reservoirs are popular recreation destinations for central Ohio. Watershed Rangers participate in the annual Boat Show and the Sports, Vacation and Travel Show, both held at the Ohio State Fairgrounds. By staffing an information booth with various brochures and computerized slide show, the rangers educate attendees on the water quality impacts of boating, and park rules and regulations (many of which are based on a water quality preservation concept).

Reservoir Litter Clean-ups

Every year, two litter clean ups are organized by the Watershed Management Section at Hoover and O'Shaughnessy Reservoirs. The clean-ups attract recreational users, scouts, school groups, and neighbors, with some year's participation totaling 400 volunteers. Gloves, bags and refreshments are provided for the volunteers who collect litter from the banks and public access areas around the reservoir. The spring clean-up is held in conjunction with other area clean-ups in the Big Walnut Creek and Scioto River Watersheds to celebrate River Pride Week.

Agricultural Programs

With agriculture as the primary land use in the Big Walnut Creek Watershed, the Division of Water has actively pursued programs to reduce erosion, pesticide and nutrient loading into Hoover Reservoir. The Big Walnut Creek Water Quality Partnership is a volunteer consortium representing producers, and agencies including City of Columbus, Soil and Water Conservation Districts, ODNR, Ducks Unlimited, Pheasants Forever and USDA.

A variety of voluntary incentive programs encourage best management practices (BMPs) such as filter strips, riparian buffers, tree plantings and wildlife habitat. In 2002, the Partnership was instrumental in establishing a Conservation Reserve Enhancement Program (CREP) for the Big Walnut Creek Watershed. This program provides more than $13 million in financial incentives to farmers and other landowners to establish important watershed protection activities with a goal of enrolling 3,500 acres into conservation practices. The Division of Water has contributed funds and in-kind services to support these programs.

In addition to CREP, the Big Walnut Creek Water Quality Partnership facilitates enrollment in the Environmental Quality Incentive Program (EQIP) program which has enrolled more than 28 thousand acres of land in Delaware and Morrow counties between 1998 and 2002. This program minimizes atrazine use through use of alternative herbicides. The Division of Water has also established funds for perpetual conservation easements. Interest in these easements is being pursued with a large egg farm operation in the Scioto River Watershed, as well as from individual landowners who do not qualify for conservation programs like CREP.

Currently work is underway to establish a CREP in the Scioto River Watershed. With a much larger watershed drainage area, the Scioto CREP is a challenge for the many stakeholders, including the Division of Water, but progress is being made.

Case Study #4
Upper Big Walnut Creek
Reducing Atrazine in Drinking Water via Watershed Protection

FOCUS - Atrazine is a persistant pesticide that is occasionally found in drinking water. This case study demonstrates how watershed protection efforts can be used to minimize impacts of this agricultural chemical on drinking water.

Reference:

- *Upper Big Walnut Creek Watershed Water Quality Management Plan* (http://www.delawareswcd.org/Watershed/UBWC/)
- *A Tale of Two Watersheds: Big Walnut Creek and the Scioto River* (Dan Binder, City of Columbus, Division of Water)

Introduction

The Upper Big Walnut Creek watershed serves as a drinking water source for the City of Columbus and surrounding communities. The presence of the agricultural chemical atrazine in the source water helped prompt the development of the Upper Big Walnut Creek Water Quality Partnership in 1997. The partnership includes diverse representation from local farmers, the City of Columbus, Ohio Farm Bureau, County NRCS and SWCD offices, state government, and many other organizations.

The goal of the Upper Big Walnut Creek Water Quality Partnership is to protect the water resource quality of the Big Walnut Creek watershed. To help achieve water quality goals, the partnership has promoted the use of Environmental Quality Incentive Program (EQIP) funds and newer Conservation Reserve Enhancement Program (CREP) (http://wwwapp.epa.ohio.gov/dsw/nps/NPSMP/FUND/fundusda.html) funds to support voluntary and innovative restoration and protection strategies throughout the watershed. To help assess the impact of these programs, a comparison of water quality between the Big Walnut Creek watershed and Upper Scioto River watershed was conducted. Future studies will attempt to assess the effectiveness of the EQIP and CREP programs more definitively.

