Step 3: Assessing the Watershed

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TARGETING PROBLEMS

After you have established your watershed partnership and have begun the important task of publicizing your efforts and educating the public, the data gathering begins. Your group will be organizing a detective force to gather all available information on the watershed drainage area by reviewing maps, mining records, and other documents; talking to local people who are familiar with the specific mines; and conducting watershed assessments. Collecting existing and new information on the watershed drainage area is very important. Identification and characterization of CMD problem sites will determine and prioritize where clean-up projects will be conducted.

Maps, mining records, and other documents can be obtained from OSM, state mining agencies, state geological surveys, county clerks and property assessors, local historians, residents, archives, libraries, or sometimes from former employees. Much of the existing information and data pertaining to natural resources is organized by

Sources of Background Information

- *County clerk offices*
- *State water quality agencies*
- *State geological surveys*
- *Local conservation districts*
- *Libraries*
- *Universities*
- *Private consultants and industry*
- *Federal agencies*

  U.S. Environmental Protection Agency

  Office of Surface Mining

  U.S. Geological Survey

  U.S. Army Corps of Engineers

  U.S. Fish and Wildlife Service

  U.S. Department of Agriculture

Since a good deal of information is often available from agencies, it is very important to contact them early in the process.

counties, states, and school districts. State water quality agencies prepare Water Quality Inventory Reports every two years, as required by Congress under Section 305(b) of the Clean Water Act. These reports contain data on stream monitoring, physical evaluations, problem areas, and other important information.

CONDUCTING A BACKGROUND SEARCH

Background information is helpful in determining where old mines are, what practices were used and who owns the land. Some early mining information may not be recorded, but most mining companies kept documents and maps of their activities. Since a good deal of information is often available from agencies, it is very important to contact them early in the process. The advice and guidance of agency staff are vital to the work of watershed partnerships, and the motivation and energy of the partnership contribute to the work of the agency. Many times, citizens are surprised to learn that their creek or river has been monitored extensively by an agency or university research team. The summarized results of that data can provide valuable information for newspaper, radio or television coverage of the problem. Be advised, however, that sometimes data are old. Take precautions to check the dates of any data or other information provided, since water quality conditions change over time.

INVESTIGATING THE WATERSHED

After you have collected background information on your watershed, you will probably want to get out in the field and take water quality measurements to determine if there are areas impacted by CMD discharges. The following section provides an overview of the tools commonly used in stream assessments, instructions on how to delineate a watershed, and recommendations for selecting sam-

MILL CREEK

Information from the U.S. Army Corps of Engineers, PA Department of Environmental Protection, and Clarion University faculty and students led to the identification of 18 CMD discharges along a ten-mile stretch of Little Mill Creek. Fifteen of the discharges were the result of surface mining, with the other three stemming from abandoned gas wells. The flow rates and chemical characteristics of each discharge varied, but the general ranges were as follows: flow rate of 10-50 gallons per minute (gpm); acidity 250-500 parts per million (ppm); iron 50-250 ppm; aluminum 0-7 ppm; manganese 1-15 ppm; and sulfates 1000-1600 ppm.

pling sites. References to obtain more detailed information on stream assessments is provided in the Resource Information section.

Collecting Data

Even though previous data on water quality in your project area might exist and should be used, it can be useful to collect site-specific data on water quality conditions as part of your background search. More comprehensive data collection will be needed when conducting the watershed assessment as discussed in the next section.

Consider asking an area college or water quality/mining agency to come out for a day to run some basic tests. College professors who teach biology, chemistry, geology, hydrology, or environmental science often welcome the opportunity to take their students on a field trip, where they can use their testing and lab equipment in a "real world" situation. Students who are interested in pursuing a career in the sciences are always looking for projects to work on for their future resumes, and many professors like to conduct research projects for eventual publication.

High school science teachers and students likewise can be valuable assets to your project. Many high schools have lab facilities and some can conduct fairly sophisticated water quality tests in the field. Involving these local teachers and students often results in the recruitment of interested parents who staff agencies, businesses, factories, and civic groups that can become partners in your project.

Do It Yourself!

