

GROUNDWATER PROTECTION AND MANAGEMENT IN PENNSYLVANIA

**An Introductory Guide for Citizens
and Local Officials**

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Introduction

Groundwater and Local Government

Groundwater is a vital resource for many Pennsylvania communities, whether it is used for household water, industrial and commercial uses, or agriculture. Groundwater contributes nearly 70 percent of the state's water resources. And Pennsylvanians increasingly depend on groundwater: groundwater resources are developed at three times the rate of surface water.

- About 4.5 million Pennsylvanians (37 percent of the population) use groundwater from wells and springs for their drinking water and other domestic uses.
- Nearly 75 percent of the roughly 2,400 community water systems in the state rely on groundwater as their source of supply.
- In rural areas, most people depend entirely on groundwater for their water supply. And in some of the densely populated suburban areas around Philadelphia, 60 percent of the population uses groundwater.
- Many campgrounds, restaurants, schools, factories, and other institutions have private water supply systems that rely on groundwater.
- Seventy-eight percent of the water used by agriculture in Pennsylvania is groundwater.

The Threat of Contamination

Pennsylvania's groundwater supplies are increasingly threatened with contamination by various sources. For example:

- In West Caln Township, Chester County, seepage from an old landfill site contaminated private home and

community groundwater supply wells with volatile organic compounds (VOCs) and manganese. Some VOCs are known or suspected to be carcinogenic. The site is now in the Superfund program for cleanup of sites contaminated with hazardous chemicals, and a cleanup plan is in the works.

- The primary drinking water source for Abbottstown Borough, Adams County, was threatened when excavations at a nearby golf course ruptured a pipeline and released 25,000 gallons of gasoline. The well was removed from service for six months because of the proximity of the spill. This caused severe disruption in the community because water had to be trucked in.
- Groundwater sources used by Whitehall Township in Lehigh County have been affected by chemical releases from a sinkhole in a chemical company's lagoon. During a warehouse fire at the company, runoff from fire fighting operations also entered the sinkhole. It is not known whether this event caused contamination of the drinking water source, but it demonstrates the importance of contingency planning to prevent impacts from unanticipated releases.

Take Action Before a Crisis Occurs

Once groundwater contamination occurs, restoring its original quality can be very difficult and costly. Often, hydrologists must find new sources of supply. Therefore, taking steps now to prevent contamination from occurring will help ensure that your town will have groundwater resources for the future.

But who has the authority and responsibility to protect groundwater? The answer

may surprise you. Although the state and federal governments have some responsibility to regulate certain activities that affect groundwater, local officials have the most direct influence on the resource through their authority to regulate land use. Whether or not it is their intent, local governments in effect set groundwater policy when they make decisions about subdivision and land development regulation, zoning, road design and maintenance, sewage management, and emergency spill response plans.

Counties develop comprehensive plans for their future land use and management. Municipalities then develop their own comprehensive plans based on their county's guidelines. Amendments to the Pennsylvania Municipalities Planning Code passed in June 2000 require that comprehensive plans "include a plan for the reliable supply of water..." (Section 301, 7b).

Few Pennsylvanians think about groundwater and our dependence on it until a crisis occurs. But local officials should not wait for a public outcry to take action to protect their community's groundwater resources.

Protecting groundwater makes sense because it enhances the potential for economic growth and development, protects the health of residents, and avoids the costs associated with cleanup, emergency response, or acquisition of alternative sources of drinking water.

For local government officials and citizens interested in informed and responsible government, this publication serves as an introduction to the issue of groundwater protection and as a guide to developing local groundwater protection programs. The handbook provides a very brief description of hydrogeology and describes the major sources of groundwater contamination in Pennsylvania. It then describes how to go about developing a protection program and details the specific tools or measures that local officials can use.

It is hoped that this handbook convinces you not only about the importance of local groundwater protection programs, but also that building such programs is possible! Action can and must be taken to preserve this invaluable resource for the future.

Chapter 1:

Background Information : Groundwater and Its Contamination

The Basics of Hydrogeology

Water moves in a continuous cycle, called the **hydrologic cycle**. As rain and snow, water falls on the land surface and infiltrates the soil or runs off the land into streams, lakes, and oceans. It then evaporates and transpires (is released as water vapor through the leaves of plants) back into the atmosphere where it condenses and again falls to earth (Figure 1).

The water that seeps into the ground and is not absorbed by plant roots eventually reaches the **zone of saturation**. Here, water completely fills the spaces between soil particles or rocks; this is groundwater. **Aquifers** are rock or soil layers within the saturated zone that contain enough water to be tapped for wells. They are classified into two general categories:

Consolidated aquifers, consisting of limestone, sandstone, granite, or other rock, hold water in interconnected fractures, small cracks, pore spaces, spaces between rock layers, and/or solution channel openings.

Unconsolidated aquifers, consisting of rock debris or weathered bedrock, i.e., soil particles, hold water in spaces between the particles.

Most aquifers in Pennsylvania are consolidated (Table 1 and Figure 2). The amount of water contained in an aquifer and its speed of movement depend on the type of soil or rock forming the aquifer. Clay, fine-grained sand, and silt hold a lot of water and release it very slowly; coarse-grained sand and gravel hold somewhat less water, but the water moves more freely. The amount of water held and yielded by consolidated aquifers depends on the size of the rock's openings and cracks. Limestone aquifers yield substantial amounts of water; sandstone aquifers, moderate

amounts; and granite aquifers, small amounts.

The **recharge area** consists of the land surface from which water seeps into an aquifer. The amount of precipitation that seeps into the ground depends on several variables: the composition of the soil, the time of year, the soil's moisture content prior to a rain or snowfall event, and what covers the land surface. For example, the soil absorbs about 50 percent of the precipitation received in wooded areas, but an average of only 32 percent of precipitation seeps into the ground in developed areas. This lower percentage is caused by runoff into storm sewers or directly into streams and lakes from hard surfaces, such as roofs, parking lots, and roads.

The ground absorbs about 50 percent of the precipitation received in wooded areas, but only about 32 percent of precipitation seeps into the ground in developed areas.

Groundwater does not remain forever in aquifers. Groundwater, like surface water, is constantly on the move. It usually flows toward a low elevation area of discharge—a spring, stream, river, lake, or wetland. Groundwater generally flows at a rate between five feet per day and five feet per year and in a direction that mimics the surface topography. It may flow in a different direction, however, if it encounters an obstructing geologic formation or if the zone of saturation lies deep within the earth.

Because of the above complications, determining the path of groundwater flow can be difficult, especially in Pennsylvania's complex geology. Therefore, determining the movement of groundwater depends on data

Figure 1: Hydrologic cycle

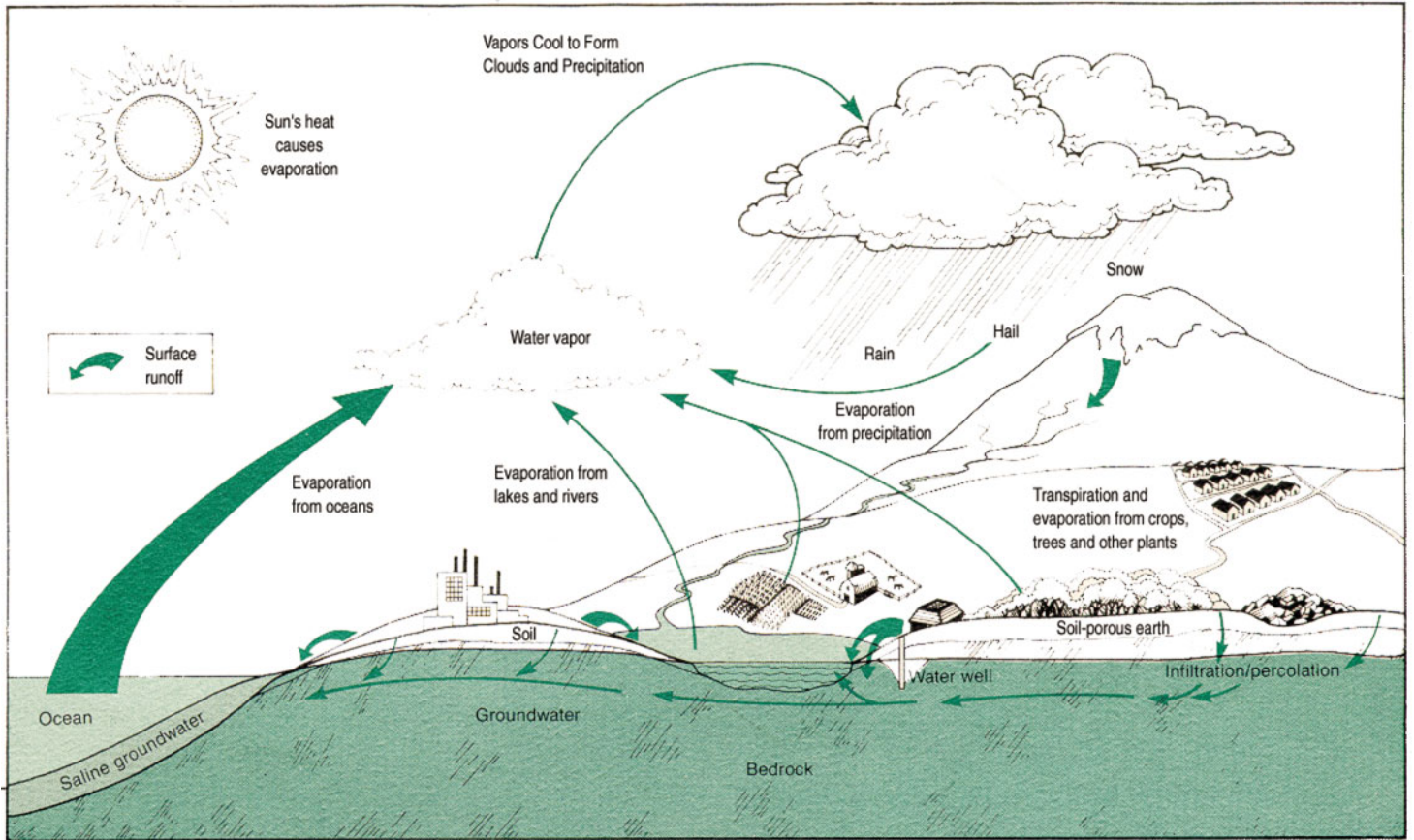


Table 1.

Pennsylvania's Aquifers

Pennsylvania's complex geological history has resulted in a diverse set of rock types and a varied physical geography that make generalizations about the groundwater in our state difficult. Nevertheless, hydrogeologists have identified four principal types of aquifers in the state: sand and gravel, sandstone and shale, carbonate rock, and crystalline rock.

- Sand and gravel aquifers are located in the southeastern coastal plain along the Delaware River, along the Lake Erie shoreline, and in most major stream valleys. Those in the Delaware estuary were deposited when oceans covered the area millions of years ago. Those in the rest of the state are glacial outwash and alluvial (stream) deposits from the time when part of the state was covered by glaciers. Sand and gravel aquifers contain large quantities of water that can be easily withdrawn; well yields of 1000 gallons per minute (gal/min) are common. The natural quality of the water is good to excellent.
- Sandstone and shale aquifers are dominant in Pennsylvania. Shales, sandstones, and siltstones are interlayered, and more than one water-bearing zone can occur in a vertical sequence. Where sandstones dominate, the water is soft, or low in calcium and/or magnesium content; where shales predominate, the water is hard, or high in calcium and/or magnesium. Yields from these aquifers are lower than sand and gravel aquifers; shale yields 5-20 gal/min and sandstone yields 5-60 gal/min. However, drilling on a fracture intersection—the meeting of two or more cracks in the bedrock—can increase these yields substantially.
- Located in the valleys of central and southeastern Pennsylvania, carbonate rock aquifers contain limestone and dolomite. The caves, solution channels, and sinkholes of these regions result when water dissolves portions of the carbonate rock. Consequently, this water contains relatively large amounts of dissolved solids and is described as “hard.” Yields of several thousand gallons per minute are possible.
- Crystalline rock aquifers are located in most of southeastern Pennsylvania. These rocks include igneous and metamorphic rocks, such as granite, gneiss, and schist, with very small fractures, so storage capacity and yield are relatively low. Water is generally soft, and yields are commonly 5-25 gal/min.

derived from detailed, site-specific hydrogeologic investigations. Public agencies have these data and much of it is available to download from the Internet. See Chapter 2 for more information.

How Contamination Occurs

Contamination of groundwater usually begins with activities on the land surface in the aquifer's recharge area. Although a contaminant or contaminated water may enter the soil at just one place, the contaminated water may expand underground into a wider **plume**, which moves with the groundwater flow.

Contamination of groundwater usually begins on the land surface in the recharge area of an aquifer.

Wells that pump water from a depth above or below the plume are unlikely to be affected unless they draw enough water to divert the plume into the well. But wells in the path of the plume will draw contaminated water and may be useless as water sources for years or decades afterward.

Principal Sources of Contamination in Pennsylvania

The potential for groundwater contamination varies across Pennsylvania and depends on the types of land use activities in an area, as well as the area's geologic characteristics. For example, in western, northeastern, and north-central Pennsylvania, leaking storage tanks, acid mine drainage, and oil and gas drilling operations pose the greatest threats to groundwater. In the coastal plain of extreme southeastern Pennsylvania, industrial waste sites create the major problem; in the south central and southeastern regions, agricultural activities are the greatest threat to groundwater. In the state as a whole, however, the most significant sources of contamination are listed below.

1. *Underground and aboveground storage tanks* constitute a serious pollution risk.

- Tanks, pipes, and fittings may leak.
- Leaks may not be detected for a long time.
- Very small leaks can contaminate a large area.

Although many industrial and commercial storage tanks have been removed, many others remain in the ground. Of particular concern are old tanks for agricultural and personal use for which records are sketchy or nonexistent. Contaminants from storage tanks include hydrocarbons, especially gasoline, solvents, and other organic chemicals, some of which are known or suspected carcinogens.

Federal and state regulations required that all existing tank systems be upgraded, replaced, or closed by December 1998. Owners of non-compliant tanks may be forced to shut down operations. Through this program, many problem tanks should have been remedied. For more information, about storage tank regulations, see the Pennsylvania Department of Environmental Protection's (DEP) Storage Tank Cleanup Homepage (www.dep.state.pa.us, subject "storage tanks").

2. *Oil and gas drilling operations* frequently cause contamination, chiefly from petroleum products and brine, the brackish water containing sulfates and chlorides that may be injected into the ground during oil and gas production operations. If not managed correctly, this brine may migrate to an aquifer. Oil spills on the land surface are also dangerous. Although the amounts may be small, oil from equipment failures can degrade a shallow aquifer.

Pipelines should be monitored as well. For instance, polychlorinated biphenyls (PCBs), which are used as fire retardant lubricants at pipeline compressor stations, can get into fluids released from storage pits and enter surface water and groundwater. Pennsylvania has at least 15 pipelines and 133 compressor stations that could cause problems.

3. Agriculture can contribute significantly to groundwater pollution. Problems include:

- nitrates from fertilizers and manure, which are soluble and easily get into groundwater. Excess nitrogen in water can reduce the oxygen-carrying capacity of blood and can be fatal to infants.
- herbicides and pesticides, some of which are soluble.
- disease-causing microorganisms (such as *Giardia lamblia* and *Cryptosporidium*) from animal waste and improperly treated sewage. Both of these parasites can cause diarrhea, vomiting, and cramping a week or two after ingestion of the pathogens.
- irrigation water, which can carry mineral salts, metals, nitrates, phosphates, and pesticides to groundwater. Although irrigation is not as widely used in this state as in other sections of the nation, if its use increases, so will the potential threat.

Similar threats to groundwater contamination can result from management activities (using fertilizers, herbicides, pesticides, and irrigation) on golf courses and playing fields.

4. Malfunctioning on-lot sewage systems, which serve one or a few private households, pose one of the largest threats to groundwater in Pennsylvania. Although properly installed and maintained systems can help recharge the groundwater, DEP estimates that 35 percent of on-lot sewage systems malfunction and cause groundwater pollution. Problems with these systems result from poor design and improper installation and maintenance. In addition, although all on-lot systems depend on soil to treat the wastewater, many areas of Pennsylvania have soils unsuitable for this use.

Possible contaminants from malfunctioning on-lot systems include harmful microorganisms such as bacteria, viruses, and protozoa, nitrates, detergents, household chemicals, pesticides, and even the organic solvents used to clean the systems.

