



Drinking Water: Protecting the Source

USDA
NRCS
United States Department of Agriculture
Natural Resources Conservation Service



Source Water Protection in Agricultural Communities: The Watershed Management Approach

Lesson: 17

National Science
Education
Standards for
Grades 9-12

Content Standard A: Abilities Necessary to Do Scientific Inquiry

- *Design and conduct scientific investigations.*

Content Standard D: Earth Science: Geochemical Cycles

- *The earth is a system containing essentially a fixed amount of each stable chemical atom or element. Each element can exist in several different chemical reservoirs. Each element on earth moves among reservoirs in the solid earth, oceans, atmosphere and organisms as part of geochemical cycles.*

Content Standard F: Science in Personal and Social Perspectives: Natural Resources

- *Human populations use resources in the environment in order to maintain and improve their existence. Natural resources have been and will continue to be used to maintain human populations.*

Content Standard F: Science and Technology in Local, National and Global Challenges

- *Humans have a major effect on other species. For example, the influence of humans on other organisms occurs through land use—which decrease space available to other species—and pollution—which changes the chemical composition of air, soil and water.*

Student Learning
Objectives

- 17.1 Describe the watershed approach to protecting aquatic ecosystems.
- 17.2 Describe their own watershed in great detail to apply the watershed approach to protecting sources of drinking water.

Teacher Info Table Time

Instruction time for this lesson: 50 minutes

Resources, Tools, Equipment and Supplies

17.1 Describe the watershed approach to protecting aquatic ecosystems.

Resources

- Slide SW.17.TM.A – *The Watershed Approach Framework*
- Slide SW.17.TM.B – *Aquatic Ecosystems*
- Ecological Society of America. (2003). Sustaining healthy freshwater ecosystems. *Issues in Ecology*. 10, 1-16. Retrieved August 24, 2009, from http://www.esa.org/science_resources/issues/FileEnglish/issue10.pdf
- Watersheds, U.S. EPA: <http://water.epa.gov/type/watersheds/index.cfm>
- Watershed Approach Framework, U.S. EPA: <http://www.epa.gov/owow/watershed/framework/>
- Watershed Academy Training Module on Surf Your Own Watershed and other EPA tools: http://water.epa.gov/learn/training/wacademy/epatools_index.cfm
- Watershed Central website: <http://water.epa.gov/type/watersheds/datait/watershedcentral/index.cfm>
- Healthy Watersheds website: <http://water.epa.gov/polwaste/nps/watershed/>

Equipment

Computer
LCD projector

Resources, Tools, Equipment and Supplies

17.2 Describe their own watershed in great detail to apply the watershed approach to protecting sources of drinking water.

Resources

- Science in your Watershed, USGS: <http://water.usgs.gov/wsc/>
- Surf Your Watershed (EPA): <http://cfpub.epa.gov/surf/locate/index.cfm>
- Water Quality Assessment and Total Maximum Daily Loads Information (ATTAINS) [Check condition of local surface waters with this database.] <http://www.epa.gov/waters/ir/>

Tools

Topographic map of your county
Road map that includes your county

Equipment

Computer with Internet access for groups of 2-3 students

Supplies

Copies of worksheet SW.17.2.AS, *My Community's Watershed*, for each student

Key Terms

Adaptive management
Aquatic ecosystems
Ecosystem services
Impaired water
Stakeholders
Stream flow
Watershed
Watershed approach

SUMMARY OF CONTENT AND TEACHING STRATEGIES: [BACKGROUND FOR TEACHERS]

Watershed Approach Framework¹

Watershed Approach Framework

People working together to protect public health and the environment – community by community, watershed by watershed.

Carol M. Browner, Administrator
U.S. Environmental Protection Agency
June 1996

The watershed approach is a coordinating framework for environmental management that focuses public and private sector efforts to address the highest priority problems within hydrologically-defined geographic areas, taking into consideration both ground and surface water flow.