If you are unable to interest a university or high school in testing the water, consider doing it yourself. Many grassroots groups and watershed partnerships—such as the Isaak Walton League—have members who have at least some college chemistry and/or biology training and are more than capable of gathering baseline information on flow rates, fish habitat conditions, acidity, and other parameters. Check to see if there is a volunteer monitoring program in your watershed. These programs are usually staffed by trained nonprofessional citizen members who are usually well-organized and operate under rigorous quality control guidelines. Many of the organizations take water quality samples and assess stream and lake conditions on a periodic basis.

.The Stoneycreek-Conemaugh River Improvement Project (SCRIP) developed a CMD monitoring program using trained volunteers and university students with considerable success.

The Field Crew

The watershed assessment will most likely involve a host of volunteers. A lot of people who attend your meetings want to do something—they aren't happy sitting around talking about organizational issues, funding research, or deciding who is going to be on the communications committee. Many of them will find their niche

through the field work aspect of the project. There is a lot of work involved, but it is rewarding, interesting and often enjoyable.

Proper organization, supervision, and management of field work is absolutely essential if your findings are going to be used as the basis for a clean-up program. It is important to obtain professional help when defining and conducting the actual data collection process. If you have water quality or mining agency people in your partnership who are willing to handle the field assessment, let them. Agency personnel can sometimes train field volunteers, supervise them, and manage the investigation. In addition, established environmental organizations such as the *River Network* and the *Izaak Walton League*, etc. may be able to provide training. For more information on these different organizations, refer to the Resource Information section at the end of this chapter.

Potential Volunteers Are Everywhere

University and high school students

Members of local environmental organizations

Scout troops

Teen clubs

Civic groups

Retired persons

Training field volunteers

Field volunteers require some basic training in using the sampling tools, interpreting the different color conditions of the stream, and identifying bugs that could be potential indicators of CMD. It will also be important for volunteers to learn the proper use of topographic maps, pH testers, and conductivity meters. Ideally, many of your volunteers will be somewhat knowledgeable about the work they will be doing. Make every attempt to pair up an experienced assessor with inexperienced volunteers for the best results.

It is a good idea to recruit water quality agency staff, university personnel, or watershed organization members to conduct the training. Hopefully, you will have some of these people within your partnership and can interest them in coordinating training for the field staff.

Field Assessment Tools

Maps are excellent reference and planning documents, but when it comes to pinpointing CMD sources, the best method is to find the sites in the field, locate them on a topographic map, take water quality samples, estimate volume or discharge amounts, and enter the information into your database.

Topographic Maps

Before you conduct your watershed assessment, you will need to obtain topographical maps. "Topo" maps show the "lay of the land" with their detailed contour markings, making it easy to identify hills, ridges, waterways, roads, and other features. Each map measures about 18 x 20 inches and covers an area of about 7 miles by 8.5 miles. The production dates of these maps vary across the country, so

be sure to note when your maps were printed. If they are very old, be alert for possible differences in road routes, buildings, and other features.

Two types of maps should be used to assess the watershed: a county highway map and a U.S. Geological Survey (USGS) 7.5-minute topographical map. The county highway map provides a detailed layout of roads, creeks, and other landmarks of the area and is useful for finding general regions to be investigated. The USGS topographical maps are used to delineate watershed boundaries and to identify sources of water, drainage ditches, creeks, rivers, some mine sites, structures, power lines, pipelines, ponds, and other features.

Testing Equipment

Basic test kits for pH can be purchased from any national firm for less than $75, with some of the color comparator pH kits priced in the $30 range. The best pH testers are the newer microprocessor-based units, which fit easily in a shirt pocket and can detect changes down to one-tenth or even one-hundredth of a pH standard unit. They cost $45 to $100, and display readings on a small digital screen. A pocket-sized conductivity meter is another good investment for field testing and is used to measure the amount of dissolved metals found in water samples. Conductivity refers to the ability of an electric current to pass through the water more quickly due to the presence of dissolved solids.

If you decide to do the testing yourself, it is a good idea to involve professionally trained partners, agency staff, or volunteers so that the readings are taken in the right places at the right times, and good records are kept of the sampling stations and results.