5. Waste disposal sites (including landfills for municipal and hazardous waste), storage pits, lagoons, and other surface impoundments pose an obvious risk of contamination. Although new installations must meet stricter standards than were previously required, especially for monitoring to detect leaks quickly, pollution from abandoned sites and illegal dumping remains a critical problem. State and federal agencies have targeted nearly 100 such sites in Pennsylvania as Superfund sites (see Table 2).

6. Industrial production sites, as well as smaller industrial and retail sites (such as dry cleaners and gas stations), can also cause contamination from leaky storage tanks, hazardous material spills, runoff from unprotected stockpiles, or improper handling of waste.

7. Coal mining has contributed to water pollution problems in broad areas of the state. Acid mine drainage releases iron, manganese, and sulfates to groundwater and surface water. Although current mining methods aim to prevent pollution from acid mine drainage, they still pose a threat. The scope of the acid mine drainage problem left from earlier years is overwhelming: despite efforts to seal old deep mines and reclaim strip-mined land, thousands of acid mine drainage points remain active.

Deep mining of coal also can affect the amount of groundwater available for use. Removal of a coal seam may cause drastic changes in an aquifer, for example, by fracturing a rock layer that confines the aquifer, causing the water to drain to a deeper aquifer. With long-wall mining in particular, rapid water loss may occur. Although this water loss is often temporary and well yields may be restored after a time, sometimes another water supply must be found.

8. Household, lawn, and garden activities pose yet another threat to groundwater because of improperly used and/or disposed of chemicals. Cleaning compounds, paints, pesticides, oil, and antifreeze are often improperly sent to landfills with garbage, dumped on the ground, or in sewers or septic tanks. Lawn fertilizers and pesticides frequently are applied too liberally or at the wrong time,

and the excess washes off to the nearest stream or migrates through the soil to groundwater. Although the amount of contaminants coming from any one household may be small, the combined total from many households warrants concern.

9. *Abandoned oil and gas wells and municipal and commercial water wells* represent a more serious threat than generally recognized. Improperly plugged and sealed wells are sometimes used for illegal waste dumping. They serve as a path for contaminants to reach groundwater. Inadequate or deteriorated well casings or grouting can result in the contamination of more than one aquifer or the spreading of contaminants from one aquifer to another.

10. *Poorly constructed or deteriorated private wells* present a similar problem. Depending on the specifications used, between 40 and 80 percent of private wells in Pennsylvania have structural deficiencies and could provide a way for polluted surface water to contaminate groundwater. There is no statewide and little local regulation of the design or construction of private wells.

11. *Road deicing operations* can result in groundwater contamination from salt spread on roads or stored without adequate protection against runoff.

12. *Over pumping of wells* can lead to groundwater contamination as, for example, in southeastern Pennsylvania, where seawater has been pulled into drinking water aquifers.

After Contamination Occurs

Several natural processes can lessen contamination as water moves from the ground surface to an aquifer. These include:

- filtration, or entrapment, of suspended solids as contaminated water seeps through the soil;
- sorption, the physical or chemical capture of contaminant molecules on soil particles (a reversible process limited in capacity);

- chemical reactions that change the contaminant;
- biological action by plants, soil fauna, and bacteria, which can be especially effective in breaking down organic compounds; and
- dilution by the uncontaminated water of the aquifer.

Few natural mechanisms, however, can remove contamination once water reaches the saturated zone. Therefore, treatment of contaminated water in aquifers depends on human intervention. Researchers have achieved some success in groundwater “remediation” by introducing bacteria capable of breaking down unwanted material (a process called biodegradation or bioremediation) and pumping the contaminated water out of the ground. Then clean groundwater is allowed to refill the aquifer gradually or the soil is “steam cleaned” to remove contaminants clinging to soil particles. However, remediation by any method is typically a slow and expensive task.

Few natural mechanisms can remove contamination once water reaches the saturated zone.

To date, rather than treating water while in the ground, most individuals and communities have coped with contamination by:

- finding another source (a new well or a public water supplier);
- blending the water with uncontaminated water to reduce contamination to an acceptable level; or
- treating the water after withdrawal from the aquifer.

All these ways of coping with the problem are costly. Rather than waiting for a crisis to happen, many communities in Pennsylvania already have taken the initia-

Table 2.
Pennsylvania Superfund Sites by County (Updated February 2001)

COUNTY	MUNICIPALITY	SITE	
Adams	Gettysburg	Westinghouse Elevator Co.	
	Hanover	Keystone Sanitation LF	
	Straban Twp.	Shriver's Corner	
Armstrong	Straban Twp.	Hunterstown Rd.	
	Perry Twp.	Craig Farm Drum	
	Coraopolis	Breslube-Penn (new site 6/17/96)	
	Harrison Twp.	Lindane Dump	
	Jefferson Boro	Resin Disposal	
Allegheny	Neville Twp.	Ohio River Park	
	Bally Boro.	Bally Groundwater	
	Hereford Twp.	Crossley Farm	
	Longswamp Twp.	Berks Sand Pit	
	Spring Twp.	Berks LF	
	Tildon Twp.	Brown's Battery Breaking	
	Union Twp.	Douglassville Disposal	
	Worman	Cryochem	
	Antis&Logan Twps.	Delta Quarries	
	Terry Twp.	Bell LF	
Blair	Bridgeton Twp.	Boarhead Farms	
	Bristol Twp.	Croydon TCE	
Bradford	Dublin	Dublin TCE	
	Nockamixon Twp.	Revere Chemical	
	Warminster Twp.	Fischer & Porter	
	Warminster Twp.	Naval Air Development Cntr	
	Nesquehoning	Tonolli Corp	
Bucks	Palmerton	Palmerton Zinc Piles	
	State College	Centre County Kepone	
Carbon	E. Whiteland Twp.	Foot Mineral	
	E. Whiteland Twp.	Malvern TCE	
	Honeybrook Twp.	Welsh Road LF	
	Kimberton	Kimberton Site	
	Newlin Twp.	Strassburg LF	
	Paoli	Paoli Rail Yard	
	Parker Ford	Recticon/Allied Steel	
	W. Whiteland Twp.	A.I.W. Frank	
	West Caln Twp.	Blosenski LF	
	West Caln Twp.	Old Wilmington Road	
	West Caln Twp.	William Dick Lagoons	
	Clinton	Lock Haven	Drake Chemical
	Crawford	Saegertown	Saegertown Industrial Area
	Cumberland	Mechanicsburg	Navy Ships Parts Control Cntr
	Delaware	Haverford Twp.	Havertown PCP
Lansdowne		Austin Ave. Radiation Site	
Erie	Marcus Hook	East 10th St. (proposed)	
	Girard Twp.	Lord Shope LF	
	Mill Creek Twp.	Mill Creek Dump	
Franklin	Chambersburg	Letterkenny Army Depot	
	Chambersburg	PDO Area	
	Chambersburg	SE Area	

Table 2. (continued)
Pennsylvania Superfund Sites by County (Updated February 2001)

COUNTY	MUNICIPALITY	SITE
Lackawanna	Old Forge	Lackawanna Refuse
	Scott Twp.	Aladdin Plating
Taylor	Taylor	Borough Dump
Lancaster	Columbia	UGI Columbia Gas Plant
	Denver	Berkley Products Co. Dump
	W. Donegal Twp.	Elizabethtown LF
Lebanon	Jackson Twp.	Whitmoyer Labs
Lehigh	Emmaus	Rodale Manufacturing
	N. Whitehall Twp.	Heleva LF
	S. Whitehall Twp.	Novak Sanitary LF
	U. Macungie Twp.	Dorney Road LF
	Weisenberg Twp.	Hebelka Auto Salvage Yard
Luzerne	Foster Twp.	C & D Recycling
	Pittston	Butler Mine Tunnel
Lycoming	Williamsport	AVCO Lycoming
Mercer	Hermitage	River Road LF
	Hickory Twp.	Sharon Steel
	Pine Twp.	Osborne LF
	Sharon	Westinghouse Electric (Sharon)
Mifflin	Maitland	Jacks Creek/Sitkin Smelting
Monroe	Jackson Twp.	Butz LF/North Road
	Stroudsburg	Brodhead Creek
	Tobyhanna	Tobyhanna Army Depot
Montgomery	Hatboro	Raymark
	Hatfield	North Penn 2
	King of Prussia	Stanley Kessler
	Lansdale	North Penn 6
	Lower Pottsgrove	Occidental Chemical Corp
	Lower Providence Twp.	Moyers LF
	Lower Providence Twp.	Commodore Semiconductor Grp
	Montgomeryville	North Penn 5
	North Wales	North Penn 7
	Salford Twp.	Salford Quarry (proposed)
	Souderton	North Penn 1
	Upper Merion Twp.	Crater Resources
	Upper Merion Twp.	Tyson's Dump
	Willow Grove	Willow Grove Naval Air Station
	Worcester	North Penn 12 (Transicoil)
Montour	Valley Twp.	MW Manufacturing
Northampton	Hellertown	Hellertown Manufacturing
	Williams Twp.	Industrial Lane
Philadelphia	Philadelphia	Metal Banks
Schuylkill	Frackville	Metropolitan Mirror & Glass
	McAdoo/Kline Twp.	McAdoo Associates
	Tamaqua	Eastern Diversified Metals
Susquehanna	Bridgewater Twp.	Bendix Flight Systems
York	Hopewell Twp.	York County Solid Waste LF
	Spring Twp.	Old City of York LF
	Springettsburg	East Mount Zion
	Windsor Twp.	Modern Sanitation

tive and adopted specific groundwater protection measures. The purpose of this guide then is to describe the management tools that concerned local governments can use to help prevent contamination of their community's valuable groundwater resources.

Why Watersheds?

Why the recent emphasis on planning at the watershed scale? Because water knows no political boundaries. Rivers don't stop flowing at state lines, and county and municipal boundaries don't stop groundwater flow. A watershed-based approach also assumes that all water resources and the water/land connection are considered as communities plan their futures. Therefore, it's important that all levels of government whose jurisdiction falls within a watershed act in a concerted effort toward a common goal. Otherwise, the progress that one municipality makes could be quickly negated by the activities of another municipality. EPA's Office of Water estimates that nationally at least 4,000 local organizations are working on watershed-based issues.

In Pennsylvania, the Department of Environmental Protection has embraced the watershed approach as well. This approach promotes broad-based stakeholder partnerships, increased understanding of stream water quality and pollution, drinking water source protection, pollution prevention and

resource stewardship, comprehensive resource-based planning, and integration of strategies for protecting wetlands, fish and wildlife, and local lands.

Groundwater Protection or Wellhead Protection?

This handbook refers to groundwater protection and wellhead protection somewhat interchangeably, and indeed, in the real world they are. In the world of regulations, however, the two terms have slightly different meanings.

Wellhead protection refers to protecting a defined area that contributes groundwater to, and could contaminate, public water supply wells or springs. Wellhead protection areas may include only a portion of the aquifer from which groundwater is withdrawn. For example, if groundwater flows away from the well faster than it may be pumped out, then the area down-gradient of the well would not be included in the wellhead protection area.

Groundwater, or aquifer, protection refers to protecting the whole water resource on a watershed basis. It considers future uses of water and uses other than public consumption, such as the provision of flow to streams and rivers. An area that depends on private wells for drinking water will need to consider protecting the entire aquifer, not just the portion of the aquifer that supplies public water wells.

Chapter 2:

The Basics of Groundwater Protection for Local Governments

A Five-Step Process for Groundwater Protection

To develop and put into place an effective groundwater protection program, local officials need to use a planned and deliberate process. This process generally includes five steps:

1. Involve the community by organizing a committee of interested individuals from the community, and neighboring communities, if appropriate.
2. Determine sources and uses of the community's water supply and define the proposed groundwater protection areas.
3. Identify possible contamination sources—past, present, and future—in the groundwater protection areas.
4. Establish goals and priorities based on an evaluation of the groundwater threats.
5. Implement appropriate management measures, including plans for future needs.

Involving the Community

For a groundwater protection program to succeed, it must have the backing of the people whom it will affect, directly or indirectly. To help assure this, community residents, businesspersons, and other interested citizens must be involved in the process of developing such a program.

This involvement should begin with the education of interested citizens about groundwater and the need for its protection. Next, the community should gather information about local groundwater supplies and

continue through the other steps as described below. Throughout this process, local residents should constantly receive information and provide feedback. In particular, feedback is needed to determine how the residents perceive the risks to groundwater and what actions they would support to address those risks. Only in this way can officials choose protective measures likely to have public support.

For a groundwater protection program to succeed, it must have the backing of the people whom it will affect. The process must start with educating citizens about the importance of groundwater.

One way to get public involvement is to organize a groundwater protection committee consisting of open-minded residents interested in a wide range of public issues. These people must be willing to commit sufficient time to the assigned tasks. The members of this committee should come from local government, civic groups, and businesses, including as many diverse interests in the community as possible (Table 3). The experiences of many municipalities across the country show that broad memberships help in gaining public support for groundwater protection efforts.

The committee may help gather and review the information about local water sources and the threats to them; make recommendations to local governments concerning the specifics of a groundwater protection program; and help build support in the community for whatever program is eventually adopted.

Table 3.

Key Individuals, Agencies, and Organizations to Consider for Inclusion on a Local Groundwater Committee

- Water supply agency or authority representatives
 - Planning board members
 - Elected officials
 - Environmental officials
- Fire officials, emergency management officials
 - Zoning officials
- Officials of neighboring municipalities
 - County planning officials
 - County conservation district officials
- Penn State Cooperative Extension county agents
- Natural Resources Conservation Service representatives
 - State water resources management officials
- County/state department of health representatives
 - Federal water resources management officials
 - Private water suppliers
 - Agricultural representatives
 - Chamber of commerce representatives
 - Developers
 - Industry representatives
- Representatives of local military installations or government facilities
- Technical experts from nearby universities or government agencies
 - School teachers
- Members of League of Women Voters
- Neighborhood and civic associations
 - Watershed associations
 - Environmental organizations

Identifying Sources and Uses of Local Water Supplies and Defining the Groundwater Protection Areas

The next step in the groundwater protection process requires gathering a good deal of information, a task that should proceed in stages. First, the sources and uses of local water supplies must be determined. To do this, find answers to the following questions (potential sources of information are discussed below):

- Which areas of the community are served by community water supplies? (A community water supply serves 15 or more connections or 25 people on a regular basis.) What is the source of each supply—a river, lake, reservoir, spring, or well? How many people rely on each water supply system?
- Which areas of your community and how many households rely on private individual wells?
- Are significant quantities of groundwater used for other purposes in your community—by agriculture or industry, for example?
- What is the present quality of the groundwater used in the community?
- If the primary water supply source became contaminated or depleted, are alternative water sources available?
- Which uses of surface water, including streams, rivers, lakes, and wetlands, might be affected by a reduction in the quality and quantity of groundwater?

After this information has been gathered, the committee must obtain the hydrogeologic data indicating where the groundwater that feeds local water supplies comes from and, ultimately, which land surface areas affect the quantity and quality of this water and therefore need to be protected. The relevant questions include:

- Where do the aquifers that provide drinking water lie? What geologic characteristics (i.e., depth, rock type, typical yield, recharge areas, vulnerability to contamination) do they possess?
- In what direction does groundwater flow?
- How and where does groundwater connect to the surface—i.e., where are the discharge areas?

Compiling all the information necessary to answer the above questions and others is, admittedly, not a quick and easy task, and it can be further complicated by a number of factors.

- Many agencies and private organizations often hold bits and pieces of information.
- Lack of standardization among disparate data sometimes limits their usefulness.
- The scales of maps are often different.
- The geographic area covered by available data may not be readily applied to a municipality; for example, the data might be organized by quadrangles, watersheds, groundwater basins, or physiographic provinces.

Protective measures can begin before the fact-finding is completed.

Not surprisingly then, given the size of the task and possible complications, information gathering can be quite expensive. Such studies often cost between \$35,000 and \$250,000, depending on the area under study and the kinds of data needed. See section F.2 for information about potential sources of funds.

Nevertheless, the task of gathering information necessary for a groundwater protection program is manageable. Keep in mind several considerations. Although obtaining the hydrogeologic data will probably require the services of a technical consultant, much of

the other material, particularly that pertaining to surface activities, is easily obtainable from local sources by municipal staff and/or interested volunteers. These people can provide administrative support and oversight for contracted services. This will help keep costs down. For example, in Marlborough Township in Montgomery County, volunteers compiled information about local wells and created a computer database and well location map.

Protective measures can begin before the fact-finding is completed. Officials can develop a tentative groundwater protection plan on the basis of information obtained in the early stages and modify the plan as new data emerge.

