TOOLBOX 3

WATERSHED ASSESSMENT

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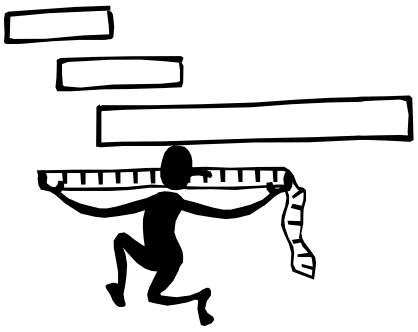
TOOLBOX 3 - WATERSHED ASSESSMENT

SELF EVALUATION

Please complete the following self evaluation to determine if there are areas for improvement or if you are ready to proceed to the next toolbox.



1. Do you have a purpose for conducting a watershed assessment?
2. Do you have maps available for your watershed?
3. Do you have first hand knowledge of the conditions of the watershed?
4. Do you have volunteers, a consultant or a team that combines volunteers and consultants that will conduct the assessment?
5. Do you know where to obtain existing data and how to interpret it?
6. Do you know how to go about collecting various types of data?
7. Do you know how to use the data to help you make decisions about your watershed?
8. Is there a local volunteer monitoring group or other helpful organization (see Appendix C of this guide for a list of helpful organizations with contact information) available to assist you in data collection?
9. Do you have recommended actions or an implementation schedule based on the data?
10. Have you summarized the data into a report or action plan?

If you answered YES to all ten questions you may skip to Toolbox 4 of this guide.
If you answered NO to any of the questions you may feel free to visit Toolbox 3 for suggestions or proceed to Toolbox 4.

Comprehensive Watershed Management Planning Process

YOU ARE HERE

Toolbox 1
Form and Sustain Partnerships

Toolbox 2
Secure Financial and Human Resources

Follow Processes for Toolboxes 1 & 2 Throughout

Toolbox 3
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Prioritize Subwatersheds for Protection

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Prepare Restoration & Protection Plans

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TOOLBOX 3
WATERSHED ASSESSMENTS

Introduction

This toolbox provides general information about planning for and conducting watershed assessments. **Assessing your watershed is the third step in comprehensive watershed management planning.**

What Is A Watershed Assessment?

The goal of a watershed assessment is to determine the important issues that impact the environment within the boundaries of a watershed. Often the term "watershed assessment" is used interchangeably with "water quality assessment". Assessing water quality is an important activity, but it is only one step in the assessment process. If existing water quality is impaired, then additional assessment activities to determine the cause will likely be your focus. Conversely, if water quality is acceptable, then assessing trends or making future projections that will preserve, and perhaps enhance, the quality will probably be your focus.

To conduct a watershed assessment, you must look beyond the surface water and groundwater and begin focusing on activities that may have a direct or indirect impact on the actual water resources. These activities may include: land use practices and the local controls that govern them, industrial use, soil characteristics, population, impervious surfaces, riparian buffers, sewage disposal, and drinking water sources.

Why Conduct A Watershed Assessment?

The reason you are thinking about an assessment is because you have a fundamental desire to make a difference or play a role in protecting and/or restoring the water quality where you live. Reasons that motivate groups to conduct assessments vary. Some groups may be curious to see what is flowing in the stream they drive over every day. Others may be concerned about the quality or quantity of drinking water that the stream produces. Some groups live in watersheds with impaired streams and want to restore the quality of the stream. Still others want to be able to catch trout or bass without driving to another watershed.

Whatever the reason, some type of an assessment is absolutely critical to set the stage for developing effective plans and goals that will guide your group's activities. Completing a thorough assessment also adds a great deal of credibility to any future activities your group pursues. For instance, by taking time to assess existing water quality and watershed issues, you have a better chance of convincing partners to join your cause. You also have concrete evidence to support your goals and viewpoints and to request money and assistance.

How Detailed Does A Watershed Assessment Need To Be?

You are completing an assessment for a purpose that your group has defined. The ultimate length and content of the assessment is up to you and the funding source.

Watershed assessments need to consider the entire watershed, not just an area along the stream. Remember, all activities in a watershed have the potential to impact the water resources. Since both surface water and groundwater are linked, you need to keep that in perspective as you develop an assessment.

You also need to guard against having too narrow or too broad of a focus for your assessment. It's easy to get caught up in trying to address a high profile impact in your watershed without considering the impacts of more subtle activities. Besides, if you try to assess every conceivable issue impacting your watershed, you may never get to solve any of them. Any type of watershed activity (assessment, plan, or goal) is not "cast in stone", but should be reviewed, revised, and reassessed periodically.

The bottom line is to agree on a purpose for your assessment that meets the needs of your watershed and then find the right amount of detail that can be effectively managed or completed by your group. Each watershed has its own distinct features. Therefore, assessments need to be flexible to address watershed specific characteristics.

The Watershed Assessment Process

Planning and conducting a watershed assessment follows a simple process that includes the following activities:

1) Define a purpose.

2) Get to know your watershed.

3) Determine what will be assessed and who will do the assessment.

4) Gather existing data.

5) Collect new data.

6) Turn data into decisions.

This document will describe each step in this process and provide helpful resources you can access to aid in the completion of your watershed assessment. By taking a little time to follow this process, you will increase the chances that your efforts will have valuable results.

STEP 1. DEFINE A PURPOSE

Defining a purpose for your assessment is very important. The purpose guides all assessment activities. There are many distractions and forks along the "assessment road" that can easily get you off track. A purpose statement or statements allows you to stay focused and increases the chances of success in your watershed.

Purpose statements need to be clear, concise and easily understandable to you and your partners. They should be written as "action" phrases that describe an action your group is going to take during the assessment.

One of the best ways to determine your purpose statement is to have plenty of discussion and idea exchange among your partners (See Toolbox 1 "*Watershed Organization Development and Sustainability*"). Examples of specific purpose statements are:

1. To identify the number, location and discharge volume of abandoned mine discharges draining into Yellow Boy Creek and its tributaries.

2. To identify existing impervious surfaces and calculate the acres of impervious surface draining to High Flow Creek, a tributary to Sandy Bottom Creek.

3. Locate and measure the length of denuded stream banks along Eroded Bank Creek.

Less specific purpose statements may also be useful:

1. To identify and inventory exceptional resource areas needing protection from development in the Pure Creek Watershed.

2. To determine the existing quality of Clear Creek and it's tributaries.

3. To collect and interpret water quality data from the Misunderstood Creek Watershed to educate others and recruit more watershed partners.

Remember, purpose statements help you focus on what's important in your watershed. Spending time discussing a series of purpose statements will ultimately yield benefits.