Bug Cards

In addition to visual observations, an effective water quality assessment tool for field volunteers is a simple pictorial key to stream insects and crustaceans. The Izaak Walton League of America publishes an excellent "bug card" printed on both sides of a notebook-sized sheet of poster board. The organisms on the key are grouped according to their pollution tolerance.

Field Assessment Procedures

Ask Permission

Make sure your assessors have landowners' permission before they work on private property. Landowner information is available

Typical Watershed Assessment Parameters

- *Water quality measurements (pH, dissolved oxygen, biological oxygen demand (BOD), conductivity, metals)*
- *Flow*
- *Visual observations*
- *Biology*

Tools of the Trade

- *Topographic and county map*
- *Compass*
- *Clipboard, pen, and paper*
- *File folders in which to collect information on each site*
- *pH tester*
- *Flow measurement devices*
- *Camera*
- *Macroinvertebrate keys*
- *Pocket-sized electrical conductivity meter*

from county clerks, property assessors, neighbors and other knowledgeable local people. This also allows the collection of information from each landowner, who can often direct field volunteers to sites that require investigation. Interest and support from landowners will be needed if treatment needs to occur on their property.

Safety First

Since some field sites will be remote, field workers should make sure that other people know exactly where they are going and when they expect to return. Investigators should always travel in pairs and should be in fairly good health for the physically demanding task they will be performing. If water samples are to be taken downstream from houses with questionable septic systems, plastic or rubber gloves, antiseptic towelettes, and a hepatitis shot are advisable. Make sure volunteers are advised to never drink water from streams, springs or other untreated sources in the field. Drinking water from a reliable source should be brought into the field in canteens or jugs.

Keep Your Data Organized

As information becomes available from these and other sources, it will be important to keep it organized. Subdividing the watershed into smaller units (subwatersheds, or the drainage areas of smaller feeder streams) will allow for easy processing and storage of information. Chart information collected on maps, labeled with file numbers of pertinent information at specific sites. For example, a map for the Mill Creek subwatershed might pinpoint a site as "CMD Source #12," which would correspond with a file folder (Mill Creek #12) which contains documented site information and water test results for that particular location. Organizing your watershed assessment in this manner will help to keep all your information in an easy-to-use format.

Oven Run

A resource inventory found six sites of significant CMD discharges from deep mine openings, stripping and erosion of land downhill from CMD discharges, erosion in spoil areas, seepage of CMD into streams, and infiltration of CMD-ponded water into the ground water. These six sites were chosen for treatment due to potential public health and safety risks, the high acidic content of the water, and the destruction of aquatic life in many sections of Stoneycreek River. The main public health concern focused on the Borough of Hooversville, which has a drinking water intake pipe in Stoneycreek River two miles downstream from the CMD sites.

CONDUCTING THE WATERSHED ASSESSMENT

Delineate Your Watershed

Prior to conducting your field assessment, you must first delineate the boundaries of your watershed on a topographic map. See **Appendix C** for step-by-step instructions to watershed delineation. Marking off watershed boundaries on a USGS "topo" map is easy once you understand how the contour lines correspond to the elevation (above sea level) of the land. In delineating watersheds and subwatersheds, the trick is to use the contour map to find the ridges that separate watershed drainage areas. Establishing all the high points surrounding a drainage area will provide a "connect-the-dots" outline of the watershed boundary.

Visual Survey of the Watershed

After delineating the watershed boundaries and any subwatersheds, volunteers will conduct a visual survey of the area to identify major geographic features, land use activities, and other characteristics. Locate any piles of coal or coal waste, particularly if obvious contaminated CMD is flowing from them. Investigators should record the location of coal strata, or areas where pieces of coal are exposed on the ground surface. Maps should locate any CMD seeps, abandoned houses or towns, old buildings and mining equipment, abandoned railroad tracks or ties, and disturbed areas where water is standing.

Establish Sampling Sites

The volunteers' job is to methodically cover the tract assigned, which is a portion of the subwatershed along and above a stream with verified CMD problems. CMD-affected streams can be identified by sampling water quality at selected points. Sampling sites should be selected carefully, since they will provide baseline and post-project data that will help to determine how effective the clean-up effort has been.