Background

The Upper Scioto River and Big Walnut Creek flow through similar primary land cover of row crop agriculture in central Ohio. Soils in the watersheds vary slightly, with more limestone bedrock in the Upper Scioto River and more shale bedrock in the Big Walnut drainage. Both watersheds are used for drinking water supply and both water sources have problems with seasonal atrazine runoff. Due to differences in the two waterway reservoir systems there is a difference in how runoff can affect the water quality of the reservoirs. In the Big Walnut, the Hoover reservoir can contain up to 22 billion gallons of stored water. The Griggs and O'Shaughnessy reservoirs together hold only 6 billion gallons of Upper Scioto River water. As a result of Hoover reservoir's larger size, problems in water quality can really linger. The long time that a pollutant stays in Hoover is a primary reason why the Big Walnut partnership was formed.

Water Quality Sampling

Comparison of atrazine concentrations in the Upper Scioto River with those in the Upper Big Walnut Creek may demonstrate whether the best management practices used in the Big Walnut EQIP project (which have not been used in the Upper Scioto River) are making a difference in atrazine run-off. However, each year the weather and runoff patterns present a unique set of variables to consider and the 2002 season was no exception. Rainfall June 5-6, 2002, was nearly two inches across the region. Basin-wide corn planting and atrazine spraying likely had occurred by this time in both watersheds. Since there are differences in rainfall and farm activities in the two watersheds, only a general comparison is possible.

Atrazine run-off in the Upper Scioto River occurred quickly following the June 2002 rain events, spiking to nearly 20 ppb in samples taken at several water quality monitoring locations by June 10th. In contrast, atrazine values rose to less than half the Upper Scioto levels in samples taken from Big Walnut Creek and tributaries. For example, a sample taken from Duncan Run, a tributary to the Big Walnut, exhibited 12 ppb atrazine shortly after June 5th, while at the same time the Upper Scioto samples were analyzed at 25 ppb. The pulse of atrazine moved rapidly down the Upper Scioto reaching the Dublin Road Water Plant intake by June 10th. A powdered activated carbon feed treatment system was initiated and an atrazine maximum contaminant level exceedance was averted. By August 21, 2002, no powdered activated carbon treatment had been necessary for atrazine removal in the Hap Cremean Water Plant, which treats the Hoover reservoir drinking water supply. Concentrations in Hoover Reservoir stayed below the 3 ppb maximum contaminant level for the rest of the season.

Preliminary Results

There are uncontrollable variables between watersheds, however the data seem to indicate that significant atrazine runoff occurred as expected in the Upper Scioto River system (due to rain and crop planting schedules), but was much less for the Big Walnut Creek, as observed by the lower atrazine values in the tributaries and Hoover reservoir. This has resulted in considerable dollar savings because the use of powdered activated carbon was reduced for the Hap Cremean Water Plant, as compared to prior years.

Additional Studies

The following projects have been initiated to help determine the effectiveness of agricultural management practices implemented in the Big Walnut Creek watershed, and their applicability in other watersheds.

In 2002, the Ohio River Valley Sanitation Commission (ORSANCO) received a U.S. EPA research grant. For more information on the grant, go to http://www.orsanco.org/index.php/component/content/article/10-orsanco-programs/103-upper-big-walnut-creek and http://delawareswcd.org/Watershed/UBWC/ .

The Source Water Protection Initiative (SWPI), conducted by the Agricultural Research Service (USDA-ARS), is funded through the America's Clean Water Foundation. This research will examine the effects of both currently used conservation practices (e.g., voluntary, incentive-based Farm Bill programs) as well as some that are more innovative and untried. This will entail an intensive quantification and qualification of watershed conditions (e.g., soil type, farm management, etc.) across multiple sub-watershed spatial scales. The purpose is to look at the individual effects of specific conservation practices, as well as their relative impacts when used in combination. This will be accomplished through paired comparisons of water quality in watersheds that have these conservation practices with those that do not (control group).

The Big Walnut Creek watershed is one of three watersheds included in the Source Water Protection Initiative. The NRCS-led Conservation Effects Assessment Program (CEAP) also has designated the Upper Big Walnut as one of twelve benchmark watersheds and will cooperate in this ARS study. More information is available online at http://www.ars.usda.gov/is/AR/archive/may04/form0504.pdf. The results will likely be used to guide future decisions regarding the availability and funding allocations for USDA conservation programs.

In addition, a new guidance document based on the collaboration between the City of Columbus water department, local farmers and agricultural representatives will discuss how public water supply systems can build partnerships with the agricultural community. More information is available online at http://delawareswcd.org/Watershed/UBWC/index.php/ubwc-water-quality-partnership.