EPA supports watershed approaches that aim to prevent pollution, achieve and sustain environmental improvements and meet other goals important to the community. Although watershed approaches may vary in terms of specific objectives, priorities, elements, timing and resources, all should be based on the following guiding principles.

A. Partnerships -- Those people most affected by management decisions are involved throughout and shape key decisions.

This ensures that environmental objectives are well integrated with those for economic stability and other social and cultural goals. It also provides that the people who depend upon the natural resources within the watersheds are well informed of and participate in planning and implementation activities.

B. Geographic Focus -- Activities are directed within specific geographic areas, typically the areas that drain to surface water bodies or that recharge or overlay groundwaters or a combination of both.

C. Sound Management Techniques based on Strong Science and Data — Collectively, watershed stakeholders employ sound scientific data, tools, and techniques in an iterative decision making process. This includes:

- Assessment and characterization of the natural resources and the communities that depend upon them
- Goal setting and identification of environmental objectives based on the condition or vulnerability of resources and the needs of the aquatic ecosystem and the people within the community

¹ From Watershed Approach Framework, U.S. EPA: <http://www.epa.gov/owow/watershed/framework/>

- Identification of priority problems
- Development of specific management options and action plans
- Implementation
- Evaluation of effectiveness and revision of plans, as needed.

Because stakeholders work together in an effort to protect drinking water sources, actions are based upon shared information and a common understanding of the roles, priorities and responsibilities of all involved parties. Concerns about environmental justice are addressed and, when possible, pollution prevention techniques are adopted. The iterative nature of the watershed approach encourages partners to set goals and targets and to make maximum progress based on available information while continuing analysis and verification in areas where information is incomplete.

EPA's Watershed Approach Framework

A. Watershed Definition

1. A watershed is an area of land that drains to a particular river, lake, bay, underground aquifer or other body of water. Some watersheds are large, while others are small (like your local stream or creek). Watersheds are sometimes called “basins” or “drainage basins.” For example, water from 31 states drains into the Mississippi River, and creates a drainage basin more than 1,245,000 square miles in size. We all live in a watershed. What we do on the land impacts our water resources, including our rivers, lakes, reservoirs and underground sources of drinking water.
2. Watersheds come in all shapes and sizes. They cross state and national boundaries. In the continental US, there are more than 2,200 8-digit Hydrologic Unit Codes (which is a watershed at a certain scale) in the Continental U.S.

B. Watershed Approach Framework

1. A framework to protect aquatic ecosystems
 - a. Watersheds supply drinking water, provide recreation and respite, and sustain life.
 - b. In the U.S., more than \$450 billion in food and fiber, manufactured goods and tourism depends on clean water and healthy watersheds.

2. An approach that is
 - a. Hydrologically defined
 - b. Geographically focused
 - c. Includes all stressors (air and water)
 3. Involves all stakeholders
 - a. Includes public (federal, state, local) and private sector
 - b. Is community based
 - c. Includes a coordinating framework
 - d. Ecosystem services are the many life-sustaining benefits we receive from nature—clean air and water, fertile soil for crop production, pollination, and flood control. These ecosystem services are important to our health and well-being, yet they are limited and often taken for granted as being free. (<http://www.epa.gov/ecology/>)
 4. Strategically addresses priority water resource goals (e.g., water quality, habitat)
 - a. Integrates multiple programs (regulatory and voluntary)
 - b. Based on sound science
 - c. Aided by strategic watershed plans
 - d. Uses adaptive management
- C. Scientific evidence indicates that aquatic ecosystems can be protected by the following:
1. Human use or modification of land that tries to minimize impacts on aquatic ecosystems.
 2. Patterns of flow that are maintained within the natural range of variation will promote sustainability of freshwater aquatic systems.
 3. Aquatic ecosystems require that sediment and shorelines, heat and light properties, chemical and nutrient inputs, and plant and animal populations fluctuate within natural levels.
 - a. Failure to provide for these natural requirements result in a loss of species and ecosystem services in wetlands, rivers and lakes.