Information Sources

The Internet is a tremendous resource for general information and for data specific to your watershed. For example, the U.S. Environmental Protection Agency offers the Watershed Academy—a program of live courses, publications and training materials, support for statewide watershed management, and a Web site—over the Internet. The program, called Academy 2000 (www.epa.gov/watertrain), contains a number of free, self-paced training modules about the tenets of watershed management and related topics. Also check the Department of Transportation's Office of Pipeline Safety web page (ops.dot.gov/usa/dw/dw.htm#pa) for information and links to Pennsylvania water resources data and maps on the Internet.

Some other sources of local groundwater information include:

- ***Local agencies and institutions*** such as planning departments, health agencies, water utilities, county conservation district offices, and Penn State Cooperative Extension offices already have a great deal of useful information about communities.
- ***Pennsylvania Spatial Data Access (PASDA)*** (www.pasda.psu.edu) is an Internet-based library of geographic information about Pennsylvania, which is available for free to the public.
- ***State and federal government agencies***, including the Pennsylvania Department of Environmental Protection (DEP) (www.dep.state.pa.us, subject "GIS digital geographic information") (see also DEP's Bureau of Watershed Management, which maintains a database for some 700 groundwater monitoring wells around the state), the U.S. Geological Survey (USGS) Water Resources Division (h2o.usgs.gov), the Groundwater Protection Section of the U.S. Environmental Protection Agency's (EPA) Region III office in Philadelphia (www.epa.gov), the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) (www.nrcs.usda.gov), and the Army Corps of Engineers (www.usace.army.mil).
- ***DCNR's Bureau of Topographic and Geologic Survey*** maintains records of well log data and has published a number of Water Resource Reports covering most of the state. The Pennsylvania Geological Publications catalog lists these reports and presents a map of Pennsylvania showing the area covered by various geologic reports.

The Internet is a tremendous resource for general information and for data specific to your watershed.

- ***Regional agencies*** such as the Susquehanna River Basin Commission (www.srbc.net), the Delaware River Basin Commission (www.state.nj.us/drbc/drbc.htm), the Ohio River Basin Commission (www.uky.edu/WaterResources/ORBC.html), the Ohio River Valley Water Sanitation Commission (www.orsanco.org), and regional planning agencies can often provide high quality local data.
- ***Universities and research institutions*** near you may house natural scientists and students who can help you obtain the information and expertise you need.

Table 4.

Common Sources of Groundwater Contamination

Agricultural

animal burial areas
animal feedlots
fertilizer storage/use areas
irrigation sites
manure spreading/pits
pesticide storage/use

Commercial

airports
auto repair shops
boat yards
construction sites
car washes
cemeteries
dry cleaners
gas stations
golf courses
jewelry/metal plating
laundromats
medical institutions
paint shops
photography establishments
printers
railroad tracks and yards
research laboratories
road deicing operations
road maintenance depots
scrap and junk yards
storage tanks

Industrial

asphalt plants
chemical manufacture, storage,
and distribution activities
electronics manufacturing
electroplaters
foundries/metal fabricators

Industrial (cont'd)

machine and metal working shops
manufacturing and distribution shops for cleaning
supplies
mining and mine drainage
petroleum products manufacture,
storage, and distribution
pipelines
septage lagoons and sludge
storage tanks
toxic and hazardous chemical spills
wells (operating/abandoned)
wood preserving facilities

Residential

fuel storage systems
furniture and wood strippers and refinishers
household hazardous products
lawn chemicals
septic systems, cesspools
swimming pools

Waste management

hazardous waste landfills
highway spills
incinerators
municipal landfills
open burning sites
recycling/reduction facilities
sewer lines
storm water drains and retention basins
transfer stations

[Source: Wellhead Protection Workbook,
U.S. Environmental Protection Agency
Region III, January 1993.]

- *The Pennsylvania Rural Water Association* (www.prwa.com) provides professional technical support, certified system training, reliable and timely information, and other benefits to rural and small water and wastewater systems throughout Pennsylvania.

For additional contact information, addresses, and Web sites, see Appendix D.

Identifying Possible Contamination Sources

After the proposed area of groundwater protection has been delineated, volunteers should conduct an inventory of possible contamination sources—past, present, and future. Such sources include various agricultural, commercial, industrial, residential, and waste management facilities and activities (see Table 4).

Visit the areas of concern to most effectively conduct a pollution source inventory. (Of course, you should obtain permission to visit sites on private property.)

In Allegheny County, the health department cooperated with the Pennsylvania Rural Water Association to sponsor a tour of well-field sites and groundwater recharge areas for local officials, water suppliers, and water works operators. As the participants made the tour by bus, they identified and noted on maps the possible sources of groundwater pollution located within a one-mile radius of the well fields.

Establishing Goals and Priorities

After the groundwater protection area has been defined and the potential sources of contamination identified, the next step is to establish goals and priorities for the municipality's protection program. The local groundwater protection committee should make recommendations to local officials as to what these goals should be.

To make their decisions, the committee needs to decide which threats to groundwater are most significant. To do this, the U.S. Environmental Protection Agency (EPA) suggests asking the following questions for each

activity within the groundwater protection area.

- What risks (for example, reduced water quantity available for consumption, human health hazards, effects on wildlife and ecosystems, etc.) does the activity pose?
- How close is the activity to the water supply well(s) or the recharge area?
- How many people would be affected by groundwater contamination from the activity?
- What characteristics of the soil, geology, and drainage patterns at the site of the activity might affect the aquifer's sensitivity to contamination?

Developing and Implementing a Management Plan

After the goals and priorities of a municipality's groundwater protection program have been determined, the municipality then should develop a management plan. This plan sets forth the tools, techniques, and approaches that the municipality has selected to achieve the goals of its program. These tools can be divided into two categories: regulatory controls and non-regulatory methods. Chapter 3 describes the management tools currently available to local governments in Pennsylvania.

Examples of Local Groundwater Protection Efforts

The Lebanon County Groundwater Education Team, a coalition including the county conservation district, planning department, and water authority, and representatives of Penn State Cooperative Extension, is working on a wellhead protection project in Heidelberg Township. The coalition cooperated with the Army Corps of Engineers and the Susquehanna River Basin Commission to assess the interest in wellhead protection efforts and regionalization among local water suppliers on wells. The coalition has identified and signed up farms to participate in the Best

Management Practices for Dairy Farms project. They have obtained Growing Greener grants to implement agricultural best management practices to reduce nonpoint source pollution from farms. The group has also conducted numerous public education meetings and displays.

Kutztown Borough's (Berks County) forays into wellhead protection began in 1992 with a grant from EPA to identify pollution sources in the watershed. The borough has since adopted a wellhead protection ordinance that prohibits certain regulated land uses within the area covered by the ordinance or permits them only by Special Exception.

To educate its citizens, the borough sponsored a Water Awareness Day in conjunction with a household hazardous waste drop-off. Attractions included water taste testing and displays about the watershed and by water-related vendors.

The national Groundwater Foundation named the borough a Groundwater Guardian community in 1995 in recognition of the Borough's voluntary measures to protect groundwater. Borough staff have also prepared a how-to manual on wellhead protection especially for small communities. This manual has been well received across the state and by EPA. Contact Keith Hill, (610) 683-6131, khill@kutztownboro.org for more information.

These are just two of the groups working to protect water resources in Pennsylvania. Many groups are staffed completely by volunteers. For more information about active groups in your area, contact the DEP regional office nearest you. Contact information can be obtained from DEP's web site or from the blue pages of the phone book.

Chapter 3:

Groundwater Protection Tools for Pennsylvania's Local Governments

Much of this chapter focuses on tools that local governments can employ in land use planning. You might wonder about the connection between groundwater quality and land use. In a study commissioned by the American Planning Association, Pennsylvania ranked second in the nation in acreage developed per person (52% increase) between 1982 and 1997. Unplanned land development often results in a high percentage of the land being covered with impervious surfaces—areas that do not soak up precipitation, such as parking lots, roads, and roofs. Greater impervious area increases the frequency of flooding, the transport of nonpoint pollution to waterways, the erosion of stream banks and sediment in the water, and decreases the recharge of groundwater. Consequently, federal, state, and local officials are realizing that it makes sense to tackle water quality and quantity issues through better land use management.

Pennsylvania's "Growing Greener" and "Growing Smarter" programs provide funding and guidance to communities interested in helping themselves grow "smarter."

In selecting methods for groundwater protection, municipalities should remember to choose simple and usable approaches that have clear and predictable requirements and standards. Use the simplest tools that will accomplish the task. The list of options presented below is by no means exhaustive. It may be possible to adopt within the context of Pennsylvania law additional tools used in other states.

PLANNING PROGRAMS

A.1. Planning Commission or Department

Any municipality can create a planning commission, planning department, a combination of the two, or a planning committee. In addition, two or more municipalities can create a joint municipal planning commission.

According to Article II of the Municipalities Planning Code (MPC), a planning commission consists of three to nine members appointed by the municipal governing body. A planning commission can conduct land use studies to identify, for example, large water users, potential contamination sources, and land use relationships.

At the request of the governing body, the planning agency has the power to and is required to prepare a comprehensive plan for the development of the municipality. This commission can make recommendations to the municipal government regarding zoning ordinances, subdivision and land development regulations, planned residential development regulations, and building and housing codes. Among other things, the planning agency can prepare and present to the governing body of the municipality an environmental study and a water survey, which must be consistent with the State Water Plan and any applicable water resources plan adopted by a relevant river basin commission.

Recent amendments to the MPC, Article II (212) and Article XI (1101), authorize municipal governing bodies to engage in intergovernmental cooperation and enter into joint cooperation agreements. See section F.1 and Table 9 for more information.

A.2. Comprehensive Plan

As described in Article III of the MPC, a comprehensive plan states the objectives of a municipality regarding the timing, character, and location of future development in the municipality. It sets forth the vision and goals for the community's growth and development. It may serve as the "statement of community development objectives" required under Section 606 of the MPC before any zoning ordinance can be enacted.

The comprehensive plan may include an indication of the types of land uses desired in the community. A plan for the reliable supply

of water is now required under the June 2000 MPC amendments. This can provide a useful context within which specific policies and plans for groundwater management can be developed.

A.3. Official Map

An official map is a special, though seldom used, regulatory tool that allows local governments to place a reservation on private land for future public acquisition and use. Such uses might include, for example, water supply, storm water retention, and wastewater treatment facilities. Official maps are authorized in Article IV of the Municipalities Planning Code; elected officials adopt the map as a land use ordinance. The reservation lapses if a landowner formally applies to make private use of the property and the governing body fails to acquire the property or begin condemnation proceedings within one year of the landowner's application. Official maps also indicate all publicly owned land in the municipality, including public grounds, recreation areas, and streets.

A.4. Sewage Facilities Management

The Pennsylvania Sewage Facilities Act (Act 537 of 1965 and its 1994 amendment, Act 149) requires municipalities to prepare and adopt an Official Sewage Plan for sewage services within its boundaries. This plan is commonly known as an Act 537 Plan. DEP reviews and approves these plans. As of March 2000, all municipalities were in compliance with this requirement.

The official sewage plan can be a valuable tool for groundwater protection since it designates those areas of the municipality that are suitable for on-lot sewage systems and can include provisions for sewage management districts. Municipal comprehensive plans, zoning, and official sewage plans should be developed together so they set forth consistent goals for the municipality.

Areas within the municipality with many types of soils or slopes unsuitable for on-lot sewage systems might be areas where larger lots are required, or areas where cluster zon-

ing is preferable. Community sewage systems might be required for some of these areas if other factors, such as nearby existing systems with sufficient capacity, are present.

Permitting and inspection of construction, repair, or replacement of on-lot sewage systems are the responsibility of a municipal sewage enforcement officer (SEO). SEOs are licensed by the state and employed by a municipality. Municipalities may contract with a Local Agency to provide SEO services for its residents. A Local Agency might be a municipality, a group of municipalities, a county, or a county department of health.

DEP encourages municipalities to adopt a sewage management program to help ensure that on-lot systems are properly maintained so as to prevent contamination of groundwater. Such a program could include regular inspection of on-lot systems, pumping of septic tanks, and regulations for disposal of septage.

Areas within the municipality with many types of soils or slopes unsuitable for on-lot sewage systems might be areas where larger lots are required, or areas where cluster zoning is preferable.

DEP provides grants and reimbursements to municipalities and local agencies for costs associated with the planning and permitting programs. In addition, the Pennsylvania Infrastructure Investment Authority (PEN-VEST: www.pennvest.state.pa.us), the Pennsylvania Housing Finance Agency (PHFA), and DEP are co-sponsors of a funding program that provides low-interest loans to homeowners for the rehabilitation, improvement, repair, or replacement of existing on-lot septic systems. The loans are available to homeowners in areas where a sewer system is not available and will not be constructed in the next five years. (See www.dep.state.pa.us, subject "grants/loans").

A.5. Storm Water Management

The Storm Water Management Act of 1978 provides for planning, ordinance development, technical assistance, and funding to manage storm water runoff on a watershed basis so as to prevent downstream flooding. However, storm water management also relates to groundwater protection because storm water that runs off rooftops, driveways, streets, and other impervious surfaces usually goes directly into streams and rivers. Therefore, this water does not filter through the ground and recharge the groundwater. This can lower the water table (the top of the zone of saturation), which may affect the yields of private and municipal wells. Through appropriate site design and management methods, storm water can be retained at certain sites and then gradually released so the water has a chance to enter the soil.

Storm water management becomes more complicated if the water is contaminated.

Storm water management becomes more complicated, however, if the water is contaminated with substances such as farm fertilizers or petroleum products deposited on parking lots. Contaminated runoff poses a particular threat to groundwater in areas of the state with karst topography—limestone bedrock with sinkholes, caves, and solution channels—because these are direct conduits to groundwater. Storm water management planning in the past has not generally considered water quality impacts. However, in light of the various ways storm water runoff can affect water quality and quantity, municipalities must begin to do this. DEP's Division of Water Use Planning operates the storm water planning and management program, which provides technical assistance and funding. (Call (717) 772-5661 or see <http://www.dep.state.pa.us>, direct link "stormwater"). The Pennsylvania Infrastructure Investment Authority (PENNVEST) also funds some storm water protection projects (www.pennvest.state.pa.us/).

A.6. Source Water Assessment and Protection

Pennsylvania is in the midst of completing assessments of the sources of drinking water for all public water systems in the state. These assessments will identify potential sources of contamination in the area that the water systems draw from, either groundwater or surface water. When these assessments are complete, water suppliers and municipalities will be able to use this information to complete programs that protect their water sources.

Wellhead protection is a type of source water protection. A water supplier and/or one or more municipalities can undertake wellhead protection planning. However, if regulatory programs are included in the plan, implementation is the responsibility of the individual municipalities. DEP has developed guidelines that local wellhead protection (WHP) programs must meet to receive DEP approval. Although voluntary, municipalities are encouraged to develop and submit WHP programs because it is far less costly to protect groundwater than to clean it up after it is contaminated.

DEP requires the presence of the following six elements (www.dep.state.pa.us, direct link "source water"), at a minimum, to approve a local WHP program:

- A steering committee must be involved in developing the plan; public participation and public education must be ongoing throughout plan development.
- Rigorous wellhead protection area delineation must be performed by or under the supervision of a registered professional geologist.
- The plan must include a contaminant source inventory and a description of how the inventory was conducted.

DEP has also adopted wellhead protection regulations for wells of new community water systems or for wells to expand existing systems. The water supplier must show that it owns or controls all the land in the wellhead protection zone 1 (Figure 3) before a

Wellhead Protection Area Zones

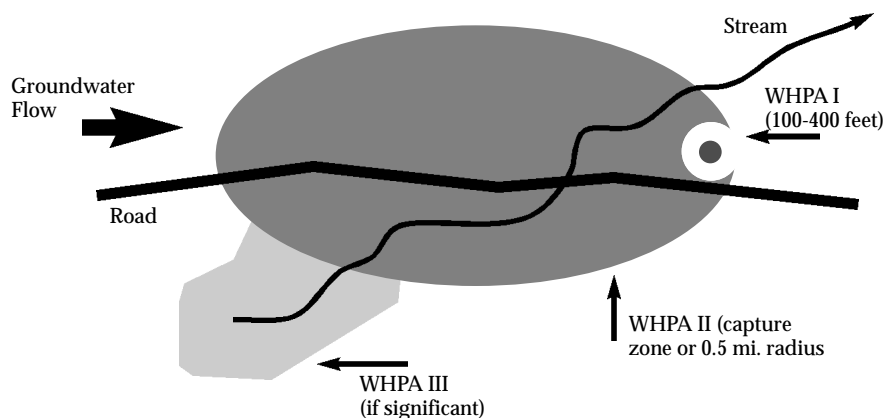


Figure 3: Wellhead protection areas

Table 5.