Funding

Substantial amounts of funding have been dedicated to reduce atrazine loadings to the Big Walnut watershed, and similar funding proposals are in place for the Upper Scioto. From 1998 to 2002, the USDA's Environmental Quality Incentives Program (EQIP) has implemented management practices (MPs) on more than 23,000 cropland acres in the Big Walnut at a cost of approximately $1.2 million. Beginning in 2002, federal, state and local funding became available for riparian corridor protection through the Conservation Reserve Enhancement Program (CREP) and will exceed $13 million for the Big Walnut over the life of the program. This is in addition to past and continued local and state funding for water quality monitoring and funding from U.S. EPA. The Upper Scioto River watershed has also received Clean Water Act Section 319 funding to support a full time watershed coordinator and development of a watershed action plan.

APPENDIX F
SUMMARY OF DRINKING WATER SOURCE PROTECTION TOOLS

Regulatory: Zoning				
	Applicability to Drinking Water Source Protection	**Land Use Practice**	**Legal Considerations**	**Administrative Considerations**
Overlay GW Protection Districts	Used to map drinking water source protection areas. Provides for identification of sensitive areas for protection. Used in conjunction with other tools.	Community identifies drinking water source protection areas on practical base/zoning map.	Well accepted method of identifying sensitive areas. May face legal challenges if drinking water source protection area boundaries are based solely on arbitrary delineation.	Requires staff to develop overlay map. Inherent nature of zoning provides ■grandfather• protection to pre-existing uses and structures.
Prohibition of Various Land Uses	Used within mapped drinking water source protection areas to prohibit ground water contaminants and uses that generate contaminants.	Community adopts prohibited uses list within their zoning ordinance.	Well organized function of zoning. Appropriate techniques to protect natural resources from contamination.	Requires amendment to zoning ordinance. Requires enforcement by both visual inspection and onsite investigations.
Special Permitting	Used within drinking water source protection areas to restrict uses that may cause ground water contamination if left unregulated.	Community adopts special permit ■thresholds• for various uses and structures within drinking water source protection areas. Community grants special permits for ■threshold• uses only if ground water quality will not be compromised.	Well organized method of segregating land uses within critical resource areas such as drinking water source protection areas. Requires case-by-case analysis to ensure equal treatment of applicants.	Requires detailed understanding of drinking water source protection area sensitivity by local permit granting authority. Requires enforcement of special permit requirements and onsite investigations
Large-Lot Zoning	Used to reduce impacts of residential development by limiting number of units within drinking water source protection areas.	Community ■down zones• to increase minimum acreage needed for residential development.	Well recognized prerogative of local government. Requires rational connection between minimum lot size selected and resource protection goals. Arbitrary large lot zones have been struck down without logical connection to Master Plan or drinking water source protection program.	Requires amendment to zoning ordinance.

APPENDIX F
SUMMARY OF DRINKING WATER SOURCE PROTECTION TOOLS

Regulatory: Zoning				
	Applicability to Drinking Water Source Protection	**Land Use Practice**	**Legal Considerations**	**Administrative Considerations**
Transfer of Development Rights	Used to transfer development from drinking water source protection areas to locations outside protection areas.	Community offers transfer option within zoning ordinance. Community identifies areas where development is to be transferred ■from• and ■to.•	Accepted land use planning tool.	Cumbersome administrative requirements. Not well suited for small communities without significant administrative resources.
Cluster/PUD Design	Used to guide residential development outside of drinking water source protection areas. Allows for ■point source• discharges that are more easily monitored.	Community offers cluster/PUD as development option within zoning ordinance. Community identifies areas where cluster/PUD is allowed (i.e., within drinking water source protection areas).	Well-accepted option for residential land development.	Slightly more complicated to administrator than traditional ■grid• subdivision. Enforcement/ inspection requirements are similar to ■grid• subdivision.
Growth Controls/ Timing	Used to time the occurrence of development within drinking water source protection areas. Allows communities the opportunity to plan for wellhead delineation and protection.	Community imposes growth controls in the form of building caps, subdivision phasing, or other limitation tied to planning concerns.	Well-accepted option for communities facing development pressures within sensitive resource areas. Growth controls may be challenged if they are imposed without a rational connection to the resource being protected.	Generally complicated administrative process. Requires administrative staff to issue permits and enforcement growth control ordinances.
Performance Standards	Used to regulate development within drinking water source protection areas by enforcing predetermined standards for water quality. Allows for aggressive protection of drinking water source protection areas by limiting development to an accepted level.	Community identifies drinking water source protection areas and established ■thresholds• for water quality.	Adoption of specific drinking water source protection area performance standards requires sound technical support. Performance standards must be enforced on a case-by-case basis	Complex administrative requirements to evaluate impacts of land development with drinking water source protection areas.