STEP 2: GET TO KNOW YOUR WATERSHED

The best way to begin to understand your watershed is to get out and walk your watershed. Once you have a better understanding of your watershed, you will need to define/delineate your watershed boundaries. A watershed map can be drawn from a topographic map or a GIS generated, color-coded map. There are many different types of maps and sources of maps available. Government agencies and programs often have maps already developed for specific purposes and are generally able to share those with the public. Appendix A lists several sources for maps. Regardless of what type of map you use, it is important that the watershed boundaries are accurately defined.

Many potential watershed partners have little knowledge of what a watershed is or how they are linked to the water resources. Yet, these same partners will ultimately make the difference in the water quality of the watershed. Therefore, it's important to get as many watershed partners "in touch" with the watershed as possible.

Finding "active" partners to support your watershed initiative may be difficult (See Toolbox 1 - *"Watershed Organization Development and Sustainability"*). Getting people out in the watershed

combined with involving them in fun assessment activities are good ways to accomplish tasks and spark interest.

Here are some examples of how this can be done:

1. **Watershed Tour** – Organize a watershed tour that shows as much of the watershed as possible. Give them maps and locate the sites you visit on the maps. Stop frequently in order to allow participants to see the watershed first-hand. Be sure to point out degraded, pristine or protected areas; key tributaries; point sources and critical areas including wetlands along the way. A watershed tour helps participants see the big pictures and get a better sense of what you ultimately want to accomplish. At the conclusion of the tour, refreshments and a short "sales pitch" could yield some newly active partners.

2. **Stream Walk/Cleanup** - Stream walks are ideal for getting people acquainted with the stream and watershed. Get a group together that is willing to get out on a nice sunny afternoon for a look around the watershed. Break them into small groups and provide them with clear, concise instructions. Also, include a map and some type of data sheet to record the information you need. The group will not only collect valuable information, they will also learn more about their watershed. An alternative to a stream walk is having a stream cleanup. Either method is a great way to get people involved. It's important to conduct a little reconnaissance of the areas before the walk/cleanup because you want them to be safe and focusing on the watershed, not the dangers they may encounter. After the walk/cleanup, meet together and reflect on the afternoon as a group. Always have some refreshments to sooth tired muscles.

   Helpful Tip:

   Disposable cameras are also a good idea. A photo of unique sites or conditions they encounter (as long as it's location is recorded on the map) can be invaluable.

3. **Canoe/Tubing Trip** – Canoeing or tubing a stream gives a first hand look at the watershed. The trip can be planned with a few stops along the way to discuss watershed issues, take photographs, have lunch or engage in recreational activities (fishing, swimming, etc.). You would need to do some reconnaissance before the trip so that the planned path is clear and **safe**. After the trip is completed, meet with participants to discuss any issues or concerns they found along the way. Also, rehash what your group wants to accomplish and ask for support and input for these initiatives.

STEP 3: DETERMINE WHAT WILL BE ASSESSED AND WHO WILL DO THE ASSESSMENT

Once you have defined the purpose for the assessment, it is time to start answering some of the basic questions of who is going to do what and when, what are you going to assess and what materials do you need? These tasks should be related to the overall purpose statement(s) you developed. An assessment can be conducted in a couple different ways:

1. Team Effort

It is very common for a watershed assessment to be undertaken by a variety of agencies and organizations in a collaborative effort. You will need to assemble a "team". Your team should have a diverse background. The following is a list of some individuals you might want on your team:

- Biologists
- Civic organization members
- College or high school science teachers and students
- Community leaders
- Computer technician
- Conservation district staff
- County or local planning commission members
- Engineers
- Farmers
- Local business leaders
- Local elected officials
- Local environmental advisory committee
- Nature center members
- Other environmental groups
- Retired persons
- Volunteer monitors
- Water company/authority members

2. Contractors and Consultants

An alternative is to hire a consultant to help conduct your assessment. There are numerous for-profit contractors and consultants with the expertise to conduct watershed assessments. Consultants can be located by referring to the business section of your telephone book, contacting municipal or county officials such as land use planners, contacting statewide association members or getting recommendations from other watershed groups.

If you do hire a consultant, it is important that you continue to have control over what is being done, so that you are meeting your goals and objectives. See Toolbox 5 for more guidance on hiring a consultant.

Regardless of which approach you choose, it will be helpful to develop a table that includes a list of tasks to be completed ("what"), who will complete the task ("who"), a timetable ("when") and an identified funding source. The following is an example of some typical assessment tasks. This assumes you have already identified partners and have met to determine your purpose and are now ready to identify tasks to achieve your purpose.

Tasks	Who	When	Resource Needs
Develop watershed maps	Ted and Rhonda S.	Feb. 2003	DEP; Sandy Ck. auth.; $___ copy costs
Organize two watershed tours to acquaint partners with the watershed	Betty R. Robert T.	March-April 2003	Watershed map with key points; $___ snacks and drinks
Begin identifying existing watershed data	Ted S. John C. Mary P. Clay S. (data group)	March-May 2003	DEP's Watershed Planning Guide
Identify data gaps	Partners Group	May 2003	Summary of existing data; meeting location
Develop tasks to fill data gaps	Partners Group; Data group (lead)	May 2003	None

*A blank assessment table is presented at the end of this toolbox.

The assessment tasks outlined may be in phases. In the example above, the outline guides the group to a point where more specific tasks can be developed.

Considering that a watershed group may do some portions of an assessment, while a consultant may do other portions, an obvious need for coordination exists. Local municipal officials and landowners (public and private) in the watershed need to be apprised of your work. Remember to obtain permission before entering anyone's property. Hold enough meetings to keep your watershed group and all active parties (stakeholders) working on the assessment up to date. See Appendix B, Primary Contact Information, for a list of governmental officials that you may work with on an assessment.

What Can be "Assessed" in a Watershed?

An important part of starting an assessment is determining what to do. Your purpose and goals lead you to what needs to be done. The following provides general information on some common factors that may need to be assessed in your watershed.