Adopted Wellhead Protection Ordinances in Pennsylvania (Known to DEP)

Municipality	County	Date Adopted	Water System
Heidelberg Twp.*	Lebanon	~1975	Heidelberg Twp. Munic. Auth.
East Stroudsburg Boro	Monroe	1990	E. Stroudsburg Boro Water Dept.
Cornplanter Twp.	Venango	1994	Rouseville Boro Water Auth.
Kutztown Boro	Berks	1995	Kutztown Boro
Topton Boro	Berks	1995	Boro of Topton Water Supply
Upper Mt. Bethel Twp.	Northampton	1995	Evergreen Village/Tuscarora Village Mobile Home Parks
Telford Boro	Mont./Bucks	1997	Telford Boro Auth.
East Petersburg Boro	Lancaster	1997	East Petersburg Water Auth.
Dover Boro	York	1997	Dover Boro Water System
Dean Twp.	Cambria	1997	Dean Twp.
Catasauqua	Lehigh	1998	Catasauqua Munic. Water Works
South Middleton Twp.	Cumberland	1998	South Middleton Twp. Water Auth.
West Rockhill Twp.	Bucks	1998	Telford Boro Auth.
Ayr Twp.	Fulton	1999	McConnellsburg Boro Munic. Auth.
Springdale Boro	Allegheny	1999	Springdale Boro Water System
Bedminster Twp.	Bucks	1999	various small community water sys.

Unless otherwise indicated, protection is by overlay zoning.

* watershed conservation district

(Compiled by G.P. Bowling, DEP, March, 2001)

permit for a new or expanded well may be issued. Zone 1 includes the area immediately surrounding the well; the radius may range from 100 to 400 feet, depending on the pumping rate and depth of the well and the type of aquifer intercepted. This control will allow the water supplier to prohibit activities that could adversely impact the well. But because this requirement applies only to new systems or to wells to expand existing systems, municipalities, residents, and water suppliers must take responsibility for protecting existing water supplies.

Because of the overlapping responsibilities and authorities of water suppliers and municipalities for ensuring a safe water supply, cooperation in developing wellhead protection programs is essential. DEP provides funding through the Source Water Protection Grant Program to support development of local WHP plans. (See www.dep.state.pa.us, direct link "source water" for more information.) More than 30 communities have already taken advantage of this grant. County plans can be useful in outlining the programs needed to protect local water supplies. But unless municipal officials understand and accept their responsibility to adopt the necessary controls, the plans will remain unimplemented and water sources will go unprotected.

More than 160 water supply systems in the state are conducting local wellhead protection activities. More than a dozen systems are protected by wellhead protection (WHP) ordinances (Table 5) adopted by the communities they serve.

The Telford Area Steering Committee has led the charge for wellhead protection with six of its neighboring municipalities in Bucks and Montgomery counties. Of these six, so far only Telford Boro and West Rockhill Township have adopted ordinances, but several other municipalities are close to adoption. This effort is significant for the cross-county cooperation demonstrated.

Kutztown Borough and neighboring Topton Borough in Berks County have adopted similar ordinances. Nearby Maxatawny Township and Lyons Borough are working on ordinances as well. Kutztown Borough began working on wellhead protection in 1992 upon receiving a grant from EPA

to identify pollution sources in the watershed. The borough has adopted a wellhead protection ordinance that prohibits certain regulated land uses within the area covered by the ordinance or permits them only by special exception. Kutztown's primary wells are outside borough boundaries, but land around the wells is owned by the Borough. Therefore, the municipality can exercise control over this land.

Borough staff, the U.S. Department of Agriculture Natural Resources Conservation Service, and the farmer of the land around the wells collaborated on the development and implementation of an integrated crop management plan to protect water quality in the wells. The plan includes information about the types and rotation of crops to be planted, kinds of fertilizers and pesticides allowed, establishment of buffer zones, and plans for conservation tillage. Thanks to this careful land management, there have been improvements in water quality from the wells.

Summary of a Sample Wellhead Protection Ordinance

The heart of the Kutztown ordinance is summarized as follows: "Section 3: Regulated Land Uses, establishes that certain particular regulated land uses will be prohibited or permitted only by Special Exception, within Zone 2 or 3, as applicable, as set forth in a schedule of these regulated land uses, which is incorporated in the ordinance. Section 5: Administration, provides that uses of land in existence on the date of enactment of the ordinance are deemed to be "nonconforming uses" and may be continued by the present or any subsequent owners with certain provisions. Some of these provisions are that it be in compliance with all laws and regulations; that the nonconforming use is not discontinued for twelve consecutive months; and provisions that the nonconforming use is not materially altered, changed, or expanded. This section also provides that a regulated land use is deemed to be new or materially altered, changed, or expanded under certain conditions. Some of these include the production and/or storage capacity of the regulated land use is increased; the types of any substances which give rise to the

regulated land use are changed; and the quantity of any substance which gives rise to the regulated land use is materially increased. Section 4: Reporting Requirements, provides that for each lot or tract of land within the overlay district, upon which is conducted a regulated land use, that certain reports or information must be submitted to the Borough's Code Enforcement Officer." (D. Kratzer and K. Hill, *Pennsylvanian*, July 1995. pp. 4-14.)

SUBDIVISION REGULATION

Article V of the Municipalities Planning Code grants authority to municipalities to regulate the subdivision of land and the improvement of parcels for use as residential, commercial, or industrial building sites. These regulations are intended to ensure that building sites will have adequate water supply, wastewater disposal, and accessibility for emergency vehicles. Communities without a zoning ordinance are authorized to use their subdivision and land development ordinance to set minimum lot area and setback. These communities are thus able to control, to some degree, development that might impact groundwater resources.

B.1. Mandatory Dedication of Open Space

As part of a subdivision and land development process, some municipalities require that a development plan include a specific amount of land for parks or recreational facilities. To make this requirement, however, a municipality must have a formally adopted recreation plan. The land set aside for recreation might also serve as part of a municipality's groundwater protection area.

B.2. Site Design Standards

Site design standards can help protect groundwater by controlling runoff and potentially polluting activities. Examples of such standards include limitations on the amount of impervious surface allowed or on the storage and stockpiling of potential contaminants, as well as requirements concerning landscaping or the preservation of forested areas.

ZONING REGULATION

Zoning is another land use control that can be helpful in protecting a municipality's groundwater resources. Zoning controls the location and intensity of land uses so that, for example, activities that have the potential to contaminate groundwater resources can be prevented from locating close to sensitive areas. The authority to zone, which comes from the Municipalities Planning Code, is based on a local government's "police power" to create ordinances to protect and promote public health, safety, and the general welfare. The Planning Code (Article VI, Section 604) specifically includes among the purposes of zoning the provision of safe, reliable, and adequate water supplies, and the preservation of forests, wetlands, aquifers, floodplains, prime agricultural land, and environmentally sensitive areas.

A state policy enacted in September 2000 requires that DEP verify that new proposed projects meet local land use ordinances before about 80 types of environmental permits dealing with air, water, waste, and mining can be issued. The impetus for the policy stems from the state's Growing Smarter legislation, which aims to control sprawl. DEP also requires permit applicants to give more notice of their plans to the affected counties and municipalities and to solicit comments on potential conflicts with local land use plans.

Among the approaches and techniques to consider for groundwater protection are: conditional uses, agricultural zoning, zoning to ensure open space, planned residential development, wellhead and aquifer protection zoning, performance zoning, and transfer of development rights.

C.1. Conditional Uses and Special Exceptions

Conditional uses and special exceptions require a special review and public hearing for activities that may have a significant impact on surrounding areas. Special exception applications are heard and decided by the local zoning hearing board; conditional use applications are heard and decided by the governing body. In all other aspects, the two techniques are similar. Districts in which

these uses may be located are established in the zoning ordinance, as are the specific requirements governing the use. For example, to ensure that a wellhead or aquifer recharge area is not harmed, there might be a “condition” that gasoline stations located within wellhead protection areas install double-walled underground storage tanks. Applications that meet the specific requirements in the ordinance generally must be approved.

C.2. Agricultural Zoning Districts

Municipalities may establish agricultural zoning districts in which land uses that are incompatible with agriculture are prohibited. Usually these districts are established in areas of a community with productive soils and active farms. Although many municipalities have some degree of agricultural zoning, a 1995 study funded by the Center for Rural Pennsylvania found 92 municipalities in 14 counties with truly effective agricultural zoning covering about 725,000 acres. A typical restriction associated with agricultural zoning districts states that agricultural land parcels may not be reduced to a size that would be economically unviable for farm use.

Local officials should adopt the simplest controls that will enable the municipality to achieve its objectives.

Even though a municipality may have agricultural zoning districts, some caution is advised. This type of zoning prevents or reduces development and associated threats to groundwater resources, but some agricultural activities can themselves cause contamination. Therefore, agricultural districts can help in groundwater protection efforts only if farmers are well educated about and use safe methods of pesticide, fertilizer, and animal manure application.

C.3. Cluster (or Open Space) Zoning

This flexible zoning approach groups buildings, usually homes, on individual lots smaller than those allowed under convention-

al zoning. This allows for the preservation of open space and groundwater recharge areas. The overall density of development remains the same as for conventional developments, although sometimes an incentive, in the form of bonus lots, is given as a way of encouraging the use of clustering. The open space preserved can encompass lands the municipality has designated for groundwater protection.

Mount Joy Borough in Lancaster County has adopted cluster zoning. The ordinance specifies a minimum size of 15 acres for a cluster development project, a density of no more than six units per acre, a minimum of 30 percent of each parcel preserved as open space, and other requirements for maintenance of the common area.

C.4. Planned Residential Development

Planned residential development (PRD) offers another way to preserve open space. A PRD project is usually used for a large-scale development that includes different types of housing, businesses, offices, open space, and recreational facilities. The plan concentrates the building activity on the most suitable sites, thereby accommodating natural features and contributing to groundwater protection.

C.5. Wellhead and Aquifer Protection Districts

Wellhead and aquifer protection districts are specially created zones around wells or above drinking water aquifers that have more stringent protection standards than other districts in a municipality. Certain land uses may be prohibited entirely, and others may be allowed only as conditional uses or as special exceptions under strict performance standards.

Wellhead protection districts protect the land area that contributes to a single well or wellfield. This type of zoning is more useful for protection of wells in an ***unconfined aquifer***—one that has no impermeable layer of clay or rock above it. In this case, the aquifer recharge area is more easily defined (it generally lies directly above the aquifer) and is more apt to lie within a municipality’s boundaries or the boundaries of neighboring

municipalities. Conversely, water likely enters a confined aquifer, an aquifer with an impermeable layer above it, at a place some distance away.

Wellhead and aquifer protection districts are specially created districts around wells or above drinking water aquifers.

Aquifer protection districts safeguard the entire recharge area of an aquifer and therefore tend to be larger than wellhead protection districts. The former should provide for the possible future construction of additional wells drawing from that aquifer.

These protection zones are often set up as “overlay” zones. This means that special wellhead and aquifer protection criteria are added to the basic underlying restrictions imposed on the entire zoning district. East Marlborough Township in Chester County, for example, has adopted an ordinance that established a groundwater protection district as an overlay on the existing zoning districts. According to the special performance standards that apply to this district, development must not create a risk of contamination by sewage effluent or of structural damage from subsidence and must not result in any additional storm water runoff.

West Whiteland Township in Chester County has a Carbonate Area District Ordinance the purpose of which is to “protect the water resources associated with carbonate geologic formations in [the township] from land-use and development patterns that would threaten their quality and quantity as a result of pollution and the alteration of natural drainage patterns.” The ordinance requires that certain measures to prevent pollution of the aquifer be taken in new or altered construction within the district. Some of the requirements include: possible need to encase gasoline and other storage tanks in impervious liners; prohibition of potentially contaminating fill material; prohibition of storage, handling, processing, or disposal of toxic materials; and prohibition of activities that would diminish the flow of natural springs.

C.6. Performance Zoning

Performance zoning dates from the early 1970s and is intended to improve land use management for the protection of natural resources. In its purest form, performance zoning would allow all land uses in all zoning districts, provided they conform to established standards. However, municipalities generally use a hybrid version that combines conventional and full-scale performance zoning.

The Bucks County Planning Commission has advocated performance zoning, and many of the county’s boroughs and townships now use this approach. In addition to natural resource protection standards, the zoning regulations contain three primary performance criteria for any development: a minimum open space requirement, a maximum density standard, and a maximum impervious surface ratio. Various natural resources are protected by limiting the extent of development in each resource. For example, no development is permitted in floodplains and wetlands—100 percent of these areas must remain as open space. (See www.sustainable.doe.gov/codes/bucks.shtml for more information.)

C.7. Transfer of Development Rights

Municipalities can provide for transferable development rights (TDR) (MPC, Section 619.1) to help protect groundwater supplies in a way that uses the mechanisms of the marketplace and therefore may have more public support than governmental regulation usually does.

The concept of transferable development rights is based on the idea that the ownership of property consists of several separable rights: development rights, mineral rights, the right to grant easements, etc. The owner of one property can sell development rights to another property owner, allowing the buyer to intensify the use allowed on his or her property. The buyer pays the seller the value of the development rights. The seller’s property remains in its open, unbuilt condition. The municipality’s tax base grows because the development has occurred, although in a different location. TDR allows municipalities to create a financial incentive to landowners

in sensitive areas not to develop their properties.

The concept of transferable development rights is based on the idea that the ownership of property consists of several separable rights.

The ability to transfer development rights across municipal boundaries when there is an intergovernmental cooperative agreement (see section F.1) with a plan for growth areas and rural resource areas is one of the significant new provisions of the MPC amendments of 2000. In this situation, a joint municipal zoning ordinance is not required. The municipal ordinance establishing TDR designates sending (preservation) areas and receiving (development) areas and assigns development rights to the sending areas. The number of development rights may be based, for example, on the number of dwelling units allowable under existing zoning regulations. The municipality may then encourage purchase of these rights by property owners in the receiving district by allowing higher densities with the purchase than would otherwise be allowed.

TDR programs have been set up in Berks, Bucks, Chester, Lancaster, and York counties, although actual transfers have been infrequent and small. As of 1998, Buckingham Township in Bucks County had protected 280 acres of farmland through a TDR ordinance enacted in 1994. (See www.farmlandinfo.org/fic/tas/tafs-tdr.html).

Impacts of the Revised Municipalities Planning Code on Zoning and Other Water-related Regulations

The June 2000 amendments to the MPC make it easier for municipalities to use joint planning and zoning (see section F.1 for more information). They also require that comprehensive plans

“include a plan for the reliable supply of water ...” (see section A.2 for more information).

However, the MPC amendments also introduced some potential conflict between zoning issues and water resources protection. For example, the revised MPC provides for broad placement of mining. Section 603 (c), subpart I states that “[z]oning ordinances shall provide for the reasonable development of minerals in each municipality.” Coal mining is specifically named as a land use that may not be excluded from each municipality’s zoning plan. It is not clear, however, whether municipalities using joint planning must allow for mining uses in all municipalities. This pervasive authority could be at odds with a well-head protection ordinance.

Similar conflicts may arise with forestry. Section 603 (f) states that forestry activities are to be treated in zoning ordinances as a “permitted use by right in all zoning districts in every municipality.” These changes mark a shift away from resource conservation toward resource utilization.

Section 105, Purpose of Act, was amended to support a farmer’s right to change the operation in any way to “remain viable.” This provision effectively protects farmers from community complaints, especially about the industrialization of farming.

Section 301 (6) (ix) removes municipalities’ option to impose stricter nutrient management standards on farming operations with less than 2 animal units per acre. This could lead to surface and/or groundwater contamination.

Section 603 (g) (1) states that “zoning ordinances shall protect prime agricultural land and may promote the establishment of agricultural security areas.” It is unclear how this requirement will be implemented, but it may conflict with landowners who want to convert farm land to other uses. Subpart (h) of this section severely limits the application of zoning ordinances to agricultural land, especially to control the transition of traditional operations to industrialized operations, unless there is a direct adverse effect on public health and safety.