INTEREST APPROACH:

Conserving community water resources is a complex undertaking. Protecting and restoring watersheds should be a community-driven effort, defined by a certain geographic focus (a watershed) and based on sound management technologies based in strong science and data. Management areas may vary depending on the priority problems to be addressed. When the vulnerability of drinking water is of particular concern, then the drinking water source (i.e., source water protection area for surface or groundwater sources) should be the area where actions are focused. States have defined source water protection areas and identified potential sources of contamination. Farmers and ranchers have an interest in protecting and restoring their local river, lake or stream or aquifer, and they are important stakeholders in the watershed management planning process. By implementing conservation practices, they can help protect their own drinking water sources and downstream water uses, including other communities' drinking water supplies, swimming and fishing. Other groups and individuals—drinking water utilities, watershed groups, businesses, local officials and individuals should be involved in setting priorities, determining priority actions and implementing solutions

This lesson builds on watershed concepts covered in Lesson 1 and concepts about conservation practices discussed in a number of lessons to introduce students to a comprehensive way of looking at watershed management in agricultural areas, using the Watershed Approach Framework. A suggestion for getting started:

If we think about creeks, streams or rivers near our homes, schools, or parks, they eventually flow towards a larger body of water. It all starts when it rains. Rainwater runs off the land or it soaks into the ground and eventually enters a creek, stream, or river, which flows towards a lake, bay, or even the ocean. All of the land that the creek, stream, or river runs through as water travels towards a larger body of water is part of a **watershed**.

People throughout our community have a huge impact on our water resources. We also play important roles in recognizing those impacts and protecting aquatic ecosystems. In this lesson you will explore how a water management strategy focused on watersheds can help protect aquatic ecosystems in our community.

OBJECTIVE BY OBJECTIVE:

Activity Outline and Teacher Support Information:

17.1. Describe the watershed approach to protecting aquatic ecosystems.

Show slide SW.17.1.TM.A to initiate a class review of basic information about watersheds:

A watershed is an area of land that drains to a particular river, lake, bay, underground aquifer or other body of water. Some watersheds are large, while others are small (like your local stream or creek). Watersheds are sometimes called “basins” or “drainage basins.” For example, water from 31 states drains into the Mississippi River, and creates a drainage basin over 1,245,000 square miles in size. We all live in a watershed. What we do on the land impacts our water resources, including our rivers, lakes, reservoirs and underground sources of drinking water.

Watersheds come in all shapes and sizes. They cross state and national boundaries. In the continental U.S., there are more than 2,200 8-digit Hydrologic Unit Codes (which is a watershed at a certain scale). For additional information about watershed classifications, visit the USGS web site <http://water.usgs.gov/GIS/huc.html>.

Discuss the definition of aquatic ecosystems with the help of slide SW.17.1.TM.B.

Define aquatic ecosystems - basic ecological unit composed of living and non-living elements interacting in an aqueous environment (U.S. Fish and Wildlife Service)

17.2. Describe their own watershed in great detail to apply the watershed approach to protecting sources of drinking water.

To apply a watershed approach to protect drinking water, we must first learn a great deal about the condition of the existing water resources. There are a number of online resources available to help natural resource professionals and the public gain information about specific bodies of water (both surface and groundwater) in the U.S. Students have explored some of these resources in other lessons, but in this exercise, they will be using them to get a more in-depth look at their community's watershed.

Provide a county topographic map and a road map for the class so they can connect the watershed maps to local landmarks. Make a copy of worksheet SW.17.2.AS for each student. Break the class into small groups (2-3 students). Provide a computer with Internet access for each group. Handout copies of the worksheet to students after they are sitting with their group in front of their computer.

Groups will use Surf Your Watershed (EPA), <http://cfpub.epa.gov/surf/locate/index.cfm>, to locate their watershed. They will use worksheet SW.17.2.AS to guide them through the activity. Ask students to answer the following questions, provided on the worksheet, to help them describe their watershed in detail. After they've collected data on their watershed, ask the students if any of the information is important for informing water management practices in the watershed? If so, which ones?