A. Water Quality (biological, chemical, physical, and habitat)

How do we know if water in our watershed is of a good "quality"? We can rely on biological, chemical, physical or habitat indicators to give us a "picture" of the overall water quality. For biological indicators, we often rely on the types and abundance of organisms found in surface waters (rivers, streams, lakes and ponds) to act as "canaries" in the watershed to give us an indication of the quality of that water. The diversity and abundance of benthic macroinvertebrates (organisms that lack backbones and spend at

least part of their life cycles in the stream bottom) and fish are good indicators of water quality. We also use chemical factors to furnish us with information on stream health. For instance, high nutrient concentrations may suggest problems from sewage, fertilizers or animal wastes while high metal concentrations like iron or aluminum may point out abandoned mine problems. Observing and measuring physical characteristics can show if erosion or sediment deposition is occurring. Physical information can reveal problems from storm water or inadequately sized stream structures like bridges and culverts. Looking at impervious cover and the function or malfunction of stormwater basins may also be helpful. Finally, we look at the habitat provided by the river, stream, lake or pond. Habitat changes impact biological communities and diversity so by monitoring habitat, long-term changes can be documented. These changes may include loss of spawning beds or macroinvertebrate living areas due to sediment deposition or loss of instream habitat because snags and undercut banks are removed.

In addition to surface water, another indicator of watershed health is groundwater (the water found within the pore spaces of geologic material beneath the surface of the earth). This is especially important if drinking water supplies are from groundwater sources like wells and springs. Reviewing groundwater chemistry data can yield valuable information. Bacterial contamination is an indicator of sewage problems. While high metal concentration could indicate abandoned mine drainage problems, high nutrients could indicate runoff from agriculture is getting into the groundwater.

Depending on your purpose for this assessment and the issues you have identified in your watershed, you may want to consider existing data or collection of new data to determine the quality of surface water and/or groundwater. Refer back to Step 1 of this Toolbox for help in developing a purpose for your assessment.

B. Water Quantity

How much water do we have and how much do we use? What will be the demand for water in the future? If water quantity is an issue in your watershed, you may need the answers to these questions to help you identify areas where the demand for water outstrips the supply. This involves the assessment of total surface water balances or budgets and groundwater balances or budgets. The main elements of the total water balance include:

- Precipitation – the total rainfall and snowfall in your watershed.

- Recharge – the part of precipitation that moves downward from the land surface into and through the soil to replenish the groundwater. When groundwater seeps into a stream channel it is called baseflow.

- Runoff – the part of precipitation that flows over the surface of the land into streams, rivers, lake and wetlands.

- Evaporation – the part of precipitation that is transformed into water vapor and returns to the atmosphere.

- Transpiration – the part of precipitation that reaches the roots of plants and is returned to the atmosphere by the plant via the stem and leaves.

The main elements of the groundwater balance or budget are:

- Total volume of water withdrawn from the groundwater or aquifer.
- Total volume of water recharged to the aquifer.
- Total volume of water discharged to a stream or lake.

You may also want to inventory the water withdrawal points, groundwater recharge points and stream discharge points along with public and private water supply systems. Many times we think that runoff is a major factor of flow, but in fact, it is baseflow that we "see" most often in streams. Problems that arise from decreasing water quantity include loss of private water supplies and degradation of aquatic habitats. During times of drought, baseflow can be critical to stream health.

C. Fish, Wildlife and Habitat

Wild places and wildlife are an important part of Pennsylvania's heritage. Hunting and fishing are integral to the culture and traditions of many communities. Including a fish and wildlife species evaluation, along with a summary of the current and future state of fish and wildlife habitat, may be important in your watershed assessment. If your purpose for assessing your watershed is to track comprehensive trends over a relatively long time period, you may want to consider adding a component that addresses fish and wildlife. If your community has many avid anglers, hunters and birdwatchers, you may want to involve them in an inventory of fish and wildlife species and habitat in your watershed.

When looking at habitat for wildlife, you want to think about "fragmented" habitats, especially if you live in a watershed that has lots of development. When habitat is lost or fragmented, as a result of urban development, forestry or agriculture, the ecological effects are complex. Generally, when the size of a natural area decreases, the total number of species also decreases. When a natural landscape is fragmented, or broken up into smaller and smaller pieces as we see when "sprawl" development takes place, the quantity of natural habitat is obviously affected. In addition, the quality of the habitat is also negatively impacted. Even a roadway that cuts through the middle of woodland can have far-reaching results because many species do not like living near the edge of habitats while other species use an "edge effect" to their advantage. Invasive plant species often threaten fragmented woods and are able to out-compete native plants in these conditions. Overpopulation of deer and Canada geese can also indicate fragmented areas and areas where humans have changed the landscape to encourage these high densities.

When assessing wildlife in your watershed, you may want to consider the following about their habitat:

1. ***Wildlife Corridors*** – strips of habitat that connect fragmented natural areas. They make it possible for wildlife to travel between habitat "islands." Forested riparian buffers (wooded edges of streams and rivers) are a good example of a wildlife corridor.

2. ***Edge Effect*** – area outside the native habitat type is called the "edge", whereas the "interior" habitat is found inside. Many native species, such as migrant songbirds, require large tracts of interior habitat and avoid edges. The amount of edge habitat increases as the habitat becomes more fragmented.

Assessing habitat for fish species involves gathering data on various factors in the streams, rivers, ponds and lakes of your watershed. In terms of stream or river habitat, you will be gathering information on "in-stream cover" (rocks, submerged logs, undercut banks and other features in the stream that can provide hiding places for fish); particle sediments (sand, silt and mud that can clog gills of fish); "flow patterns" (different fish species like different velocity/depth patterns such as: slow/deep, slow/shallow, fast/deep, fast/shallow); condition of the banks and coverage of the banks with grasses, bushes and trees that can affect water temperature. In terms of ponds and lakes, you will be looking at vegetation and substrate in the shallow areas for fish spawning, the condition of the lake's banks and the different depths of the lake that can provide habitat for various fish species.

By observing fish and wildlife, changes in biodiversity may be detected. If species are disappearing, there may be too much development and sprawl impacting the watershed.

D. Channel Stability and Flood Prone Areas

Channel stability and flood prone areas may be important components to consider in your assessment especially since Pennsylvania is one of the most flood prone states in the country. Many Pennsylvanians like to be near water whether it is a stream or lake; however, they often pay a price from flooding if they build too close to the water. Channel stability changes can be observed or measured using methods like cross sections and bank pins to look at sediment deposition and erosion. Photos can also be used to document changes. Aerial photography can be used to pinpoint current land uses. Flood maps can be reviewed to show where floodplains exist and where past flooding has occurred. Increased flooding can indicate that storm water problems exist or that too much impervious surface is present due to development.