OTHER REGULATORY TECHNIQUES

D.1. Source Prohibitions

In certain instances, municipalities protect groundwater resources by regulating the types of activities that can occur in sensitive areas. An example would be the prohibition of gasoline stations using underground fuel storage tanks within the wellhead protection area. Other prohibited land uses might include sewage treatment plants, landfills, or other activities involving the use, storage, or disposal of toxic and hazardous materials (see discussion on principal sources of contamination in Chapter 1). Conflicts may arise, however, with MPC limitations on how municipalities can regulate some activities, including mining, forestry, and agriculture.

Nothing is accomplished just by placing regulations on the books. Local governments that choose regulatory techniques to implement their groundwater protection programs must be prepared to enforce them.

D.2. Well Construction Standards

Pennsylvania has no regulations for private well construction. However, counties or municipalities can write and adopt their own. Chester County has adopted regulations establishing minimum standards for the location, construction, modification, or abandonment of private and semi-public wells. The Chester County Health Department administers the program.

A Note About Using Regulatory Measures

Nothing is accomplished just by placing regulations on the books. Local governments that

choose regulatory techniques as a way to implement their groundwater protection programs must be prepared and committed to enforcing them.

An effective enforcement program involves having a record system that lists all limitations, restrictions, and standards included in the regulations, as well as enough personnel to monitor development activities and enforce the regulations. And, of course, ongoing education about the regulatory program and the reasons for it will also aid in enforcement.

NON-REGULATORY PROGRAMS

E.1. Agricultural Security Areas

Farming is the predominant land use in agricultural security areas. Under the provisions of Pennsylvania's Agricultural Security Areas Law, municipal officials designate these areas upon the petition of local farm owners. Participating landowners in agricultural security areas receive special consideration so that farming is not hampered by state or local restrictions. The law does not impose any additional restrictions on the use of farm properties, nor does it waive the application of local ordinances.

Farmers in an agricultural security area are eligible to participate in the agricultural conservation easement purchase program. This joint effort between the state and participating counties preserves the land perpetually as farmland, which can be beneficial to groundwater protection efforts.

The Pennsylvania Department of Agriculture's Farmland Protection Program is the fastest growing program of its type in the country. Since the program began in 1989, about 165,000 acres of prime Pennsylvania farmland have been preserved in 42 counties. The Growing Greener Initiative, a state funding program initiated in 1999, includes about \$100 million for farmland preservation. In addition, many counties have included funding for purchases in their budgets. Pennsylvania dedicates \$0.02 of the state tax on the sale of cigarettes to the purchase of development rights for farmland. This tax brings in about \$20 million per year.

E.2. Land and Easement Purchases and Donations

In Pennsylvania and elsewhere in the United States, some municipalities and counties are protecting their groundwater supplies by buying land, purchasing conservation easements and development rights, and encouraging donations of land and development rights. Bucks, Montgomery, Chester, and Monroe are some of the counties that have recently passed bond issues dedicated to purchase of open space. Municipalities in Bucks, Centre, Chester, Delaware, Montgomery, and Philadelphia counties passed voter referenda in 1999 or 2000 authorizing bond issues or tax increases for open space preservation.

Some municipalities are protecting their groundwater supplies by buying land, purchasing conservation easements and development rights, and encouraging donations of land and development rights.

There are advantages and disadvantages to all methods of land protection.

- The purchase of property by a municipality involves costs including the purchase price, maintenance, and loss of tax revenues, and therefore may seem extravagant. However, land purchase may prove the most cost-effective way to protect water supplies, because continued protection is assured. In addition, the community gains land that can be used for public purposes—for example, a park.
- Purchasing a conservation easement or development rights also gives a municipality reasonable assurance that a sensitive area will be protected. Furthermore, since ownership of the land does not change, purchasing an easement or development rights costs less than buying the property outright (although development rights

may cost 75-90 percent of the land's total value). However, the municipality does not have the land to use for other public purposes.

- Donating land and development rights to private, nonprofit land trusts, such as those organized by nature conservancies, is another way to preserve land and natural resources. According to the Land Trust Alliance, there are now at least 90 local land trusts in Pennsylvania and as of 1998, they had preserved a total of 348,239 acres—54,014 acres owned in fee, 59,774 acres under conservation easements, and 234,451 acres transferred to government agencies. Landowners can receive tax benefits from the donation of easements or bargain land sales to nonprofit land trusts.

The LeTort Regional Authority is an example of an innovative approach to water quality control through easement purchase. This is a joint effort undertaken by four municipalities (Carlisle, South Middleton, North Middleton, and Middlesex) and Cumberland County to protect LeTort Spring Run, one of the finest limestone trout streams in the country. The Authority, which receives funding from the four municipalities based on their population within the watershed, and also from Cumberland County, provides an example of how municipalities can use easements to protect natural resources. The authority initiated a conservation easement program that allows interested landowners to place restrictions on current and future uses of their streamside properties. The easement provides a buffer zone between the stream and future development and forbids the use or storage of any potentially toxic or polluting materials within the area. Land in the easement program may not be plowed or stripped of grass, shrubs, trees, or plants, and no new buildings may be erected. The landowner retains full ownership of the easement area and can choose whether or not to allow public access. As of 1998, the Authority held ten easements on 15 parcels of land, with several additional easements pending.

E.3. Environmental Advisory Councils

Act 148 of 1973 authorized local governments to appoint Environmental Advisory Councils (EACs) that, according to the act, “have the power to identify environmental problems and recommend plans and programs to the appropriate agencies for the promotion and conservation of the natural resources and for the protection and improvement of the quality of the environment.” Although by law a council can consist of only seven members, many more people can be involved in any public education programs the EAC undertakes.

According to the Pennsylvania Environmental Council, about 150 municipalities in Pennsylvania have established EACs, including communities in Adams, Allegheny, Berks, Bucks, Centre, Chester, Cumberland, Dauphin, Delaware, Lehigh, Montgomery, Westmoreland, and other counties.

EACs can play a direct or indirect role in groundwater protection. The EAC of Towamencin Township in Montgomery County has been coordinating a stream corridor study on Towamencin Creek. This watershed and the surrounding area have been heavily impacted by Interstate 476 and the development and traffic it has brought. This development has reduced groundwater recharge and flood storage and increased stream bank erosion and siltation. The EAC hired the Heritage Conservancy to develop a complete picture of both the natural assets and the impacted areas of the stream corridor. The plan is to restore areas of the stream corridor by planting trees and shrubs to control erosion and increase groundwater recharge.

E.4. Public Education

Local officials should make it public policy to encourage voluntary actions by residents to protect groundwater. Although unlikely to work as the sole means of preserving groundwater, a voluntary program can be a valuable supplement to governmental regulation and public land acquisition. Inspiring residents voluntarily to change their lifestyle and actions requires that they understand why change is needed and what actions should be changed.

A public information program about the value of groundwater protection could, for example, describe how improper waste disposal, the overuse of lawn and garden chemicals, and poorly maintained septic systems threaten groundwater quality. The program should then explain what individuals can do to minimize or eliminate these threats. It should further explain that although the actions of individuals may seem inconsequential, when multiplied by thousands of households in an aquifer area, these actions may have very serious consequences.

You may have noticed signs along roadways informing drivers when they enter a public water supply area. These signs include information about whom to call if a chemical spill occurs along the road. This road sign program has been a useful tool for raising public awareness about threats to community water supplies.

Here are some pointers on effective watershed education and involvement programs from the U.S. Environmental Protection Agency’s publication, “Top Ten Watershed Lessons Learned.”

- A sustained effort is necessary; a one-shot or scattered approach is unlikely to be successful.
- Seek out public views through meetings, personal contact, and surveys. The passive approach—just saying that people are available to answer questions—won’t work.
- Information in any form—publications, videos, exhibits, and charts—must be clear, concise, easy to understand, and locally relevant.

Many publications are available about engaging the public in water resources education programs. See Appendix B for more information.

E.5. Monitoring

Municipal officials and residents can initiate a comprehensive monitoring program to track contamination from specific or potential pollution sources in a designated area. (For

more information, see www.dep.state.pa.us, subject “water management.”) Sources are determined by the pollution inventory described in the previous chapter. As part of the monitoring program, a municipality should conduct periodic testing of groundwater samples from observation wells to allow early detection of contamination. These monitoring wells should be located down-gradient from potential contamination sources.

DEP supports an extensive volunteer monitoring network called the Citizens’ Volunteer Monitoring Program (CVMP). The goals of the CVMP are 1) to foster stewardship by giving communities the tools they need to meet their own goals related to water resources, and 2) to give DEP a better understanding of the state’s water resources by receiving quality-assured data from volunteers. The CVMP includes both surface and groundwater monitoring efforts. Surface water monitoring can be helpful in identifying places where contaminated groundwater enters streams. (See www.dep.state.us, subject “Citizens’ Volunteer Monitoring Program.”)

Monitoring programs can produce important data for wellhead protection planning. The USGS is collaborating with DEP to study bacterial contamination in private wells in southeastern and south central Pennsylvania. The goals of the study are to determine whether wells constructed to high standards (with grout and surface seal) provide better protection against bacterial contamination than less stringently designed wells (with no grout or surface seal) and whether rock type affects bacterial contamination of well water. The wells are being sampled for total coliform and *E. coli* bacteria. Municipal officials in these areas might wish to obtain the results of this study.

E.6. Contingency Plans

DEP requires that community water systems have emergency plans as part of their wellhead protection programs. Such a contingency plan includes provisions for alternate water supplies in the event of well or well-field contamination, and detailed procedures to follow in case of an environmental incident impacting a well or wellfield. An emergency response plan is developed to ensure an

orderly and efficient transition from normal to emergency operations. The plan should include:

- an updated emergency organization chart illustrating the chain of command.
- a current list of federal, state, and municipal officials to contact in an emergency, as well as contact points for the media and priority users (e.g., hospitals, nursing homes).
- a plan detailing the physical layout of the source, distribution system, and all equipment.
- agreements with neighboring municipalities, local industries, and utilities to cooperate by lending personnel and equipment.
- table and related map indicating potential sources of contamination and appropriate emergency response procedures.
- provision for alternate water sources and a rationing system that meets the needs of priority users.
- procedures for the dissemination of factual information to the media.
- assurance that personnel have been trained to handle emergency situations.

Coordination between various levels of government is essential in an emergency. Local and county officials should have copies of public water suppliers’ contingency plans, and contact information should be kept up to date. For more information on developing contingency plans, obtain DEP’s booklet “Public Water Supply Manual Part VI: Emergency Response” (www.dep.state.pa.us/dep/subject/All_Final_Technical_guidance/bwsch/bwsch.htm) or EPA’s “Guide to Ground-Water Supply Contingency Planning for Local and State Governments” (#EPA 440/6-90-003). See appendix B for EPA publication ordering information.

E.7. Household Hazardous Waste Collection

Municipalities can organize hazardous waste collection days to ensure proper disposal of household hazardous wastes and to emphasize the need to protect groundwater through the proper handling of hazardous materials. These collections divert household hazardous wastes, such as pesticides, herbicides, paint, cleaning chemicals, batteries, pool chemicals, and motor oil, from local landfills, sewers, and septic systems to licensed hazardous waste disposal sites.

DEP provides matching grants to municipalities, counties, private organizations, or companies that sponsor household hazardous waste collections. Contact the Bureau of Land Recycling and Waste Management or see www.dep.state.pa.us, subject "waste management" for more information.

The Pennsylvania Department of Agriculture (PDA), in cooperation with Penn State Cooperative Extension, operates programs to allow safe disposal of old, unusable, or unwanted pesticides and empty pesticide containers. (See www.pested.psu.edu/pdaprog.html).

ADDITIONAL CONSIDERATIONS

E.1. Intergovernmental Cooperation

For various reasons, municipalities usually fare better in protecting groundwater resources by working with other municipalities. Aquifers and wellhead protection areas may extend into neighboring territory, and more rational water management can be achieved by cooperative planning that crosses governmental boundary lines. Besides, the costs of a groundwater protection program may be too great for one municipality to bear alone. Whatever the reason, intergovernmental cooperation is a viable option authorized by the 2000 amendments to the Municipalities Planning Code.

Municipalities that want to work together to protect their groundwater resources can establish an intergovernmental cooperative agreement. Under the Intergovernmental

Cooperation Act (Act 180 of 1972), local governments can cooperate with other municipalities, school districts, counties, or other levels of government to perform any governmental function in just about any way. An agreement can provide for a joint activity, such as joint comprehensive planning, or the agreement can assign different responsibilities to the participating governments.

Neighboring municipalities jointly can undertake studies, for example, to delineate an overlay district for a groundwater recharge area. The resulting recommendations can then be implemented by individual ordinances in each of the cooperating municipalities. Inter-municipal cooperation has resulted in the development of wellhead protection ordinances in Kutztown and Tipton boroughs in Berks County and in Telford Borough and West Rockhill Township in Montgomery and Bucks counties. In early 2001, there were no approved Intergovernmental Cooperative Plans, but a number were in development.

A municipality may fare better in protecting groundwater resources by working with neighboring municipalities.

JOINT PLANNING

One form of intergovernmental cooperation is a joint planning commission. Two or more municipalities that each adopt ordinances establishing a joint planning commission can prepare a joint comprehensive plan, including plans for protecting water supplies. The commission may also prepare a joint zoning ordinance that could include land use controls for environmentally sensitive lands. The June 2000 amendments to the Municipalities Planning Code changed the title of Article XI from "Joint Municipal Planning Commissions" to "Intergovernmental Cooperative Planning and Implementation Agreements." However, joint planning commissions established under the former provisions of Article XI can continue to function under the amended article.

The 2000 MPC amendments facilitate joint planning in the following ways:

- Cooperating municipalities do not have to form joint planning commissions and do joint zoning to create Intergovernmental Cooperative Planning and Implementation Agreements. However, the comprehensive plans of cooperating municipalities must be generally consistent, and zoning ordinances must be generally consistent with the plans.
- Municipalities are encouraged to use transferable development rights (see Section C.7) to preserve open space and place growth where it is wanted. Use of TDR is facilitated.
- Consistent planning is encouraged at the local, county, and regional levels while retaining local control.
- Incentives are provided for municipalities undertaking joint planning, including priority consideration for state grants and loans, authority to create future growth areas, ability to share taxes and fees within the plan region, ability to carry out inter-municipal transfer of development rights, and improved ability to withstand legal challenges to planning decisions.
- Cooperating municipalities no longer need to allow for every conceivable kind of land use in each municipality. It might be agreed, for instance, that one municipality will have mainly urban zoning and another will allow for mining.

According to the organization 10,000 Friends of Pennsylvania, as of December 2000, there were 42 completed joint comprehensive plans in Pennsylvania, including five that also involve joint zoning ordinances. (See www.10000friends.org for more information about multi-municipal planning and zoning.)

An example of intergovernmental planning and cooperation is the Newtown Jointure in Bucks County. This is a multi-municipal land use planning and zoning organization that has been operational for more than 15 years. It includes Upper

Makefield, Wrightstown, and Newtown townships. Heavy residential, commercial, and light industrial development is concentrated in Newtown Township, because a sewer system was already in place there when the jointure was formed. Upper Makefield and Wrightstown are conserved for open space and farmland. The population density in these two townships is about one-fifth that of Newtown. Most services in the jointure's area are concentrated within an area of less than one square mile in Newtown. This results in reduced impervious area, which allows for greater groundwater recharge. The jointure has a standard for the amount of impervious surface allowable per acre in residentially zoned areas. Also, by concentrating development in an area where a sewer system was already in place, the threat to groundwater quality from failed septic tanks was lessened. The three townships are in the same school district and residents of each township pay the same assessment rate, so everyone pays to support the infrastructure.

Incentives are provided for municipalities undertaking joint planning, including priority consideration for state grants and loans.

COUNCILS OF GOVERNMENT

Another kind of cooperative agreement is a council of governments (COG). An administrative and coordinating agency organized by two or more municipalities, a COG addresses regional issues of concern. It is run by a board made up of one or two representatives from each municipality and operates under its own bylaws. One disadvantage to COGs is that they do not have a stable source of funding; they have no power to levy taxes, so they have to fund services and programs through dues, fees, and grants. The Pennsylvania Department of Community and Economic Development (DCED), which encourages the formation of COGs, offers various forms of assistance. (See www.dced.state.pa.us).

The Centre Region COG in Centre County was a pioneer in bringing the issue of groundwater management to the local political table. Through a Regional Groundwater Study Committee formed by the COG, an updated groundwater table contour map and water budget were prepared for the Spring Creek Basin. This cooperative effort between the COG's Groundwater Committee and the Susquehanna River Basin Commission involved the measurement of water levels for more than 200 water wells in the community. The groundwater table map allows planners to identify areas where groundwater is close to the land surface and therefore more prone to contamination.