In general, a primary sampling site is situated at the lowest elevation of the target watershed, where the stream or river exits the project area. Other sites are located along the main stem of this waterway (3 to 6 sites, or more if necessary) and at the mouth of each feeder stream that empties into the main stem. (Note: Be sure to take mouth samples well upstream from where the feeder stream empties into the main stem, since some mixing of main stem and feeder stream water normally occurs at the point of confluence). Other sampling sites can be located up from the mouth of the feeder streams if they are large and contain areas of possible CMD. Of course, if a feeder stream mouth sampling site does not appear to be

Clues to Contaminated CMD

1. Contaminated Colors

Red, rusty-colored stream banks and bottoms indicate the presence of iron; white deposits indicate the presence of aluminum; and black deposits indicate the presence of manganese.

2. No Bugs

The absence of aquatic organisms like stonefly and mayfly nymphs, hellgrammites (go-devils), crawdads, caddisfly nymphs, and other insect larvae and crustaceans that usually live among and under the rocks in clean streams.

3. Toxic Readings

Readings on color comparators or pH testers below the 6.0 range can be good indicators of CMD as well. (Note: Normal rainwater has a pH of around 5.6 and lower in some parts of Appalachia due to acid rain, so avoid testing right after significant rainfall.) If you also measure conductivity, readings above 800 generally indicate the presence of dissolved metals and probable CMD. However, a conductance of 800 or greater is frequently obtained in areas where bicarbonate, sodium, and chlorides are high. Highly alkaline groundwater discharge from aquifers can also cause such a reading.

Stream Quality Reporting Form

Name of sampler _____ Date _____

Property owner _____ Topographical map name _____

Watershed or subwatershed name _____

Location description (i.e., 4.2 miles up Caney Creek Road in Caney Creek) _____

_____

Unique sampling site identification number (also noted on the topographical map) _____

SITE CONDITIONS:

Description of water conditions:

_____ color (green, brown, etc.) _____ estimated flow at site (gallons per minute)

_____ pH _____ conductivity _____ other (oil sheen, foam)

Mark One:

___ very clear ___ slightly cloudy ___ muddy

___ clear ___ very cloudy

Number of days since last rainfall over a half-inch (e.g., 2 days, 4 days, more than a week, etc.) _____

_____

AQUATIC ORGANISMS (FISH, INSECTS, ETC.):			APPEARANCE OF STREAMBED/ROCKS:	
Type	Number		_____ grey	_____ brown
_____	_____	_____	_____ orange/red	_____ silt
_____	_____	_____	_____ yellow	_____ sand
_____	_____	_____	_____ black	_____ other (_____)

STREAMBED ODOR:		STREAMBANK CONDITIONS:
_____	_____ rotten egg	_____ stable
_____	_____ musky	_____ no vegetation
_____	_____ oil	_____ eroding
_____	_____ sewage	_____ well-vegetated
_____	_____ none	_____ other (_____)

Presence of garbage: ____ yes ____ no Describe type of litter in and around the stream: _____

_____

Circle one: Litter problem is severe / moderate / no litter.

Obvious septic system problems: ____ yes ____ no Describe _____

Channel blockages: ____ yes ____ no Describe _____

Severe erosion: ____ yes ____ no Describe _____

Other degraded conditions: ____ yes ____ no Describe _____

affected by CMD, it is usually not necessary to establish upstream sampling points.

Identify CMD Discharges

While in the field, volunteers should take water quality samples, conduct a visual survey of the stream, record flow measurements, and note the presence of any aquatic organisms. If they find indications of CMD, they should look first along the stream channel and feeder creeks and ravines for signs of CMD sources.

Recording CMD Observations

If these signs are present, the field crew should attempt to determine whether the CMD discharge is coming from the stream bank area or even from the bed of the stream itself. This can be difficult to determine because the discharge can range from a field of small seeps to a running or even gushing flow. If the crew suspects a discharge along the bank or from the bed, they can take pH readings just above and below the suspected discharge area to see if there is a significant change (1.0 or greater difference in pH readings, or significant differences in conductivity readings).