E. Land Use

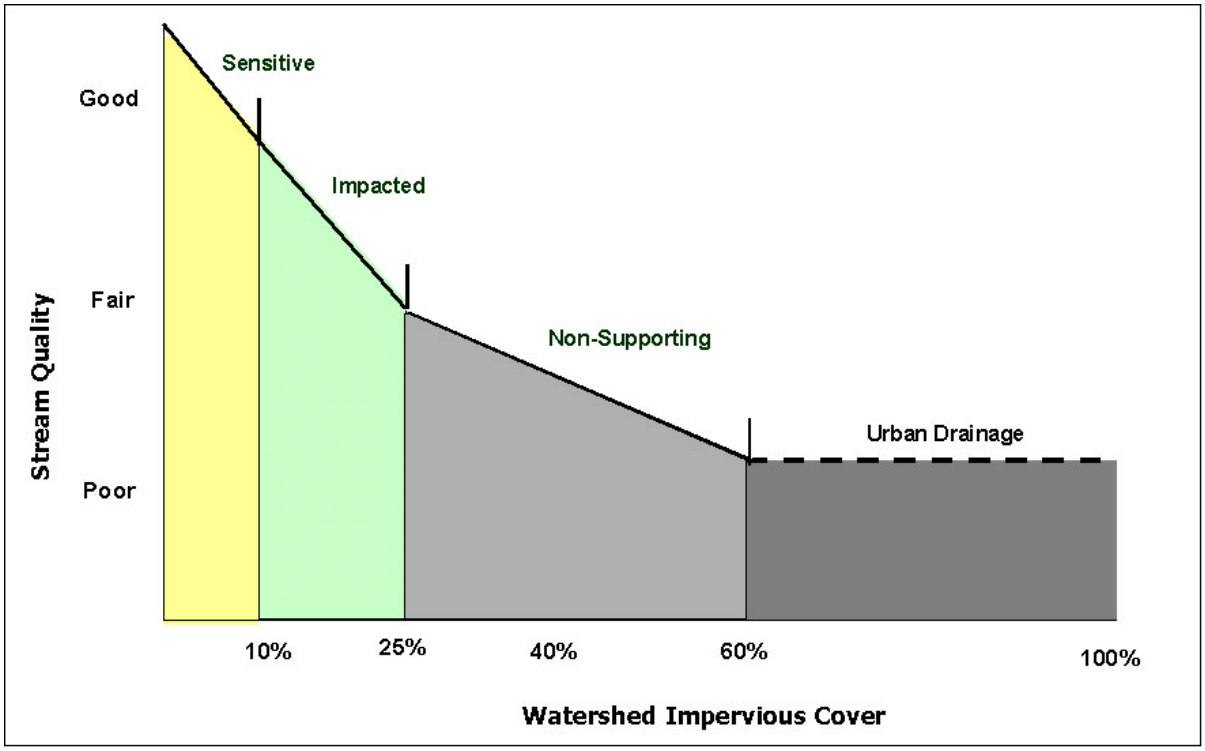
Land use in a watershed affects water quality and water quantity as well as the diversity of fish and wildlife that a watershed can support. Surface water and groundwater act as mirrors that reflect all of our actions on the land. In order to assess the present and future health of our watersheds, it is important to look at how land is used within the

watershed.

Paved or Impervious Surfaces (impervious to water infiltration), including parking lots, roofs, buildings and roads, are examples of land uses that have great impacts in the watershed. Little or no water can soak into the ground and the water flows more rapidly over paved surfaces than a forested or grassy area. In developed areas, a large volume of water heavily charged with pollutants can quickly reach nearby surface waters. Impervious surfaces are one result of community growth that can be directly measured. It is an important indicator – an understandable measure of our surroundings. It can be used to show changes in environmental conditions and to gauge the health of our streams.

Stream research generally indicates that certain zones of stream quality exist, most notably at about 10 percent impervious cover, where sensitive stream elements are lost from the system. A second threshold appears to exist at around 25 to 304 impervious cover, where most indicators of stream quality consistently shift to a poor condition (e.g., diminished aquatic diversity, water quality, and habitat scores). Figure 1 demonstrates the key findings of recent research regarding the impacts of urbanization on aquatic systems.

Figure 1



Provided by the Center for Watershed Protection Website

The Impervious Surface Model classifies streams into one of three categories: sensitive, impacted, and non-supporting. Each stream category can be expected to have unique characteristics as follows:

Sensitive Streams. These streams typically have a watershed impervious cover of zero to ten percent. Consequently, sensitive streams are of high quality, and are typified by stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects. Since impervious cover is so low, they do not experience frequent flooding and other hydrological changes that accompany urbanization. It should be noted that some sensitive streams located in rural areas may have been impacted by prior poor grazing and cropping practices that may have severely altered the riparian zone, and consequently, may not have all the properties of a sensitive stream. Once riparian management improves, however these streams are often expected to recover.

Impacted Streams. Streams in this category possess a watershed impervious cover ranging from 11 to 25 percent, and show clear signs of degradation due to watershed urbanization. The elevated storm flows begin to alter stream geometry. Both erosion and channel widening are clearly evident. Streams banks become unstable, and physical habitat in the stream declines noticeably. Stream water quality shifts into the fair/good category during both storms and dry weather periods. Stream biodiversity declines to fair levels, with most sensitive fish and aquatic insects disappearing from the stream.

Non-Supporting Streams. Once watershed impervious cover exceeds 25 percent, stream quality crosses a second threshold. Streams in this category essentially become conduits for conveying stormwater flows, and can no longer support a diverse stream community. The stream channel becomes highly unstable, and many stream reaches experience severe widening, downcutting, and stream bank erosion. Pool and riffle structure needed to sustain fish is diminished or eliminated and the substrate can no longer provide habitat for aquatic insects, or spawning areas for fish. Water quality is consistently rated as fair to poor, and water recreation is no longer possible due to the presence of high bacterial levels. Subwatersheds in the non-supporting category will generally display increases in nutrient loads to downstream receiving waters, even if effective urban BMPs are installed and maintained. The biological quality of non-supporting streams is generally considered poor, and is dominated by pollution tolerant insects and fish.

Other helpful resources on impervious surfaces can be found at:

http://nemo.uconn.edu/impervious_surfaces/literature.htm

http://www.stormwatercenter.net/

F. Wetlands

The term “wetlands” describes what are commonly known as marshes, bogs, swamps, wet meadows and shallow ponds. Wetlands are extremely important in the natural

water (hydrologic) cycle. Wetlands perform many functions including: water filtration, water recharge, flood flow abatement, and habitat. Some of the most diverse habitats in the world are wetlands; these areas of high productivity provide homes to numerous endangered species and are important to maintaining biodiversity. Wetlands are natural sponges and critical to controlling and holding high water naturally. As they hold water, they filter out pollutants and improve water quality. Since wetlands are important to watershed health, you may want to locate and identify wetlands in your watershed. Wetland maps and watershed tours can help you find more about the wetlands in your watershed.