The municipalities in the Centre Region COG have also enacted zoning regulations that enhance the protection of the communities' groundwater resources. Two of the COG's participating townships have enacted Rural Preservation Districts, which require that 50 percent of any tract developed remain as permanent open space. This open space can be used to protect sensitive groundwater resource areas. In addition, two other zoning districts have been enacted in the Centre Region requiring protection of the one-year zone of contribution for major water supply wells. This is the area around a well—including the aquifer and everything above the aquifer—from which the well draws its water over the course of one year.

The COG's water resource protection efforts are guided by a regionally consistent Comprehensive Plan, which was adopted by all six of the participating municipalities in 1991 and updated in 1999. This plan identifies future growth areas, including a growth boundary, and attempts to direct growth away from the region's sensitive groundwater resource areas to more appropriate locations.

The Centre Region COG's efforts in groundwater protection have led to other types of intergovernmental cooperation in this area. The Spring Creek Watershed Community, which is sponsored by the Clearwater Conservancy, includes a local official from each municipality in the Spring Creek watershed. The group oversees and sanctions water resources protection activities in the watershed. In 2001, the Community received a

Growing Greener grant to establish a watershed-wide groundwater level monitoring system. Since 95% of the area's municipal drinking water is groundwater and the area is undergoing rapid development, the municipalities recognize that a cooperative watershed-based approach to growth makes sense.

F.2. Financing Options for Groundwater Protection

GRANTS

State, federal, and private funding programs for groundwater protection have expanded in recent years. This section demonstrates the array of local, state, and national agencies and organizations that fund groundwater protection. It is by no means an exhaustive list of funding sources. The Internet is a powerful tool in finding grant opportunities. You could start with the sources listed in Table 6.

The Pennsylvania Department of Environmental Protection operates many water-related grant programs for issues including source water protection, implementation of best management practices on farms, storage tank removal, regionalization of small water systems, county water supply planning, and geographic information systems software and training, among others. This is a fruitful place to begin.

At the start of the millennium, Pennsylvania had a budget surplus, so funding levels have been generous. The Growing Greener Initiative, a cooperative program of DEP, DCNR, PDA, and PENNVEST, is set to invest nearly \$650 million by 2005 in farmland preservation, open space protection, elimination of the maintenance backlog in state parks, cleaning up abandoned mines, restoring watersheds, and building and upgrading water and sewer systems.

Another large source of funds, the Drinking Water State Revolving Fund, is jointly administered in Pennsylvania by DEP and PENNVEST. The federal Safe Drinking Water Act Amendments of 1996 authorized this generous funding to allow every state to distribute grants and low-interest loans to community water suppliers. Pennsylvania's share of the federal money for fiscal year 2001

Table 6.
Potential Sources of Funding

Agency/Agencies	Program Name	Type of Projects Funded	Internet Site	Phone
PA DEP	Various	Various	www.dep.state.pa.us, direct link "grants"	varies
PA DEP	Growing Greener	Watershed assessment and restoration source water protection, etc.	www.dep.state.pa.us/ growgreen/	717-705-5400
PA DEP	Source Water Protection	Wellhead & Watershed Protection programs	www.dep.state.pa.us, direct link "source water"	717-787-5259
PA DCNR, PA Fish and Boat Commission and PA Trout Unlimited	Coldwater Heritage Partnership	Protection of coldwater ecosystems	www.fish.state.pa.us, search for "coldwater heritage"	717-787-2316
PA DCNR	Community Conservation Partnership Grants	Rivers and watersheds conservation planning & implementation, open space	www.dcnr.state.pa.us/ financialpartnersgw.html	717-783-4734
PA Infrastructure Investment Authority (PENNVEST)	Drinking Water State Revolving Loan Fund	Sewer, storm water, and water projects; on-lot sewage disposal systems	www.pennvest.state.pa.us	717-787-8137
PA Association of Conservation Districts	Chesapeake Bay Mini-projects; Section 319 NPS Mini-projects	Water quality education programs	www.pacd.org/products	717-545-8878
Community Foundation for the Alleghenies	Western PA Watershed Protection Program	Community-based watershed protection	members.aol.com/ cfdnbc/index.htm	814-669-4847
Chesapeake Bay Program	Small Watershed Grants Program	Community-based restoration projects	www.chesapeakebay.net/ http://pa.lvw.org/pa/wren	800-YOUR-BAY 800-692-7281
League of Women Voters of PA-Citizen Education Fund	Water Resources Education Network	Community-based watershed protection and education	http://pa.lvw.org/wren/ grants.html	800-692-7281
League of Women Voters of PA-Citizen Education Fund	Training Scholarships/ Opportunity Grants	For community leaders to attend conferences/ trainings in water resource educ. & management	http://pa.lvw.org/wren/ grants.html	800-692-7281
River Network	Watershed Assistance Grants	Support growth & sustainability of local watershed partnerships	www.rivernetnetwork.org/ howwecanhelp/howwag.cfm	503-241-3506
National Fish & Wildlife Foundation	Conservation Projects	Species/communities/habitat protection, restoration, inventory, assessment & public educ.	www.nfwf.org/ programs/programs.htm	202-857-0166
U.S. Department of Agriculture Natural Resources Conservation Service	Farmland Protection	Farmland protection	www.usda.gov	717-237-2202
U.S. Fish & Wildlife Service	Wetlands Project Grants	Wetlands acquisition, creation, enhancement, & restoration	grants.fws.gov	703-358-1784

alone was almost \$25 million. The overall goals of the program are to have all public water systems in the state comply with drinking water standards and to ensure that present and future Pennsylvanians have access to safe and adequate supplies of potable water.

The national Conservation and Reinvestment Act (CARA) could be funded up to \$12 billion over fiscal years 2002-2008 to finance federal, state, and local land acquisitions. Many other conservation programs would benefit as well, but it's still unclear how the money will be divided among the states. The funding is subject to congressional appropriations, so the total amount is uncertain.

The Water Resources Education Network of the League of Women Voters of Pennsylvania-Citizen Education Fund has, for almost a decade, provided small grants to community coalitions undertaking water resources education activities. Projects may relate to protection of drinking water sources or to groundwater protection. Funding for the grant program now comes from the Pennsylvania Department of Environmental Protection.

The Community Foundation for the Allegheny accepts proposals from nonprofit organizations for the Western Pennsylvania Watershed Protection Program funded by the Howard Heinz Endowment and the Katherine Mabis McKenna Foundation. The program supports community-based watershed protection programs emphasizing non-point pollution control, land management and acquisition, environmental education, and riparian zone protection.

There are hundreds of foundations, both philanthropic and corporate, that fund environmental initiatives. Some are national or international; others are regionally focused. It is wise to start by demonstrating success with a small regional grant and then build up to a larger one. Some foundations that are regionally based or have a regional focus in Pennsylvania include the Heinz Endowment (www.heinz.org) and The Pittsburgh Foundation (www.pittsburghfoundation.org) in southwestern Pennsylvania; the Pew Charitable Trusts (www.pewtrusts.com), the

William Penn Foundation (www.wpennfdn.org), and The Philadelphia Foundation (www.philafound.org) in the Philadelphia area; and The Greater Harrisburg Foundation (www.tghf.org) in the capitol region.

Check the following pages for links to many foundations and tips about writing grants:

- Council of Foundations-www.cof.org
- Foundation Center-fdncenter.org
- Grants and Related Resources-
www.lib.msu.edu/harris23/grants.priv.htm

For more information on financing options, see Appendix B.

TECHNICAL ASSISTANCE AND IN-KIND SERVICES

The Small Water Systems Technical Assistance Center (DEP) and the Pennsylvania Rural Water Association offer free technical assistance to rural public water supply systems. A municipality may encourage area environmental consulting firms, for example, to donate their time to the delineation of wellhead protection zones. Staff of the Penn State Cooperative Extension office nearest you can provide technical guidance and information sources.

The Rensselaerville Institute in New York also offers technical assistance of various kinds (www.tricampus.org; MMARSTERS@TRICampus.org; 518-797-3783).

And don't sell your citizens short. Citizen volunteers could help gather data about water use within the municipality. Marlborough Township in Montgomery County effectively used such in-kind services during the organization of a local groundwater education project. Volunteers compiled and mapped domestic well data obtained from DEP and town residents. A local hydrogeologist helped sort out the data and assess the area's groundwater resources.

Appendix A:

The Legal Basis for Groundwater Protection in Pennsylvania

A number of federal and state laws directly or indirectly address issues related to groundwater quality. This federal and state legislative authority provides a context within which local governments can implement policies for groundwater protection.

Federal Legislative Authority

Federal laws form the basis for many environmental protection activities through regulation, standard-setting, and permit programs (Table 7). However, because the states administer most federal environmental laws, it is sometimes difficult to determine which activities come under federal jurisdiction. In addition to administration, the state government may provide support and coordinate activities at the regional or local level.

Under the auspices of the 1972 Federal Water Pollution Control Act (FWPCA) and the 1977 Clean Water Act and its 1987 amendments, the nation has been working for many years to eliminate water pollution. Efforts have concentrated more on cleaning up and protecting surface water than groundwater, especially the efforts initiated under the FWPCA permit program for discharges to streams, rivers, and lakes (the National Pollution Discharge Elimination System). However, groundwater protection is definitely included: the act requires reporting on both surface and groundwater contamination and establishes the Groundwater Quality Protection Program. This broad program requires EPA to plan for groundwater quality protection and monitoring. EPA's plan, developed in 1991, places primary responsibility for protecting groundwater resources at the state level and encourages states to develop programs that address groundwater protection comprehensively rather than the potential sources of contamination individually.

The federal Safe Drinking Water Act (SDWA) also applies to groundwater protection, primarily through the Wellhead Protection Program adopted in the 1986 amendments. The Underground Injection Program, another part of the SDWA, regulates injection activities, especially waste injection into wells (including shallow "dry wells" in automotive repair facilities).

Yet another part of the SDWA is the Sole Source Aquifer Designation Program, which protects aquifers that supply at least 50 percent of the drinking water for an area. This designation by EPA means that no federal funds may be used for projects that could contaminate the aquifer. The only sole source aquifer entirely in Pennsylvania is the Seven Valleys Aquifer in York County. The New Jersey Coastal Plain Aquifer lies partly in Pennsylvania.

Regional Compact Commissions

Regional river basin commissions have some authority over surface- and groundwater use throughout most of Pennsylvania. The Delaware River Basin Commission (DRBC) and the Susquehanna River Basin Commission were established in 1960 and 1971, respectively, by compacts between the basin states and the federal government. The compacts authorize the two commissions to review and approve projects withdrawing more than an average of 100,000 gallons per day for any consecutive thirty-day period from a groundwater or surface water source within their respective basins. The DRBC also requires permits for all groundwater withdrawals that exceed 10,000 gallons per day within special groundwater protection areas in a five-county region of southeastern Pennsylvania where groundwater is limited.

The Ohio River Valley Water Sanitation Commission (ORSANCO) is more concerned

with water quality than quantity. The Commission monitors water quality conditions on the river and regulates wastewater discharges through the implementation of pollution control standards.

Highlights of the Safe Drinking Water Act Amendments of 1996

The Safe Drinking Water Act as amended in 1996 includes provisions for a multi-billion dollar Drinking Water State Revolving Fund, monitoring relief, source water assessment programs, water conservation planning, and consumer confidence reports.

The national Drinking Water State Revolving Fund allows states to make grants and low-interest loans to community water suppliers. Loans may finance expenditures that “facilitate compliance with national primary drinking water regulations.” Pennsylvania’s share of the federal money for FY 2001 alone was almost \$25 million. Fifteen percent of the money is set aside for loans to small water systems serving fewer than 10,000 people. In addition, these small systems may receive up to 2 percent of the fund for technical assistance.

The ‘96 SDWA amendments also authorized \$15 million per year between 1997 and 2003 for state grants to develop groundwater protection programs.

The amendments required that by August 1998, EPA review drinking water monitoring requirements for at least 12 contaminants and make any necessary modifications. States may grant monitoring relief to systems that have approved wellhead and source water protection programs. Eligibility for monitoring relief is based on evidence provided by the water supplier to the state that a contaminant is not present in the water supply or is consistently below maximum contaminant levels. Only contaminants associated with the land use activities surrounding the wellhead must be monitored regularly. Parameters ineligible for monitoring relief include microbial contaminants, disinfection byproducts, and corrosion byproducts.

A state that chooses to change its monitoring requirements must adopt a source water assessment program. The assessment program delineates areas that provide source water for public water

supplies, identifies contaminants for which monitoring is required, and identifies sources of contamination within the assessment area. Wellhead protection programs may fulfill this requirement for systems using groundwater. (See section A.6 for more information on source water assessment and protection.)

The 1996 amendments also require that EPA establish guidelines for water conservation plans for community water systems. After the guidelines are published, a state may require that a community water system have a water conservation plan before receiving a grant or loan from the state revolving loan fund.

The amendments also require public water suppliers to provide customers with annual “consumer confidence reports” on contaminants in their drinking water, the source of their water, and definitions of terms.

Pennsylvania’s Legal Authority

The lack of a single law for groundwater protection makes comprehensive management of groundwater in Pennsylvania somewhat difficult. Nevertheless, the state’s various mandates and regulations offer local government officials a useful foundation for local groundwater protection programs (see Table 8).

The Pennsylvania Clean Streams Act, first passed in 1937, regulates discharges to the state’s waters. The Pennsylvania Safe Drinking Water Act of 1984 (amended in 1996), which is administered by DEP’s Bureau of Watershed Management, implements the federal Safe Drinking Water Act in Pennsylvania. This law regulates the safety of drinking water supplied by public water systems, allowing DEP to set standards for drinking water contaminants for which no federal standards exist. Unlike the federal law, however, it does not provide for regulation of underground injection activities.

A third law, the Water Well Drillers License Act of 1956, is not regulatory and does not set standards for the construction of wells. It was designed instead to acquire groundwater information from the mandated filing of well logs for new wells, including information on location, yield, rock strata tapped, and well design. Even in this goal,

Table 7.

Federal Laws and Programs Pertaining to Groundwater

The U.S. Environmental Protection Agency (EPA) has most of the responsibility for federal activities relating to the quality of drinking water. Other agencies, such as the departments of Agriculture, Interior, and Energy, and the Army Corps of Engineers, also have some jurisdiction over activities affecting groundwater. The following are the major federal laws that regulate groundwater.

Clean Water Act-regulates pollutant discharges from point sources, requires development of surface water quality criteria, provides funding for construction of sewage treatment plants, and authorizes states to develop controls for nonpoint source pollution and groundwater protection strategies. (see www.epa.gov/region5/defs/html/cwa.htm)

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund)- authorizes EPA to clean up contamination caused by chemical spills or hazardous waste sites that could or do pose threats to the environment. Amendments in 1986 authorize citizens to sue violators and establish “community right-to-know” programs. (see www.epa.gov/region5/defs/html/cercla.htm)

Federal Insecticide, Fungicide, and Rodenticide Act-authorizes EPA to control the use of pesticides that have the ability to leach into groundwater. (see www.epa.gov/region5/defs/html/fifra.htm)

Resource Conservation and Recovery Act-regulates the storage, transportation, treatment, and disposal of solid and hazardous wastes to prevent contaminants from leaching into groundwater from municipal landfills, underground storage tanks, surface impoundments, and hazardous waste disposal facilities. (see www.epa.gov/region5/defs/html/rcra.htm)

Safe Drinking Water Act-authorizes EPA to set standards for maximum levels of contaminants in drinking water, to regulate underground injection wells, to designate areas that rely on a single aquifer for their water supply, and to establish a nationwide program that encourages states to develop programs to protect public water supply wells. (see www.awwa.org/govtaff/advisor/sdwasum.htm)

Toxic Substances Control Act-authorizes EPA to control the manufacture, use, storage, distribution, and disposal of toxic chemicals. (see www.epa.gov/region5/defs/html/tsca.htm)

Water 2000 was the Clinton administration’s initiative to solve critical drinking water quantity, quality, or reliability problems for many rural homes. At least 2.5 million Americans lack safe, plentiful, and reliable drinking water. This loan and grant program, which was administered by the U.S. Department of Agriculture (USDA), had, as of July 2000, invested \$2.5 billion in critical projects. Pennsylvania had the second greatest monetary need among all the states. The Rural Utilities Service estimated in 1995 that almost 62,000 households in Pennsylvania had serious drinking water issues and that it would cost \$923 million to rectify these problems. (see www.usda.gov/rus/watr2000/index.htm)

though, the law has fallen far short of its intent, for it has not produced reliable data. Although the act does require well drillers to be licensed, no testing is required to get the license, and the program does not provide for certification, bonding, or enforcement of the program. This may account for the high percentage of wells in Pennsylvania with structural deficiencies. Pennsylvania is one of the few states that does not set standards for private wells.