Regulatory: Subdivision Control				
	Applicability to Drinking Water Source Protection	**Land Use Practice**	**Legal Considerations**	**Administrative Considerations**
Drainage Requirements	Used to ensure that subdivision road drainage is directed outside of drinking water source protection areas. Used to employ advanced engineering designs of subdivision roads within drinking water source protection areas.	Community adopts stringent subdivision rules and regulations to regulate road drainage/runoff in subdivisions within drinking water source protection areas.	Well accepted purpose of subdivision control.	Requires moderate level of inspection and enforcement by administrative staff.

Regulatory: Health Regulations				
	Applicability to Drinking Water Source Protection	**Land Use Practice**	**Legal Considerations**	**Administrative Considerations**
Underground Fuel Storage Systems	Used to prohibit underground fuel storage systems (USTs) within drinking water source protection areas. Used to regulate USTs within drinking water source protection areas.	Community adopts health/ zoning ordinance prohibiting USTs within drinking water source protection areas. Community adopts special permit or performance standards for use of USTs within drinking water source protection areas.	Well-accepted regulatory option for local government.	Prohibition of USTs require little administrative support. Regulating USTs requires moderate amounts of administrative support for inspection follow-up and enforcement.
Privately Owned Wastewater Treatment Plants/ Small Sewage Treatment Plants	Used to prohibit small sewage treatment plants (SSTP) within drinking water source protection areas.	Community adopts health/zoning ordinance prohibiting the use of septic cleaners containing 1,1,1-trichloroethane or other solvent compounds within drinking water source protection areas.	Well-accepted regulatory option for local government.	Prohibition of SSTPs require little administrative support. Regulating SSTPs requires moderate amount of administrative support of inspection follow-up and enforcement.
Septic Cleaner Ban	Used to prohibit the application of certain solvent septic cleaners, a known ground water contaminant, within drinking water source protection areas.	Community adopts health/ zoning ordinance prohibiting the use of septic cleaners containing 1,1,1-trichloroethane or other solvent compounds within drinking water source protection areas.	Well accepted method of protecting ground water quality.	Difficult to enforce even with sufficient administrative support.

Regulatory: Health Regulations				
	Applicability to Drinking Water Source Protection	**Land Use Practice**	**Legal Considerations**	**Administrative Considerations**
Septic System Upgrades	Used to require periodic inspection and upgrading of septic systems.	Community adopts health/ zoning ordinance requiring inspection and, if necessary, upgrading of septic systems on a time basis (e.g., every 2 years) or upon title/property transfer.	Well accepted as within purview of government to ensure ground water protection.	Significant administrative resources required for this option.
Toxic and Hazardous Materials Handling Regulations	Used to ensure proper handling and disposal of toxic materials/ waste.	Community adopts health/ zoning ordinance requiring registration and inspection of all businesses within drinking water source protection area using toxic/hazardous materials above certain quantities.	Well accepted as within purview of government to ensure ground water protection.	Requires administrative support and onsite inspections.
Private Well Protection	Used to protect private onsite water supply wells.	Community adopts health/ zoning ordinance to require permits for new private wells and to ensure appropriate well-to-septic-system setbacks. Also requires pump and water quality testing.	Well accepted as within purview of government to ensure ground water protection.	Requires administrative support and review of applications.

Non-regulatory: Land Transfer and Voluntary Restrictions				
	Applicability to Drinking Water Source Protection	**Land Use Practice**	**Legal Considerations**	**Administrative Considerations**
State/Donation	Land acquired by a community with drinking water source protection areas, either by purchase or donation. Provides broad ground water supply protection.	As non-regulatory technique, communities generally work in partnership with non-profit land conservation organizations.	There are many legal consequences, mostly involving liability.	There are few administrative requirements involved. Administrative requirements for maintenance may be substantial, particularly if the community does not have a program for open space management.
Conservation Easements	Can be used to limit development within drinking water source protection areas.	Similar to sales/donations, conservation easements are generally obtained with the assistance of nonprofit land conservation organization.	There are many legal consequences, mostly involving liability.	There are few administrative requirements involved. Administrative requirements for maintenance may be substantial, particularly if the community does not have a program for open space management.
Limited Development	As the title implies, this technique limits development to portions of a land parcel outside of drinking water source protection areas.	Land developers work with community as part of a cluster/ PUD to develop limited portions of a site and restrict other portions, particularly those within drinking water source protection areas.	Similar to those noted in cluster/PUD (under zoning).	Similar to those noted in cluster/PUD (under zoning).