G. Geology and Soils

The types of geologic formations and soil types/characteristics are of major interest when assessing or managing a watershed. Both may influence water quality and/or water quantity. Limestone, which has a natural alkaline quality, may buffer waters creating water conditions that support specific organisms and handle acidic inputs while sandstone contributes little to buffering capabilities of the water but does provide a variety of suitable habitats for other organisms. Limestone formations also may limit water supplies because of the development of underground caverns and sinkholes that can redirect groundwater. Other geologic formations may contain clay that could form perched water tables capable of providing efficient water supplies. Geology information can be found in maps and surveys from libraries, county and municipal offices and state and federal agencies.

Soil types influence activities in your watershed. They are useful in identifying and locating habitats like wetlands and flood plains, which would contain hydric soils. They also influence vegetation types found in your watershed. Soils information may be found in maps and surveys from libraries, county and municipal offices and state and federal agencies. The Natural Resources Conservation Service, through the Consortium for Scientific Assistance to Watersheds, is able to provide soil maps to qualified watershed groups.

H. Historical/Cultural Sites

Historical and cultural sites may be important components of your watershed. Historical sites illustrate the heritage of an area and may add to the character of the watershed like a wooden covered bridge. The history of an area also points to why certain industries/activities took place in a watershed and may help show both past impacts (steel mill slag or relic dams) to the watershed and potential new impacts (restoring a mill along a stream). Cultural sites are important to a watershed because they are enjoyable assets of the community. They can also indicate past occurrences in the watershed like the existence of Native American villages along a river. You may find that longtime residents of the watershed have much history and culture to share about your watershed. Information can also be found in maps and archives of your local museum, historical society or newspapers.

I. Best Management Practices (BMPs) – Restoration Projects in Your Watershed

Best management practices (BMPs) are defined as "any program, process, siting criteria, operating method, measure or device that controls, prevents, removes or reduces pollution." BMPs can be structural (i.e. storm drains) or non-structural (i.e., public education). Specific pollution problems that can be abated by BMPs include: abandoned mine drainage, agricultural runoff, urban development, storm water runoff, and septic system discharges. During your assessment, it would be beneficial to locate BMPs in your watershed and see if they are working efficiently or ineffectively. Watershed walks can help locate BMPs. Maps from counties and municipalities may show where BMPs are located. Check with your municipality to see if there are local ordinances that apply.

J. Vegetative Cover and Plant Information – Riparian Buffers

Riparian buffers are vegetated areas along a stream corridor that buffer/filter impacts from overland runoff. Knowing the amount/type and location of buffers in your watershed would be helpful when completing your assessment. Buffers may be forested or grassed. They filter and transform some pollutants from runoff preventing them from entering the waterway. If forested, they supply shade and food (leaf litter) to the stream. Buffers also provide habitat for animals and plants that live on the edge of the land-water interface. Buffers can be located by walking the watershed, utilizing existing maps or obtaining aerial photographs.

Identifying plant types enable you to document plant communities. Recognizing plant types allows you to gauge impacts from invasive plants as well as to identify endangered plants. The overall health of your watershed could depend on you preventing the influx of invasives and preserving existing habitat. Once plants are identified by using plant guides while walking the watershed or by using existing reports, locations can be mapped. These maps, along with buffer information, could be useful for overall planning purposes in the watershed.

K. Endangered Species and Invasive Species

Watersheds offer unique habitats that may support endangered species. Generally, as development increases, species diversity decreases. So finding out where special habitats are located and identifying whether endangered species exist would help you in overall planning processes and protection of your watershed. Reports may exist that document endangered species. You can also do watershed walks during which you would look for and identify unusual species.

Invasive species are species that are not native to an area. They may come into a new area and dominate. By "taking over", they force native plants and animals out and impact the overall ecosystem by decreasing biodiversity. Programs can be put in place in your watershed to help identify, locate and eradicate invasives. During your initial assessment, locate as much information as possible about invasives in your watershed.

A watershed walk can discover if you have been "invaded".

L. Recreation

Recreational sites may be of interest when assessing your watershed. State Parks add to the enjoyment of the community by offering trails and areas for swimming, boating and fishing. Other significant recreational areas included National Parks, natural areas, county and municipal parks, the Appalachian Trail and National Wildlife Refuges. Since many of these areas connect the natural aspects of a watershed with people activities, they are good areas to use to educate the community and enhance watershed stewardship in your community. Many of these areas are located on local maps or may be found by visiting tourism offices.

STEP 4: GATHER EXISTING DATA

A watershed assessment involves gathering existing data from secondary sources. This step will help identify and explain types of existing data that could be collected for a watershed assessment along with some suggestions on where to find data on your watershed that someone else has collected. See Appendix D for a description and matrix of some prior studies that may be useful to you in gathering data for your assessment.

A. Water Quality

Surface Water

1. Watershed associations with a volunteer monitoring component may be able to supply data. Click on "Watershed Directory" for a listing. www.pawatersheds.org

2. United States Geological Survey (USGS) provides real-time water quality data that is continuously collected for pH, specific conductance, water temperature, and dissolved oxygen at 38 sampling stations across the state. http://waterdata.usgs.gov/nwis. USGS also has macroinvertebrate data from the National Water Quality Assessment Program (NAWQA). www.water.usgs.gov/nawgu

3. The Pennsylvania Senior Environment Corps collects water quality data on over 500 stream sampling stations throughout the state. www.environmentaleducation.org.

4. The Pennsylvania Department of Environmental Protection (DEP) – Office of Water Management has a number of programs that collect water quality data. To learn more about these programs go to www.dep.state.pa.us. Choose the subject "Water Management" which takes you to the Water Management home page. Once there, click on "Surface Water Quality" under "Main Topics". You can access the following reports:

   - Section 305(b) – Water Quality Assessment Report

- Section 303(d) Report – List of Impaired Waters
- EPA's STORET system that houses DEP's water quality data from the Water Quality Network Stations
- Statewide Existing Use Classifications
- Stream Redesignation Evaluations
- Pennsylvania's Surface Waters Assessment Program
- Total Maximum Daily Load (TMDL) reports (See Hot Topic)

HOT TOPIC

TMDL reports are required to be developed by DEP for all streams and lakes that have been assessed and determined to be impaired. The pollutant(s) causing the impairment are determined and each pollutant is assigned a maximum daily "load". This number is the ceiling on the amount of pollutant that can enter a water body so that the water body will still meet water quality standards. The Clean Water Act requires states to list all waters that do not meet their water quality standards even after pollution controls required by law are in place. For these waters, the state must calculate how much of a substance can be put in the water without violating the standard and then distribute that quantity to all the sources of the pollutant in that water body. The TMDL report can be very useful to watershed groups because it already identifies problem pollutants and assigns a target goal "the maximum daily load". While TMDL reports assign loads to both point and nonpoint sources, they usually do not identify where the nonpoint source problems exist. This is the task of the local watershed partners. Developing a watershed assessment to identify sources and locations of TMDL pollutants is the first step toward restoring the water body.