The Storage Tank and Spill Prevention Act of 1989 regulates installation and operation of storage tanks, both aboveground and underground, and tank facilities, and establishes protocols for reporting and cleaning up spills.

In December 1996, DEP finalized a technical guidance document entitled, "Principles for Ground Water Pollution Prevention and Remediation." The document provides an overview of the importance of groundwater resources, establishes criteria for identification of priority groundwater areas for pollution prevention, and provides a reference to current DEP groundwater monitoring guidance and cleanup activities. (See http://www.dep.state.pa.us/dep/subject/all_final_technical_guidance/wsc/361_0800_001.htm).

Although DEP is the primary agency responsible for groundwater programs, other state agencies conduct significant activities as well. The state Department of Agriculture, for example, works with the farming community to reduce contamination from agricultural sources.

The Pennsylvania Department of Agriculture (PDA) developed a draft Pesticides and Groundwater Strategy to lay a framework under which PDA can manage certain pesticides, as required by EPA. The strategy was developed to protect all groundwater sources from degradation. The strategy requires that regular monitoring be done before and after the pesticide application season. If monitoring reveals groundwater contamination with pesticide(s), PDA will apply the maximum contaminant level (MCL-highest level of a contaminant that is allowed by federal regulations in safe drinking water) to measure the extent of degradation. Pollution

prevention techniques, regulations, and remediation will be applied as needed. Pesticide applicators are encouraged to use best management practices in the storage and application of pesticides. As of early 2001, EPA was still reviewing the strategy, so it is not yet final. (See www.dep.state.pa.us/dep/subject/involved/pasmp.htm).

Although DEP is the primary agency responsible for groundwater programs, other state agencies conduct significant activities as well.

The Pennsylvania Nutrient Management Act (Act 6 of 1993) established a multi-agency effort led by the State Conservation Commission to manage the flow of farm nutrients, primarily nitrogen, in the state. Nitrogen from animal waste can enter streams and groundwater and, in high concentrations, be harmful or even fatal to infants. The act aims to increase farm efficiency and prevent nonpoint source pollution of surface water and groundwater. Only farms classified as "concentrated animal operations" (having greater than two animal units per acre of land suitable for manure application on an annualized basis (an animal unit is 1,000 pounds of animal weight) are required to develop and implement nutrient management plans. Agencies and organizations involved in the implementation of this legislation include the Pennsylvania Department of Agriculture, DEP, county conservation districts, and Penn State Cooperative Extension. PDA has several low interest loan and grant programs available to help fund development and implementation of nutrient management plans.

Judicial Authorization: Case Law

The established system of property rights in this country is based on what can be seen on the land surface. This system evolved during a time when little was known about the flow of groundwater or its vulnerability.

Consequently, in the absence of any comprehensive groundwater management plan for the state, Pennsylvania courts have allowed landowners to use groundwater under their land as they choose with no regard for the needs of neighbors. This “American rule” means that “Each owner is entitled to take what he can get; the deepest well and the most powerful pump wins” (Ground-water Law in Pennsylvania, Water Resources in Pennsylvania, p. 223). It also means that the courts have no way to prevent conflicts from arising among water users; the disputes can be adjudicated only after damage is incurred.

As for the judicial standing of local regulations concerning groundwater, two points should be made. One, local governments have the power to regulate only if no conflict exists with state laws. Two, Pennsylvania’s “Environmental Rights Amendment” to the state constitution provides a powerful basis for the protection and preservation of natural resources in the state. Interpretations of this amendment have indicated that governing bodies, including local government, have a duty to protect common property, such as groundwater.

In its handbook, *Guiding Growth: Building Better Communities and Protecting Our Countryside*, the Pennsylvania Environmental Council listed three doctrines by which local regulations, including the exercise of police power to protect public health and safety, will be judged constitutional:

1. The adoption of the regulation must have involved substantive due process. That is, it must relate directly to the health, safety, morals, or general welfare of the community; it must not be unduly restrictive in its impact upon the owner of the related property; and it must not be exclusionary.
2. The regulation must not deny any person equal protection of the law.

3. The regulation cannot be a taking without just compensation.

Municipalities Planning Code

The Pennsylvania Municipalities Planning Code (MPC) delegates to municipalities the power to control land use. Sections of the MPC pertaining to water supply (see also Table 9 and section C.8) state:

- Zoning should carry out policy goals of the municipality’s statement of objectives [sec. 603(a)];
- The comprehensive plan shall include a water supply plan, as well as provisions for the protection of water supply sources [sec. 301(b)];
- A zoning ordinance can regulate development to assure safe, reliable, and adequate water supply [sec. 603(d)];
- The list of purposes for zoning specifically includes protection of aquifers [sec. 604(1)];
- Optional land use controls include: cluster lot design and zoning, planned residential development (PRD), and transfer of development rights (TDR);
- An official map is a type of land use regulation that can be used to reserve private land for use as public open space, flood control, storm water management, drainage easements, and other public uses [sec. 401(a)].

Through the authority of the Municipalities Planning Code and other aspects of the legal and constitutional framework described earlier, local governments may select from a wide assortment of institutional tools to protect and manage their groundwater resources.

Governor's Center for Local Government Services

The Center for Local Government Services, created in 1999 within the Department of Community and Economic Development, is the principal state entity responsible for land use planning assistance and monitoring. Among the Center's goals are developing and disseminating an inventory of sound land use practices, providing assistance to local governments in imple-

menting the state's land use objectives (which include preservation of farmland and open space, planned growth in designated areas, and encouragement of regional cooperation), advising local governments on the tools available to help manage growth, and encouraging regional cooperation on planning and zoning. The amount of money available in the state budget for comprehensive and sound land use planning has increased ten-fold in recent years. (See www.dced.state.pa.us).

Table 8.

Pennsylvania Laws and Programs Pertaining to Groundwater

The Pennsylvania Department of Environmental Protection has the responsibility for administering most of Pennsylvania's laws that relate to groundwater protection. Other agencies with jurisdiction include the Department of Agriculture, the Department of Labor and Industry, the Department of Conservation and Natural Resources, and the State Conservation Commission.

Clean Streams Law (Act 394 of 1937, as amended)-authorizes DEP to regulate discharges to the waters of the Commonwealth, both surface water and groundwater.

Dam Safety and Encroachment Act (Act 325 of 1978, as amended)-regulates activities in the waters of the Commonwealth, including the construction of encroachments or the filling in of wetlands.

Growing Greener Initiative (Act 68 of 1999)-Governor Ridge's program to invest nearly \$650 million by 2005 in farmland preservation, open space protection, elimination of the maintenance backlog in state parks, cleaning up abandoned mines, restoring watersheds, and building and upgrading water and sewer systems.

Municipalities Planning Code (Act 247 of 1968, as amended)-authorizes municipalities to regulate land use and requires the inclusion of a water supply plan in municipalities' comprehensive plans.

Nutrient Management Act (Act 6 of 1993)-establishes a multi-agency effort to manage farm nutrients in the state and to prevent nonpoint source pollution of surface and groundwater. Administered by the State Conservation Commission.

The Oil and Gas Act (Act 223 of 1984) regulates the drilling, operation and closure of oil and gas wells.

Pesticide Control Act (Act 24 of 1974, as amended)-authorizes the Department of Agriculture to regulate the labeling, distribution, storage, transportation, use, application, and disposal of pesticides with regard to food safety.

Safe Drinking Water Act (Act 43 of 1984, as amended)-authorizes DEP to implement the federal safe drinking water program in Pennsylvania and to develop maximum contaminant levels for substances for which no standard has been set by EPA. Does not authorize the state to regulate underground injection wells.

Sewage Facilities Act (Act 537 of 1965, as amended)-requires municipalities to develop plans for managing sewage.

Solid Waste Management Act (Act 97 of 1980, as amended)-authorizes DEP to regulate management of solid waste, including municipal, residual (non-hazardous industrial), and hazardous waste. Other laws relating to waste management include the Municipal Waste Planning, Recycling, and Waste Reduction Act (Act 101 of 1988), the Land Recycling and Environmental Remediation Standards Act (Act 2 of 1995), which establishes cleanup standards (including for groundwater) based on health and environmental risks, and the Hazardous Sites Cleanup Act (Act 102 of 1988, as amended), which authorizes DEP to investigate hazardous sites and to clean up sites that are releasing hazardous substances.

Storage Tank and Spill Prevention Act (Act 32 of 1989, as amended)-regulates installation and operation of storage tanks, both aboveground and underground, and tank facilities, and establishes protocols for reporting and remediating spills.

Stormwater Management Act (Act 167 of 1978)-requires counties to develop watershed-based stormwater management plans that address surface water and groundwater concerns.

Surface Mining and Conservation and Reclamation Act (Act 418 of 1945, as amended)-regulates the surface mining and hydrologic impact of coal mining. Mining of noncoal materials is regulated by the Noncoal Surface Mining and Conservation Act (Act 219 of 1984).

Water Rights Act (Act 365 of 1939)-provides for allocation of surface water supplies.

Water Well Drillers Licensing Act (Act 1840 of 1956)-requires any person who drills a well to be licensed.

Worker and Community Right-to-Know Act (Act 159 of 1984)-requires employers and chemical suppliers to provide information on the identity and dangers of hazardous substances used in the workplace.

Table 9.
Pennsylvania Municipalities Planning Code (Act 247 of 1968, as amended)
Selected Provisions Related to Water and Watershed Protection

Section 107(a)–Definitions

Minerals–any aggregate or mass of mineral matter, whether or not coherent. The term includes, but is not limited to, limestone and dolomite, sand and gravel, rock and stone, earth, fill, slag, iron ore, zinc ore, vermiculite and clay, anthracite and bituminous coal, coal refuse, peat and crude oil and natural gas.

Water Survey–an inventory of the source, quantity, yield, and use of groundwater and surface water resources within a municipality.

Section 209.1 (7.1)-Powers and Duties of Planning Agency

Prepare and present to the governing body and the municipality a water survey, which shall be consistent with the State Water Plan and any applicable water resources plan adopted by a river basin commission. The water survey shall be conducted in consultation with any public water supplier in the area to be surveyed.

Section 301-Preparation of Comprehensive Plan

(a) The municipal, multimunicipal, or county comprehensive plan, consisting of maps, charts, and textual matter, shall include, but need not be limited to, the following related basic elements:

(6) A plan for the protection of natural and historic resources to the extent not preempted by federal or state law. This clause includes, but is not limited to, wetlands and aquifer recharge zones, woodlands, steep slopes, prime agricultural land, flood plains, unique natural areas and historic sites.

(7) In addition to any other requirements of this act, a county comprehensive plan shall:

(i) Identify land uses as they relate to important natural resources and appropriate utilization of existing minerals.

(iii) Identify a plan for the preservation and enhancement of prime agricultural land and encourage the compatibility of land use regulation with existing agricultural operations.

(b) The comprehensive plan **SHALL include a plan for the reliable supply of water**, considering current and future water resources availability, uses and limitations, including provisions adequate to protect water supply sources. Any such plan shall be consistent with the State Water Plan and any applicable water resources plan adopted by a river basin commission. It shall also contain a statement recognizing that:

(1) Lawful activities such as extraction of minerals impact water supply sources and such activities are governed by statutes regulating mineral extraction that specify replacement and restoration of water supplies affected by such activities.

(2) Commercial agriculture production may impact water supply sources.

Section 503-Contents of Subdivision and Land Development Ordinance

Subdivision and land development ordinances may include:

(10) Provisions and standards for insuring that new developments incorporate **adequate provisions for a reliable, safe and adequate water supply** to support intended uses within the capacity of available resources.

Section 503.1-Water Supply

Every ordinance adopted pursuant to this article shall include a provision that, if water is to be provided by means other than by private wells owned and maintained by the individual owners of lots within the subdivision or development, applicants shall present evidence to the governing body or planning agency, as the case may be, that the subdivision or development is to be supplied by a certificated public utility, a bona fide cooperative association of lot owners, or by a municipal corporation, authority, or utility. A copy of the Certificate of Public Convenience from the Pennsylvania Public Utility Commission or an application for such certificate, a cooperative agreement or a commitment or agreement to serve the area in question, whichever is appropriate, shall be acceptable evidence.

Section 603–Zoning Ordinance Provisions

(b) Zoning ordinances may permit, prohibit, regulate, restrict and determine:

(1) Uses of land, water courses and other bodies of water.

(3) Areas and dimensions of land and bodies of water to be occupied by uses and structures, as well as areas, courts, yards, and other open spaces and distances to be left unoccupied by uses and structures.

(5) Protection and preservation of natural and historic resources and prime agricultural land and activities.

(d) Zoning ordinances may include provisions regulating the siting, density and design of residential,

Table 9. (continued)

commercial, industrial and other developments in order to assure the availability of reliable, safe and adequate water supplies to support the intended land uses within the capacity of available water resources.

Section 605-Classifications

Additional classifications may be made within any district:

- (2) For the regulation, restriction or prohibition of uses and structures at, along or near:
 - (ii) natural or artificial bodies of water, boat docks and related facilities;
 - (iii) places of relatively steep slope or grade, or other areas of hazardous geological or topographic features;
 - (vii) flood plain areas, agricultural areas, sanitary landfills, and other places having a special character or use affecting and affected by their surroundings.
- (3) For the purpose of encouraging innovation and the promotion of flexibility, economy and ingenuity in development, including subdivisions and land developments as defined in this act and for the purpose of authorizing increases in the permissible density of population or intensity of a particular use based upon expressed standards and criteria set forth in the zoning ordinance.
- (4) For the purpose of regulating transferable development rights on a voluntary basis.

Section 608.1-Municipal Authorities and Water Companies

- (a) A municipal authority, water company or any other municipality that plans to expand water, sanitary sewer or storm sewer service via a new water extension to a proposed development that has not received any municipal approvals within the municipality shall notify the municipality by certified mail, return receipt requested, of its intention and shall provide the municipality an opportunity to provide written comment on whether the proposed expansion of service within the municipality is generally consistent with the zoning ordinance.
- (b) The purpose of the requirement in this section is to provide the municipal authority, water company, or any other municipality with information regarding how its decision to expand service may potentially enhance and support or conflict with or negatively impact on the land use planning of municipalities.

Section 705(j) –Standards and Conditions for Planned Residential Development

Provisions adopted pursuant to this article shall include a requirement that, if water is to be provided by means other than by private wells owned and maintained by the individual owners of lots within the planned residential development, applicants shall present evidence to the governing body or planning agency, as the case may be, that the planned residential development is to be supplied by a certificated public utility, a bona fide cooperative association of lot owners, or by a municipal corporation, authority or utility. A copy of the Certificate of Public Convenience from the Pennsylvania Public Utility Commission or an application for such certificate, a cooperative agreement, or a commitment or agreement to serve the area in question, whichever is appropriate, shall be acceptable evidence.

Section 1101-Intergovernmental Cooperative Planning and Implementation Agreement-Purposes

It is the purpose of this article:

- (8) To ensure that new public water and wastewater treatment systems are constructed in areas that will result in the efficient utilization of existing systems, prior to the development and construction of new systems.
- (9) To ensure that new or major extension of existing public water and wastewater treatment systems are constructed only in those areas within which anticipated growth and development can adequately be sustained within the financial and environmental resources of the area.
- (10) To identify those areas where growth and development will occur so that a full range of public infrastructure services, including sewer, water, highways, police and fire protection, public schools, parks, open space and other services, can be adequately planned and provided as needed to accommodate the growth that occurs.

Section 1106-Specific Plans

(a) Participating municipalities shall have authority to adopt a specific plan for the systematic implementation of a county or multimunicipal comprehensive plan for any nonresidential part of the area covered by the plan. Such specific plan shall include a text and a diagram or diagrams and implementing ordinances which specify all of the following in detail:

- (1) The distribution, location, extent of area and standards for land uses and facilities, including design of sewage, water, drainage and other essential facilities needed to support the land uses.

Prepared by Stanford Lembeck, AICP, Extension Community Planner, Penn State Extension, College of Agricultural Sciences, Nov. 1990. Revised by Lembeck, March 1997. Revised by Joy Drohan, Nov. 2000.