Non-regulatory: Other

	Applicability to Drinking Water Source Protection	Land Use Practice	Legal Considerations	Administrative Considerations
Monitoring	Used to monitor ground water quality within drinking water source protection areas.	Communities establish ground water monitoring program within drinking water source protection area. Communities require developers within protection areas to monitor ground water quality downgradient from their development.	Accepted method of ensuring ground water quality.	Requires moderate administrative staffing to ensure routine sampling and response if sampling indicates contamination.
Contingency Plans	Used to ensure appropriate response in cases of contaminant release or other emergencies within drinking water source protection areas.	Community prepares a contingency plan involving wide range of municipal/county officials.	None.	Requires significant up-front planning to anticipate and be prepared for emergencies.
Hazardous Waste Collection	Used to reduce accumulation of hazardous materials within drinking water source protection areas and the community at large.	Communities, in cooperation with the state, regional planning commission, or other entity, sponsor a ■hazardous waste collection day• several times per year.	There are several legal issues, raised by the collection, transport, and disposal of hazardous waste.	Hazardous waste collection programs are generally sponsored by government agencies, but administered by a private contractor.
Public Education	Used to inform community residents of the connection between land use within drinking water source protection areas and drinking water quality.	Communities can use a variety of public education techniques ranging from brochures detailing their drinking water source protection program, to seminars, to involvement in events such as hazardous waste collection days.	No outstanding legal considerations.	Requiring some degree of administrative support for programs such as brochure mailing to more intensive support for seminars and hazardous waste collection days.

Legislative				
	Applicability to Drinking Water Source Protection	**Land Use Practice**	**Legal Considerations**	**Administrative Considerations**
Regional Drinking Water Source Protection Districts	Used to protect regional aquifer systems by establishing new legislative districts that often transcend existing corporate boundaries.	Requires state legislative action to create a new legislative authority.	Well-accepted method of protecting regional ground water resources.	Administrative requirements will vary depending on the regional district's goal. Mapping of the regional protection areas requires moderate support, while creating land use controls within the protection areas will require significant administrative personnel and support.
Land Banking	Used to acquire and protect land within drinking water source protection areas.	Land banks are usually accomplished with a transfer tax established by state government empowering local government to impose a tax on the transfer of land from one party to another.	Land banks can be subject to legal challenge as an unjust tax, but have been accepted as a legitimate method of raising revenue for resource protection.	Land banks require significant administrative support if they are to function effectively.

Source - Modified from *Wellhead Protection: Guide for Small Communities*. (U.S. EPA., February 1993).

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U.S. Environmental Protection Agency – http://www.epa.gov
U.S. EPA's main Web site

U.S. EPA, Office of Water
Ground Water and Drinking Water Programs – http://www.epa.gov/OGWDW
This site contains information about U.S. EPA's Source Water Protection Program, fact sheets, and other materials that public water systems and protection teams will find helpful in developing a protection plan.

U.S. EPA
Region 5 Water Programs – http://www.epa.gov/r5water
This Web site holds information about source water protection in the Great Lakes Region.

Ohio Environmental Protection Agency – http://www.epa.ohio.gov
Ohio EPA's main Web site

Ohio EPA Division of Drinking and Ground Waters Source Water Assessment and Protection Program – http://www.epa.ohio.gov/ddagw/swap.aspx
These pages contain information about Ohio's Source Water Assessment and Protection Program, fact sheets, and other materials that public water systems and protection teams will find helpful in developing a protection plan. This site also provides links to other Web sites with additional drinking water source assessment and protection information.

Ohio EPA
Office of Pollution Prevention – http://www.epa.ohio.gov/opp
This Web site contains information, fact sheets, links, and other materials about pollution prevention and best management practices.

The Ohio State University Extension – http://extension.osu.edu/
These pages contain fact sheets and other educational materials that public water systems and protection teams will find helpful in developing a protection plan.

Ohio Department of Natural Resources – http://www.dnr.state.oh.us
This Web site Contains information, fact sheets, and other materials that public water systems and protection teams may find helpful in developing a protection plan. Some grants available from the Department of Natural Resources may be useful for developing greenspace in protection areas.