Your county may have more than one watershed within its boundaries. Try to make sure there is a group assigned to each of the watersheds.

This is the list of questions students will answer about their watershed:

Watershed stakeholders:

- How many citizen-based groups are at work in this watershed? Name two of those groups.
- Name two agencies or groups that are collecting water quality monitoring data from this watershed.
- Are there other environmental websites that might have information about this watershed?

Impaired Waters:

- How many impaired waters are in this watershed?
- What are the causes of water impairment?
- What is the leading cause of impairment in the watershed and how many bodies of water does it affect?
- List other sources of pollution that may be contributing to problems in your river, lake or aquifer. For example, besides agricultural runoff, are there industrial or municipal discharges, landscape modifications, changes in flow, or other forms of polluted runoff coming from urban or suburban areas?

Stream flow:

- How many water bodies are listed as being monitored for stream flow?
- Choose one of the stream numbers and record the description of the stream: Location, Drainage Area and Period of Record. Also record the date and discharge rate of the most current reading.

Science in Your Watershed:

- How many Major USGS Links are there to information describing this watershed?
- How many other related links are there (projects, publications, and info)?

Places Involving this Watershed:

- How many counties are there in your watershed?
- Click on the link for your county.
- What is the current population of the county?
- How many watersheds cross your county? Record the names of each of the watersheds.
- Is there a National Estuary Program in this watershed?
- How many states are crossed by this watershed?
- What congressional districts are crossed by this watershed?
- Are there other watersheds upstream?
- Are there other watersheds downstream?

Drinking water in your Watershed:

- Identify local drinking water sources in and under the watershed, as well as downstream from your watershed.

Hold a classroom discussion after each group has completed their worksheet. Are there other questions they have about their watershed that haven't been answered here? How would they find the answers? How did the different watersheds in the county compare in water impairment and stream flow data?

REVIEW / SUMMARY:

Imagine you are a farmer, concerned about impacts to your drinking water well, your local lake or river, or underground aquifer. Think about activities on your land that might be polluting your water or harming aquatic life. Imagine a water quality problem you're trying to solve. Write that problem down in your journal. What best conservation practice, discussed in previous lessons, might you consider as a solution to the problem? Record your thoughts in your journal.

Now imagine your farm and that problem as part of a watershed. For instance, maybe there are many farms in the watershed and a small town of 1,300 people. How might this perspective change your thinking and choices about implementing BCPs?

If you were asked to develop a watershed plan for your community, what actions would you take to protect and/or restore your lake, river or aquifer? List them in your journal. How would you prioritize them?

APPLICATION:

Extended Classroom Activity: Use EPA's Watershed Plan Builder Tool (<http://java.epa.gov/wsplanner/#>) to develop a watershed plan to protect drinking water sources in your community. EPA's Watershed Central is another great source for tools and information. <http://water.epa.gov/type/watersheds/datait/watershedcentral/index.cfm>

EVALUATION AND ANSWERS:

EVALUATION SW.17.ASSESS

1. List the three important components of the Watershed Approach Framework

a. _____

b. _____

c. _____

2. How many watersheds are in your county? _____

3. Name one of the watersheds in your county.

4. How many impaired waters are in your watershed? _____

5. In the activity you identified some watershed stakeholders listed in your county's *Surf Your Watershed* database information. Who else in the watershed should be added to the list of people who have a stake in protecting source water in your community? (name at least five)

SW.17.ASSESS Answers

1. List the three important components of the Watershed Approach Framework
 - a. Partnerships or stakeholders
 - b. Geographic or watershed focus
 - c. Sound management technologies based on strong science and data
2. How many watersheds are in your county? (Check Surf Your Watershed (EPA) <http://cfpub.epa.gov/surf/locate/index.cfm> for your county information for this and for answers 3 and 4.)
3. Name one of the watersheds in your county.
4. How many impaired waters are in your watershed?
5. Who else in the watershed should be added to the list of people who have a stake in protecting source water in your community?