5. DEP Regional and District Mining Offices have a number of programs, surveys and reports that may help you in carrying out your watershed assessment. Contact your regional DEP office to make an appointment to look at these reports and data sets (see Appendix B). These include:
   - Cause and effect surveys.
   - Details of results of Pennsylvania's Surface Waters Assessment Program (SWAP) for watersheds in your area.

- Stream files.
- Mining restoration information.

6. Keystone Watershed Monitoring Network (KWMN) is a consortium of volunteers, nonprofits and state entities that collect data, provides training and helps to connect volunteers www.pawatersheds.org .

7. Most county conservation district offices employ a watershed specialist who is directly involved with watershed projects, assessments, and planning. See Appendix B for a watershed specialist contact list.

8. Local schools and universities may have water quality data available.

9. There are a number of existing reports available from DEP and the Department of Conservation and Natural Resources (DCNR). For a description of these reports with a summary matrix of their contents see Appendix D.

10. River Basin Commissions have data on water quality (including macroinvertebrate data) in their area of jurisdiction. Susquehanna River Basin Commission (SRBC) www.srbc.net
    Delaware River Basin Commission (DRBC) www.state.nj.us/drbc
    Ohio River Valley Water Sanitation Commission (ORSANCO) www.orsanco.org
    Interstate Commission on the Potomac River Basin (ICPRB) www.potomacriver.org
    The Great Lakes Commission www.glc.org

11. The Chesapeake Bay Program offers information about water quality. www.chesapeakebay.net/

12. The Eastern and Western Pennsylvania Coalitions on Abandoned Mine Reclamation (EPCAMR and WPCAMR) have water quality data from areas affected by coal mining. www.epcamr.org and http://amrclearinghouse.org/WPCAMR/index.html.

13. Delaware Riverkeeper Network has water quality data for over 90 stations in the Delaware Watershed. www.delawareriverkeeper.org

Groundwater and Drinking Water

1. ThePennsylvania Department of Environmental Protection (DEP) – Office of Water Management has a program that collects data on groundwater and another for drinking water. Go to www.dep.state.pa.us. Choose the subject "Water Management". This will take you to the Water Management home page. Once you are there, click on "Groundwater Protection" or "Drinking Water" under "Main Topics".

2. The United States Geological Survey (USGS) displays groundwater site inventory, groundwater level data and water quality data. http://waterdata.usgs.gov/pa/nwis/gw.

3. The U.S. Environmental Protection Agency (EPA) maintains drinking water data in several databases. www.epa.gov/safewater/databases.html.

4. The Pennsylvania Rural Water Association provides leadership on the operation, maintenance and management of systems responsible for providing safe drinking water and wastewater management. www.prwa.com/

5. The League of Women Voters of Pennsylvania (LWVPA) Water Resources Education Network (WREN) website http://pa.lwv.org/wren connects Pennsylvania citizens and water resources information.

6. Contact your local water supply company for information about drinking water.

B. Water Quantity

1. The United States Geological Survey (USGS) collects real-time hydrologic data. The number of gauging stations operated by the USGS in Pennsylvania is about 250. http://water.usgs.gov/realtime.html

2. The National Oceanic and Atmospheric Agency (NOAA) collects data on precipitation for the whole country. http://www.noaa.gov/. Click on "weather" and then "precipitation" from the list on the right.

3. River Basin Commissions have data on water quantity in their area of jurisdiction:

   - Susquehanna River Basin Commission (SRBC) www.srbc.net
   - Delaware River Basin Commission (DRBC) www.state.nj.us/drbc
   - Ohio River Valley Water Sanitation Commission (ORSANCO) www.orsanco.org
   - Interstate Commission on the Potomac River Basin (ICPRB) www.potomacriver.org.
   - Great Lakes Commission www.glc.org.

4. Contact your local public water supplier for information on water quantity in your local area.

5. Some counties also have exclusive groundwater monitoring networks. Contact your local county planning office or county conservation district.

C. Fish, Wildlife, and Habitat

1.	PA Game Commission	Go to: www.pgc.state.pa.us. Click on "Wildlife" at the left to find species guides, wildlife reference guides and bird watching guides.
2.	PA Fish and Boat Commission (PAFBC)	Go to: http://www.fish.state.pa.us. Click on "Fishing" in the upper left corner of the homepage. Then click on "Gallery of PA Fishes" under the heading "Fish Pictures" to get information on numerous fish species found in PA's streams, rivers and lakes.
3.	PA Natural Diversity Index	Go to: www.dcnr.state.pa.us. Click on "PNDI" at the bottom right side of the screen to get to general information on PNDI and specific information on plant and animal species of special concern, rare and exemplary natural communities and outstanding geologic features.
4.	US Fish and Wildlife Service (USFWS)	Go to http://www.fws.gov/. This website has portal links to information on birds, endangered species, fisheries, and many other topics.
5.	The Audubon Society of Pennsylvania	Go to http://pa.audubon.org/. Click on "Important Bird Areas" for information and a map on special habitats for birds found in PA.
6.	Delaware Riverkeeper Network	Go to www.delawareriverkeeping.org. DRN has developed a wildlife survey that can be used by volunteers.

D. Channel Stability and Flood Prone Areas

1. The Pennsylvania Department of Environmental Protection (DEP) – Office of Water Management – Bureau of Waterways Engineering. www.dep.state.pa.us. Choose the subject "Water Management". Once on the Water Management homepage click on Bureau of Waterways Engineering.

2. The Keystone Stream Team Natural Stream Channel Design (NSCD) Guidelines. Guidance on how to gather information and design NSCD projects. www.canaanvi.org/nscdguidelines/document.asp

3. The Natural Resources Conservation Service (NRCS) has information on channel restoration projects. http://www.nrcs.usda.gov/

4. The U.S. Army Corps of Engineers (USACE) may have information on channel stability problems.

   - Pittsburgh District http://www.lrp.usace.army.mil/
   - Baltimore District http://www.nab.usace.army.mil/
   - Philadelphia District http://www.nap.usace.army.mil/

5. The Pennsylvania Emergency Management Agency (PEMA) has information on flood prone areas. http://www.pema.state.pa.us/.

6. Contact your local municipalities for information on flood prone areas including flood maps.

7. National Flood Insurance maps and other information including a tutorial on how to read a Flood Insurance Rate Map (FIRM) can be found at http://www.fema.gov/nfip/.