Purdue Extension - Forming the Wellhead Protection Planning Team - https://engineering.purdue.edu/SafeWater/wellhead/team1.htm
This site contains information about protection teams, the protection planning process, team membership, and conducting planning meetings.

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50 West Town Street	Ohio EPA - DDAGW
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(614) 644-2752	Columbus, OH 43216-1049

Division of Air Pollution Control (DAPC) http://www.epa.ohio.gov/dapc	(614) 644-2270
Division of Drinking and Ground Waters (DDAGW) http://www.epa.ohio.gov/ddagw	(614) 644-2752
Division of Emergency and Remedial Response (DERR) http://www.epa.ohio.gov/derr	(614) 644-2924
Division of Hazardous Waste Management (DHWM) http://www.epa.ohio.gov/dhwm	(614) 644-2917
Division of Solid and Infectious Waste Management (DSIWM) http://www.epa.ohio.gov/dsiwm	(614) 644-2621
Division of Surface Water (DSW) http://www.epa.ohio.gov/dsw	(614) 644-2001
Office of Compliance Assistance and Pollution Prevention (OCAPP) http://www.epa.ohio.gov/ocapp	(614) 644-3469
Office of Environmental Education (OEE) http://www.epa.ohio.gov/oee	(614) 644-2873

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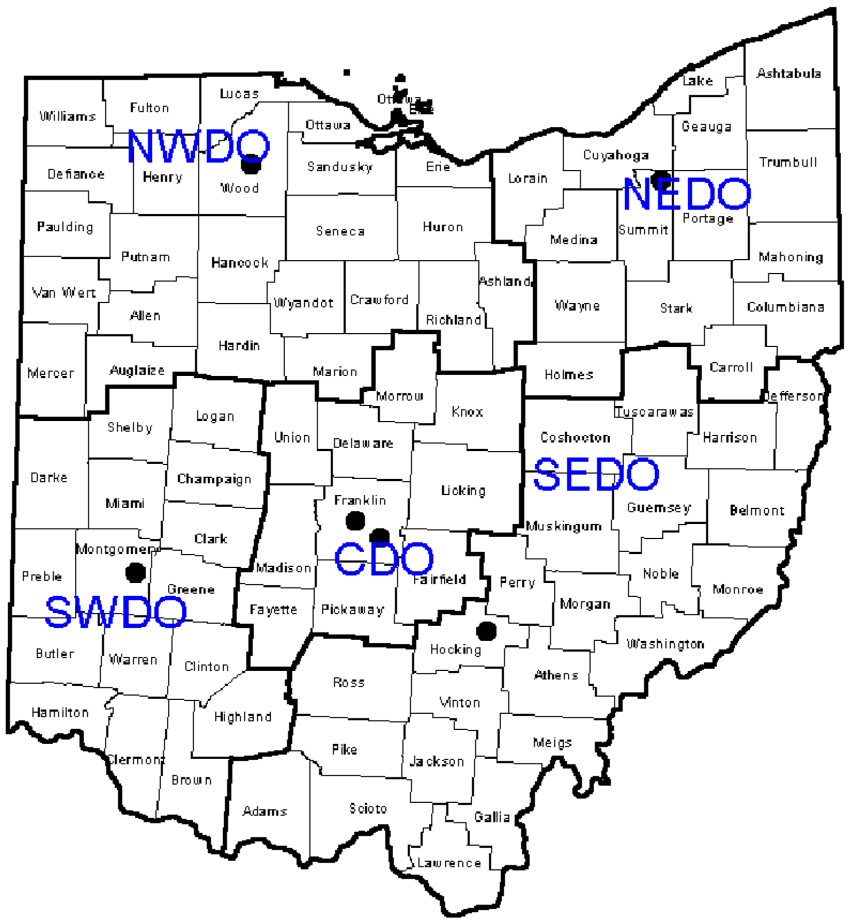

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(740) 385-8501
1-800-686-7330

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CHAPTER TWO – PLANNING :

Information about current watershed groups: http://ohiowatersheds.osu.edu/groups-huc/

List of watersheds with endorsed and conditionally endorsed watershed action plans:
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CHAPTER THREE - ASSESSMENT:

Technical Support Documents are available for most Ohio watersheds at:
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Information on TMDL program, and a list of watersheds with completed TMDLs:
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Upper Big Walnut Creek Watershed Water Quality Management Plan: http://www.delawareswcd.org/Watershed/UBWC/

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