Answers will vary. Sample answers: Homeowners, private well owners, municipal water providers, farmers, businesses, industry

ACTIVITY WORKSHEET(S) – AS NEEDED:

SW.17.2.AS

My Community's Watershed

Your group will use the Surf Your Watershed (EPA) website to locate and describe a watershed in your county. Directions for the activity are outlined below.

Go to the EPA's Surf Your Watershed website: <http://cfpub.epa.gov/surf/locate/index.cfm>. Click on your state. A state map will appear. Scroll down the page to the "Places involving this state" and click on the number next to "Counties." Choose your county from the list.

Answer the following questions to learn about your watershed in detail.

Watershed Stakeholders:

- How many citizen-based groups are at work in this watershed?

- Name two of those groups.

- Name two agencies or groups that are collecting water quality monitoring data from this watershed.

- Are there other environmental websites that might have information about this watershed? _____ If so, how many? _____ Name two of these websites.

SW.17.2.AS *(continued)*

Impaired Waters:

- How many impaired waters are in this watershed? _____
- Name the impaired bodies of water:

- What are the causes of water impairment?

- What is the leading cause of impairment in the watershed and how many bodies of water does it affect?

Stream flow:

- How many water bodies are listed as being monitored for stream flow? _____
- Choose one of the stream numbers and record the description of the stream: Location, Drainage Area and Period of Record. Also record the date and discharge rate of the most current reading.

Location: _____

Drainage Area: _____

Period of Record: _____

Current Reading – Date: _____ Discharge rate: _____

SW.17.2.AS *(continued)*

Science in Your Watershed:

- How many Major USGS Links are there to information describing this watershed? _____

Name two:

- How many other related links are there (projects, publications, and info)? _____

Places Involving this Watershed:

- How many counties are there in your watershed? _____

- Click on the link for your county.

- What is the current population of the county? _____

- How many watersheds cross your county? _____

- Record the names of each of the watersheds.

- Is there a National Estuary Program in this watershed? _____
- How many states are crossed by this watershed? _____
- What congressional districts are crossed by this watershed?

- Are there other watersheds upstream? If so, name them.

- Are there other watersheds downstream? If so, name them.

POWERPOINT SLIDES – AS NEEDED:

SW.17.TM.A

The Watershed Approach Framework

A ***watershed approach*** is a framework to protect aquatic ecosystems

- Watersheds supply drinking water, provide recreation and respite and sustain life.
- More than \$450 billion in food and fiber, manufactured goods and tourism depends on clean water and healthy watersheds

A watershed approach:

- Is hydrologically defined
- Is geographically focused
- Includes all stressors (air and water)

Involves all stakeholders

- Includes public (federal, state, local) and private sector
- Is community based
- Includes a coordinating framework

Strategically addresses priority water resource goals (e.g., water quality, habitat)

- Integrates multiple programs (regulatory and voluntary)
- Based on sound science
- Aided by strategic watershed plans
- Uses adaptive management

SW.17.TM.B

Aquatic Ecosystems

Scientific evidence indicates the following about aquatic ecosystems:

- Aquatic ecosystems are greatly influenced by human use or modification of land.
- Patterns of flow that are maintained within the natural range of variation will promote sustainability of freshwater aquatic systems.
- Aquatic ecosystems require that sediment and shorelines, heat and light properties, chemical and nutrient inputs, and plant and animal populations fluctuate within natural levels.
- Failure to provide for these natural requirements result in a loss of species and ecosystem services in wetlands, rivers and lakes.
- Ecosystem services are the many life-sustaining benefits we receive from nature--clean air and water, fertile soil for crop production, pollination, and flood control. These ecosystem services are important to our health and well-being, yet they are limited and often taken for granted as being free.”