E. Land Use

1. Municipal or county planning offices may have information not only on current land uses, but also potential uses for which the area is zoned.

2. County Conservation District (see Appendix B) and Agricultural Extension Offices may provide you with information on agricultural lands.

3. The Pennsylvania Spatial Data Access (PASDA) has land use maps available. http://www.pasda.psu.edu/.

4. The United States Department of Agriculture (USDA) and the Pennsylvania Department of Agriculture (PDA) may be able to provide information on agriculture lands and farming land use. www.usda.gov and www.agriculture.state.pa.us/

5. The Pennsylvania Farm Bureau provides information on farming land use by county. www.pfb.com.

6. The Pennsylvania Department of Community and Economic Development has land use information available. Go to: www.landuseinpa.com/ and select "Electronic Land Use Library".

7. The Pennsylvania Planning Association may provide land use data. Go to: www.planningpa.org/.

8. Watershed Restoration Action Strategy (WRAS) Report may provide information about your watershed. Go to: www.dep.state.pa.us/. Choose "Watershed Management" under subjects. Click on "main topics" and choose "Watershed Notebooks". The WRAS will be listed at the bottom of the page.

F. Wetlands

1.	PA DEP	Go to: www.dep.state.pa.us Select – "Subjects" and go to "Wetlands" for information about wetlands including regulations, guidance and wetland replacement projects.
2.	U.S. Fish and Wildlife Service	Go to: www.fws.gov for information about wetlands including National Wetland Inventory (NWI) maps.
3.	U.S. Environmental Protection Agency	Go to: www.epa.gov/owow/wetlands for information about wetlands.
4.	U.S. Army Corps of Engineers	Pittsburgh District http://www.lrp.usace.army.mil/ Baltimore District http://www.nab.usace.army.mil/ Philadelphia District http://www.nap.usace.army.mil/

G. Geology and Soils

1.	PA Department of Conservation and Natural Resources	Go to: www.dcnr.state.pa.us/topogeo for information on state geological features.
2.	U.S. Geological Survey	Go to: www.usgs.gov for geological features information.
3.	PA Conservation Districts	Go to: www.pacd.org/districts for soils information.
4.	Watershed Restoration Action Strategy (WRAS) Report	Go to: www.dep.state.pa.us. Choose "Watershed Management" under Subjects. Click on "Main Topics" and choose "Watershed Notebooks". The WRAS will be listed at the bottom of the page.

5.	National Resources Conservation Service (NRCS)	Go to: http://www.nrcs.usda.gov/ for soils information.

H. Historical and Cultural Sites

1.	PA Historical & Museum Commission	Go to: www.phmc.state.pa.us for information on archeological and historical sites.
2.	Watershed Restoration Action Strategy (WRAS) Report	Go to: www.dep.state.pa.us. Choose "Watershed Management" under Subjects. Click on "Main Topics" and choose "Watershed Notebooks". The WRAS will be listed at the bottom of the page.
3.	Local Historical Societies/Museums, Municipalities, and tourism groups	Information on historical and cultural sites.

I. BMPs

1.	Watershed Restoration Action Strategy (WRAS) Report.	Go to: www.dep.state.pa.us. Choose "Watershed Management" under Subjects. Click on "Main Topics" and choose "Watershed Notebooks". The WRAS will be listed at the bottom of the page.
2.	Natural Resources Conservation Service (NRCS)	Go to: http://www.nrcs.usda.gov/ for BMP information.
3.	Pennsylvania Association of Conservation Districts	Go to: www.pacd.org for BMP Handbook and other BMP information.
4.	Chesapeake Bay Foundation	Go to: www.cbf.org/ for BMP information for the Chesapeake Bay watershed.
5.	Alliance for the Chesapeake Bay	Go to: www.acb-online.org/for BMP information for the Chesapeake Bay watershed.
6.	PA DEP	Go to: www.state.pa.us Keyword: "DEP manure management" for Manure Management for Environmental Protection.

		Keyword: "DEP Stormwater" for approved stormwater management plans and other stormwater information. Keyword: "Chesapeake Bay" for Pennsylvania's Chesapeake Bay Tributary Strategy.

J. Vegetative Cover and Plant Information - Buffers

1.	PA Department of Environmental Protection (DEP)	Go to: www.dep.state.pa.us. Select "subjects" and go to "Stream Releaf" for information on buffers.
2.	PA Department of Conservation and Natural Resources (DCNR)	Go to: www.dcnr.state.pa.us Bureau of Forestry for plant information.
3.	Academy of Natural Sciences	Go to: www.acnatsci.org/for information on buffers.
4.	Morris Arboretum of the University of Pennsylvania	Go to: http://www.business-services.upenn.edu/arboretum/ for information on Pennsylvania plants.
5.	Alliance for the Chesapeake Bay	Go to: www.acb-online.org/ for riparian buffer information for the Chesapeake Bay watershed.
6.	Chesapeake Bay Program	Go to: www.chesapeakebay.net and search for "Riparian Handbook".
7.	University of Maryland	Go to: www.riparianbuffers.umd.edu/ to find information on riparian buffers.
8.	Stroud Water Research Center	Go to: www.stroudcenter.org to find information on buffers and access to the Leaf Pack Network.

K. Endangered Species and Invasive Species

1.	PA Department of Agriculture (PDA)	Go to: http://www.agriculture.state.pa.us/ for information on Pennsylvania noxious weeds.
2.	PA Department of Conservation	Go to: www.dcnr.state.pa.us and

	and Natural Resources (DCNR)	search for the Pennsylvania Natural Heritage Program web page for native biological diversity data.
3.	The Nature Conservancy	Go to: http://tncweeds.ucdavis.edu for invasive plant information.
4.	Plant Conservation Alliance	Go to: www.nps.gov/plants/alien for invasive plant information.
5.	PA Game Commission	Go to: www.pgc.state.pa.us Click "wildlife" then "endangered species".
6.	PA Fish and Boat Commission	Go to: www.fish.state.pa.us Click "fishing" then "endangered/threatened"

L. Recreation

1.	PA Department of Conservation and Natural Resources (DCNR)	Go to: www.dcnr.state.pa.us Bureau of State Parks for information on state parks.
2.	National Parks Service	Go to: www.nps.gov for information on national parks.
3.	Appalachian Trail	Go to: www.appalachiantrail.org for resources on the Appalachian Trail.
4.	Local municipalities and tourism sites	Information about parks and recreation.