As suspected CMD discharges are located, they should be pinpointed on the map and assigned a unique subwatershed name and identification number, as noted in the previous section. Readings on pH, color observations, insect and crustacean information, approximate discharge rates (in estimated gallons per minute), noticeable odors, and other pertinent information should be written in ink on a site assessment form and placed in a file folder. Be sure the volunteers label each form or sheet with a number that corresponds to the number designated on the topo map! Photo or video documentation of the sites should be made whenever possible.

A stream water quality reporting form is included in **Appendix D** for you to photocopy and use on your assessments.

Remember Pre-law vs. Post-law Discharges

Some of the CMD discharges might be resulting from post-SMCRA operations. If so, regulators will want to initiate an investigation quickly so contact your state water quality and mining regulatory agency as soon as possible.

Report Contaminated CMD Discharges

It is important if your field team finds a contaminated CMD site (i.e., low pH, absence of aquatic organisms, stained water, etc.), to locate it on a map, and notify state water quality and mine regulatory agencies immediately. These agency officials can then check whether or not it is an active, or post-SMCRA discharge, and take appropriate action. If not, they can also enter this information into their abandoned mine land database. Having these agency people in your partnership will ensure that this task is accomplished and that further investigation can begin in a timely manner.

RESOURCE INFORMATION

Macroinvertebrate Keys

The Izaak Walton League of America (IWLA) publishes an excellent "bug card" printed on both sides of a notebook-sized sheet of poster board. IWLA can be reached a (800) BUG-IWLA.

Topographic Maps

USGS maps are available at the geology departments of major state universities, local or county planning commission offices, sporting goods stores, or directly from the USGS (phone: (703) 648-6892; address: USGS, Reston, VA 22092).

Field Assessment

The Art and Science of Mine Drainage Prediction (paper). Hyman, D.M., J.W. Hawkins, R.L.P. Kleinmann, and G.R. Watzlaf. 1995. Attachment to letter from William J. Kovacic, Field Office Director, OSM Lexington Office, to Carl Campbell, Commissioner, Kentucky Dept. for Surface Mining, Frankfort, KY, November 29, 1995.

The Strip Mining Handbook: A Coalfield Citizen's Guide to Using the Law to Fight Back. The Environmental Policy Institute. Chapter 9 provides information on monitoring a strip mine. Contact the Institute at (202) 544-2600.

A Stream Watcher's Stream Guide. Izaak Walton League of America. Summarizes indicators of pollution in flowing waters.

Streamwalk Manual. U.S. Environmental Protection Agency, Region 10, 1994. The manual is designed to be an easy-to-use screening tool for monitoring stream corridor health. EPA 910-B-94-002.

The Volunteer Monitoring Guidance on Stream Surveys (Draft). U.S. Environmental Protection Agency. The manual will be finalized soon and will include detailed information on conducting streamside surveys.

Water Quality Testing Kits

A few of the firms that have testing equipment catalogues available are:

Forestry Supplies, Inc.	(800) 752-8460
HACH Company	(800) 227-4224
International Reforestation Supply	(800) 321-1037
LaMotte Company	(800) 344-3100
Wards Natural Science Establishment	(800) 962-2660
Wildlife Supply Co.	(517) 799-8100

Volunteer Monitoring

Save Our Streams. The Izaak Walton League of America has volunteer training materials through its Save Our Streams program. Contact IWLA at 707 Conservation Lane, Gaithersburg, MD 20878-2983, or call (800) BUG-IWLA.

The Volunteer Monitor's Guide to Quality Assurance Project Plans. U.S. Environmental Protection Agency. This document outlines the procedures a monitoring program will use to ensure that the samples collected and analyzed are of high quality. Contact the Volunteer Monitoring Coordinator at (202) 260-7018.

The Volunteer Monitor. A periodic newsletter that covers issues like the organization and management of volunteer monitoring programs, training, testing methodologies, planning approaches, and other themes. Subscriptions are available by contacting Eleanor Ely at 1318 Masonic Avenue, San Francisco, CA 94117 or by calling (415) 255-8049.