STEP 5: COLLECT NEW DATA

After gathering as much existing data as your group can find, you may need to collect new data to fill in any data gaps. In general, monitoring is the periodic or continuous collection of data (measured parameters) using consistent methods. The types of monitoring and the reasons for collecting data vary tremendously.

A comprehensive watershed assessment is an approach to data collection that incorporates water quality as well as other watershed conditions such as water quantity, fish and wildlife, channel stability, flood prone areas, land uses within the drainage area, wetlands, geology and soils, historical and cultural sites, and restoration projects already found in the watershed. A watershed assessment evaluates the condition of the water resource while also providing valuable information to help establish cause-effect relationships and provide land managers, regulators and other decision makers with the data they need to make the best decisions for the watershed. Data can also help our watershed group encourage positive actions for the watershed.

You should write a "Monitoring Program Study Design". You can find detailed guidance on this in the DEP publication "Designing Your Monitoring Program – A Technical Handbook for Community-Based Monitoring in Pennsylvania". You can find this handbook at www.dep.state.pa.us and use Keyword "Volunteer Monitoring" or call DEP's Citizens' Volunteer Monitoring Program (CVMP) at (717) 772-5807.

A Study Design is a written document that describes the choices you make about why, what, where, when, who and how you intend to monitor. These choices are organized into a ten-step process:

Step 1: What is already known about your watershed?
Step 2: Why are you monitoring and who will use the data?
Step 3: What will you monitor?
Step 4: What are your data quality objectives?
Step 5: How will you monitor?
Step 6: Where will you monitor?
Step 7: When will you monitor?
Step 8: What are you quality assurance measures?
Step 9: How will you manage, analyze and report the data?
Step 10: What are the tasks and who will do them?

In the process of completing a study design, you will choose one or more protocols that are detailed in Chapter 5 of the handbook. Chapter 5 describes different protocols that can be done in your watershed. At a minimum, you should consider doing a "Basic Watershed Inventory" that is described in Chapter 5 beginning on page 5-5. A watershed inventory is the collection of new and existing information on conditions and processes at the watershed level. This information can be used to identify problem areas for corrective action; to decide on whether, where and what type of monitoring is needed; and to bolster watershed awareness at all levels, from the individual landowners to state and federal agencies. Although the handbook is based on water quality monitoring, it can be adapted to monitor any of the topics in Step 3.

STEP 6: TURN DATA INTO DECISIONS

You have a bunch of numbers or "raw data" on your watershed. Now what? For this data to become useful, you have to figure out what your data tells you about the watershed. Turning data into decisions is just one step in your assessment. If you have geared your assessment to the needs of the identified users to answer specific questions about your watershed, you will find that you have done most of the hard work in turning your data into decisions.

The purpose of this step is to get you pointed in the right direction, so that you can begin to solve your own data interpretation mystery. Although statistical analysis is one useful tool, the emphasis here is a "low tech", yet systematic approach that can still provide reason for positive actions in your watershed.

Once you have data, turning it into decisions is a process that involves several steps:

1. Data entry and validation helps to organize your data by getting the raw information into a computer and checking the entered data against the field and lab sheets to make sure they have been entered correctly and that the results are reasonable.

2. Summarize data to help with interpretation using proper analytical equipment and methods, simple statistical analyses, summary tables and graphs to view your data as a whole.

3. Data interpretation.

    a. Assemble the information you will need including maps, units of measurements used, general observations, historical, current and anecdotal information.

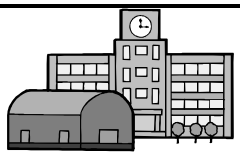
    b. Develop findings to summarize the important points into statements.

    c. Develop conclusions to explain why the data look the way they do.

    d. Develop recommendations of actions to be taken or more information that needs to be gathered based on your findings and conclusions.

4. Summarize data to tell a story using tools such as tables and graphs or compile the pieces to reinforce your findings, conclusions and recommendations to your audience who are your data users.

5. Produce a written report to summarize your monitoring activities and results and express your findings, conclusions and recommendations.



Helpful Tip:

Local college and university staff can often help you interpret your data, especially biological samples.

In conclusion, what if you go through the whole data interpretation process, and at the end you haven't solved the whole mystery? What if you haven't solved any of it? Don't worry – that's not unusual. Professional scientists have the same problem. The data you have collected on your own and from other monitors may be inconclusive especially if it was collected over a very short period of time, such as just one season or during a "snapshot" event. Don't go out on a limb if you're uncertain. It's perfectly valid to conclude that you need additional information in order to understand a system as complicated as a watershed. Maybe you need to seek additional data collected by others or consult other reports on your watershed. Maybe you need to monitor additional sites or the same sites for longer periods yourself, conduct a "windshield survey" of your

watershed or do a watershed walk.

Remember that interpreting your data is not a process that you need to do or should go through alone. Make it a collaborative effort. This is a great opportunity to involve other monitors, data users, resource agencies, service providers, academic institutions, stakeholders and the residents of your watershed in your programs.

In the data interpretation process, you move from "hard facts" to the story you think these facts tell. While your conclusions should be supported by your data, they are subjective. They are after all YOUR judgments. Others may disagree with your interpretation, but as long as the data you have gathered support it and you've followed a logical process in collaboration with knowledgeable resource people, you have valuable information that you can use in protecting and/or restoring your watershed.

Helpful Resources

1. "**Designing Your Monitoring Program - A Technical Handbook for Community-Based Monitoring in Pennsylvania".** You can find this handbook at www.dep.state.pa.us using Keyword "DEP volunteer monitoring" or call DEP's Citizens' Volunteer Monitoring Program (CVMP) at 717-772-5807.

2. "**A Guide to Common Freshwater Invertebrates of North America**" by J. Reese Voshell, Jr.

3. "**Terrestrial & Palustrine Plant Communities of Pennsylvania".** You can view this publication at: www.dcnr.state.pa.us/forestry/sfrmp/plants.htm

4. "**Adopt-A-Buffer Toolkit: Monitoring and Maintaining Restoration Projects".** You can find this handbook at www.delawareriverkeeper.org or call Delaware Riverkeeper Network at 215-369-1188.

5. "**Aquatic and Wetland Plants of Northeastern North America Volume 1 & 2**" by Garrett E. Crow and C. Barre Hellquist.

6. "**Community Watershed Assessment Handbook.**" You can view this publication at: www.chesapeakebay.net/wshed.htm or call 1-800-YOUR-BAY.

7. **EPA Volunteer Monitoring Methods Manual**-EPA Office of Water 84/-B-97-003 Nov. 1997.

WATERSHED ASSESSMENT OUTLINE
(WATERSHED NAME)

PURPOSE: _____

Task	Who	When	Resource Needs