Appendix B:

Publications and Videos about Groundwater and Groundwater Protection

Publication ordering information

Publications of the U.S. Environmental Protection Agency are available through the National Center for Environmental Publications and Information (NCEPI). You can search all NCEPI publications at www.epa.gov/ncepihom/catalog.html. To order, call (800) 490-9198; fax (513) 489-8695; www.epa.gov/ncepihom/orderpub.html; P.O. Box 42419, Cincinnati, OH 45242-2419.

The *U.S. Geological Survey* publishes data on water quality and quantity for individual states and for the whole country in hard copy and digital format. USGS Information Services, Denver Federal Center, Box 25286, Denver, CO 80225; phone (888) ASK-USGS; fax (303) 202-4693; www.usgs.gov/pubprod

To order publications from the *Pennsylvania Department of Environmental Protection*, call: (717) 787-4686; DEPINFO@dep.state.pa.us; www.dep.state.pa.us, "cyberlibrary". See also the direct link "source water" from DEP's home page for downloadable publications on wellhead and source water protection.

To obtain copies of publications from the *Department of Conservation and Natural Resources-Pennsylvania Geological Survey*, write: Pennsylvania Geological Survey, P.O. Box 8453, Harrisburg, PA 17105-8453; or call: (717) 787-2169; jzipperer@dcnr.state.pa.us

The *Water Resources Education Network* (WREN), a project of the League of Women Voters of Pennsylvania Citizen Education Fund has available many publications produced with their support and by other organizations. The project also has an extensive library of videos available for loan. Call (800) 692-7281; wren@pa.lwv.org or <http://pa.lwv.org/wren/publications.html>

The *Groundwater Foundation*, based in Nebraska, offers a number of publications, many relating to teaching children about groundwater. Call: (800) 858-4844; fax: (402) 434-2742; info@groundwater.org or www.groundwater.org/catalog/Cat_bae.htm

Penn State College of Agricultural Sciences offers a large collection of publications, slide/tape, and video programs on topics such as agriculture, natural resources, community affairs, and the operation and maintenance of private water wells and septic systems. Single copies of most publications are available free of charge. Write: Publications Distribution Center, The Pennsylvania State University, 112 Agricultural Administration Building, University Park, PA 16802-2602; call: (814) 865-6713; fax: (814) 863-5560; AgPubsDist@psu.edu; pubs.cas.psu.edu/

Grants/Funding Programs

Action Guide for Source Water Funding: Small Town and Rural. 1997. National Center for Small Communities. Cost of postage. Washington, DC. Call: (202) 624-3550; fax: (202) 624-3554; www.natat.org/nscs/publications.htm

Alternative Funding for Agricultural Best Management Practices in Pennsylvania. Drohan, J.R. and C.W. Abdalla. 1999. Penn State University, College of Agricultural Sciences, Cooperative Extension. University Park, PA. 19 pp.

Catalog of Federal Funding Sources for Watershed Protection. 1999. U.S. Environmental Protection Agency. EPA841-B-99-003. www.epa.gov/OWOW/watershed/wacademy/fund.html
Presents information on many federal funding sources (grants and loans) that may be used to fund a variety of watershed protection projects.

Directory of Pennsylvania Foundations. 1998. Triadvocates Press in cooperation with the Free Library of Philadelphia. P.O. Box 336, Springfield, PA 19064-0336. Call: (610) 544-6927.
Profiles of more than 1,500 foundations in Pennsylvania with assets of \$150,000 or more and/or total grant support of more than \$7,500, based on 1996 or 1997 records. Also available on CD-ROM.

Pennsylvania Grants Guide. 1998-2000. Pennsylvania Association of Nonprofit Organizations. 132 State St., Harrisburg, PA 17101. www.pano.org. Call: (717) 236-8584.
Profiles of 614 funding sources in Pennsylvania.

Groundwater Basics

Ground Water and Surface Water, A Single Resource. 1998. U.S. Geological Survey Circular #1139.

Groundwater: A Primer for Pennsylvanians. 2000. League of Women Voters of Pennsylvania Citizen Education Fund and Penn State Cooperative Extension. (12 pp.) E-mail wren@pa.lwv.org or call (800) 692-7281.

Describes groundwater and discusses issues surrounding groundwater protection and management. Clear illustrations help make technical concepts understandable.

Sustainability of Ground-Water Resources. 1999. U.S. Geological Survey Circular #1186. Call (717) 730-6916.

Written for a wide audience to illustrate the hydrologic, geologic, and ecological concepts that must be considered to assure the wise and sustainable use of our precious groundwater resources.

Land Use

The Costs of Sprawl in Pennsylvania. 2000. 10,000 Friends of Pennsylvania. Executive summary (14 pp.) is free; full report (90 pp.) costs \$10. www.10000friends.org; e-mail info@10000friends.org; call (877) 568-2225.

Reports on the hidden costs of sprawl, how big they are, and who pays for them.

The EAC Handbook: A Guide for Pennsylvania's Municipal Environmental Advisory Councils. 1996. PA Environmental Council. Free from PEC, (800) 322-9214.

Explains the roles and responsibilities of EACs, provides sample projects, and includes model EAC ordinances and bylaws.

Guiding Growth, Building Better Communities and Protecting Our Countryside. 1993. Robert E. Coughlin, Joanne R. Denworth, John C. Keene, John W. Rogers, and Robert F. Brown, Jr. Pennsylvania Environmental Council, 1211 Chestnut Street, Suite 900, Philadelphia, PA 19107 \$25.00 (800) 322-9214.

A comprehensive discussion of tools for planning and growth management allowed under Pennsylvania law. Of particular interest is a chapter on how to protect groundwater resources. An appendix on techniques identifies where in Pennsylvania each has been applied.

Implementation Manual for Multi-Municipal Planning. (due 2001). 10,000 Friends of Pennsylvania. www.10000friends.org; (877) 568-2225.

Outreach Strategies

Community Groundwater Education in Pennsylvania: Lessons Learned from Successful Project Leaders. 1998. Penn State Cooperative Extension and League of Women Voters of Pennsylvania Citizen Education Fund. (21 pp.) E-mail: wren@pa.lwv.org or call: (800) 692-7281.

Tips on managing local education projects gleaned from the experiences of local leaders.

Getting in Step—A Guide to Effective Outreach in Your Community. 1999. Council of State Governments. Call (606) 244-8228.

A step-by-step guide to developing an outreach plan, creating outreach materials, and working with the media.

Protect Your Groundwater: Educating for Action. 1994. League of Women Voters Education Fund. Washington, D.C. Pub. #180, \$6.95, plus shipping and handling. League of Women Voters of the United States, Washington, DC. Call (800) 287-7424.

Strategies for Effective Public Involvement: Drinking Water Source Assessment and Protection. League of Women Voters Education Fund. 1998. (50 pp.) Call (301) 362-8184; www.lwv.org/elibrary/pub/water/dw_1.html

Top Ten Watershed Lessons Learned. 1997. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds. EPA840-F-97-001. (60 pp.) Call (800) 832-7828; www.epa.gov/owow/lessons.

Developed in partnership with more than 100 watershed practitioners, this document describes the top 10 lessons (positive and negative) learned in working to restore and protect watersheds across the nation. Includes examples to illustrate each lesson, plus key contacts and resources for networking.

Nonpoint Source Pollution

Nonpoint Pointers—Understanding and Managing Nonpoint Source Pollution in Your Community. 1996. U.S. Environmental Protection Agency. EPA841-F-96-004, A-K.

A series of fact sheets on controlling nonpoint source pollution.

Pollution Paralysis II-Code Red for Watersheds. 2000. National Wildlife Federation. (89 pp.) \$6.00. Call (734) 769-3351; www.nwf.org/watersheds

Analyzes and grades federal and state programs for protecting waters from polluted runoff (PA gets a C). Explains the use of TMDLs to protect watersheds and discusses the proposed EPA rules and how they can be improved.

Protecting Groundwater from Pesticides: A Clean Water Action Guide. 2000. Friends of the Earth. (50 pp.) Call 202-783-7400.

A guide to informed participation in the debate about pesticide management in your own backyard.

Section 319 Success Stories: Volume II. 1997. U.S. Environmental Protection Agency. EPA841-R-97-001. (220 pp.)

Describes successful nonpoint source projects ranging from information and educational programs to highly technical applications of nonpoint source control technology.

Watershed Protection and Management

Drinking Water Handbook for Public Officials. 1996. National Drinking Water Clearinghouse, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064; (304) 624-8301.

Provides information to help public officials understand water systems operations, including information on relevant regulations, water sources and distribution, and operation and maintenance issues.

Drinking Water Source Assessment and Protection Workshop Guide. The Groundwater Foundation. www.groundwater.org/catalog/Cat_bae.htm. Phone (402) 434-2740; fax (402) 434-2742; info@groundwater.org.

Enables anyone with an interest in groundwater, surface water, and drinking water quality/quantity to present a community workshop on these topics.

From Assessment to Action: Protecting Small and Rural County Public Water Sources. National Center for Small Communities. Washington, DC. (202) 624-3550; Fax: (202) 624-3554. Cost of postage or free download at www.natat.org/ncsc/Action_Guide/assessment%20__to_action.htm

Discusses the process of source water assessment and how to proceed after assessment.

A Guide to Wellhead Protection. 1995. Witten, J. and S. Horsley. American Planning Association, Chicago, IL. \$34. (312) 786-6344; www.planning.org

A report designed for planners, local officials, and the public; includes overview of groundwater hydrology and contamination, planning tools, and financing.

Protecting Sources of Drinking Water: Selected Case Studies in Watershed Management. 1998. U.S. Environmental Protection Agency, EPA 816-R-98-019. www.epa.gov/safewater/swp/cstudy.html

Describes the experiences of 17 drinking water suppliers in funding and implementing source water protection activities.

Source Water 2000: Funding and Assistance Programs to Protect Small Town and Rural Drinking Water. National Center for Small Communities. Washington, DC. (202) 624-3550; Fax: (202) 624-3554. Cost of postage or free download at <http://www.natat.org/ncsc/publications.htm>

Discusses ways to get support for small town and rural county concerns and how communities, companies, farmers, and state agencies can work together to preserve drinking water quality and reduce future water treatment and monitoring costs.

Source Water Assessment and Protection (SWAP) Booklet. The Groundwater Foundation. www.groundwater.org/catalog/Cat_bae.htm. Phone (402) 434-2740; fax (402) 434-2742; info@groundwater.org

Discusses the importance of and protocol for source water assessment and protection.

Watershed Events. U.S. Environmental Protection Agency, Office of Water and Wetlands. www.epa.gov/OWOW/info/WaterEventsNews/

Newsletter provides timely information about the development and implementation of the watershed approach and about achieving watershed goals. The emphasis is on mitigating the threats to ecosystem and human health and involving stakeholders in taking action in an integrated, holistic manner.

Water Policy News. Water Resources Education Network of Pennsylvania League of Women Voters-CEF. Call (800) 692-7281; wren@pa.lwv.org or <http://pa.lwv.org/wren/publications.html>

Free newsletter highlights projects funded through this initiative, as well as relevant state laws and programs, upcoming conferences and events, new resource materials, and grant opportunities.

Watershed Protection: A Project Focus. 1995. U.S. Environmental Protection Agency. EPA841-R95-004. (108 pp.) www.epa.gov/owow/watershed/focus/index.html
Describes one aspect of the watershed approach—developing watershed-specific programs. Provides a blueprint for designing and implementing watershed projects, including references and case studies for specific elements of the process.

Watershed Weekly (newsletter). Pennsylvania Organization for Watersheds and Rivers and the Environmental Fund for Pennsylvania. www.WatershedWeekly.org
Highlights successful watershed protection efforts and provides a calendar of workshops and other events and ideas for helping solve problems in your watershed.

Wellhead Protection: A Guide for Small Communities. 1996. National Drinking Water Clearinghouse, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064; (304) 624-8301.
Provides small communities with information to help them plan for groundwater protection and manage a wellhead protection plan. Includes information about financing and the various agencies involved.

Why Watersheds? 1996. U.S. Environmental Protection Agency. EPA800-F-96-001. (8 pp.) www.epa.gov/owow/watershed/why.html
Explains why states are turning to watershed management as a means for achieving greater results from their programs.

Watershed Monitoring

Designing Your Monitoring Program: A Technical Handbook for Community-based Monitoring in Pennsylvania. 2000. Citizens Volunteer Monitoring Program. www.dep.state.pa.us, direct link “water management”
Provides a thorough briefing on volunteer monitoring efforts—how, why, where—in Pennsylvania.

Lakewalk Manual: A Guidebook for Citizen Participation. 1996. U.S. Environmental Protection Agency. EPA910-B-95-007. (25 pp.)
Presents tools for citizens to use in assessing and protecting lakes.

Monitoring Consortia: A Cost-Effective Means to Enhancing Watershed Data Collection and Analysis. 1997. EPA 841-R-97-006 (37 pp.) Call (800) 832-7828. www.epa.gov/OWOW/watershed/wacademy/its.html
Addresses coordination in watershed monitoring. Also includes four case studies that demonstrate how consortia can stretch the monitoring dollar, improve cooperation among partners, and increase sharing of expertise as well as expenses of data collection and management.

Children's Materials

Making Waves. The Groundwater Foundation. \$12.75.
Describes how to put on a children's water festival.

Making a Bigger Splash. The Groundwater Foundation. \$12.75
A collection of water education activities.

Making Discoveries. The Groundwater Foundation. \$13.50.
Groundwater activities for classroom and community.

USGS Water Resources--Education Resources. water.usgs.gov/education.html

Pennsylvania's Water Resources

The Geology of Pennsylvania's Groundwater, 1999. Fleeger, G.M. Pennsylvania Geologic Survey Educational Series No. 3, Bureau of Topographic and Geologic Survey, Harrisburg. (34 pp.) Call (717) 787-2169; e-mail sgarner@dcnr.state.pa.us.

Describes the basics of groundwater in relation to geology in Pennsylvania.

Pennsylvania Groundwater Reports and Maps. Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey.

Water Use and Water Rights in Pennsylvania, A Status Report from the Common Ground Project on Water Resources for Pennsylvania's Future. 1998. (24 pp.) The League of Women Voters of Pennsylvania-Citizen Education Fund, 226 Forster Street, Harrisburg, PA 17102. e-mail: wren@libertynet.org or call: (800) 692-7281.

Provides a brief introduction to the basics of water law and identifies gaps in the current institutional framework and options to be considered for changes in Pennsylvania's water management system.

Waterborne Diseases

Cryptosporidium and Giardia...Are They in Your Drinking Water? 1999. PA DEP.

Describes these disease-causing parasites, the illnesses they cause, and what to do if you suspect your water is contaminated. Free from www.dep.state.pa.us/dep/deputate/watermgt/wsm/wsm_dwm/complian/cryo-giardia.htm.

Appendix C: Glossary

- Aquifer**-a geologic formation that contains water in usable quantities.
- Aquitard**-a geologic formation above or below an aquifer that allows little or no water to pass through; also called a *confining bed*.
- Capture zone**-the land areas that drain into a pumping well; the size of the zone depends on the pumping rate—greater pumping rates will increase the size of the capture zone.
- Cone of depression**-the cone-shaped area around a water well where the groundwater level dips as water is pumped out.
- Confined aquifer**-an aquifer with a nonporous layer of clay or rock above it.
- Groundwater**-water in the fully saturated underground formations of rock and soil.
- Groundwater basin**-an underground area that receives recharge water from the land surface and from which groundwater discharges to the surface.
- Hydrologic cycle**-the circulation of water from air as rain or snow, to land and water bodies and underground, eventually to return to the air.
- Karst topography**-limestone bedrock with sinkholes, caves, and solution channels.
- Leachate**-the liquid that drains from landfills and dumps as rain water and snow melt seep through; it often contains contaminants dissolved from buried refuse.
- Percolation**-movement of surface water through the pores of soil and rocks to the water table.
- Permeability**-the capacity of rocks and soil to allow water to pass through.
- Plume**-a cohesive body of contaminated water from a specific source that roughly keeps its shape as it moves through an aquifer.
- Pollutant**-a contaminant in groundwater occurring in sufficient quantity to make water unfit for its intended use.
- Porosity**-a measure of the capacity of rocks to hold water; related to the number and type of small openings (pores) they contain.
- Recharge**-the replenishment of groundwater by percolation of surface water.
- Recharge area**-the area of land surface from which water percolates to an aquifer.
- Saturated zone**-formations of rock and soil underground that are filled to capacity with water.
- Soil water**-water in the unsaturated soils near the land surface.
- Unconfined aquifer**-aquifer that does not have a nonporous layer of clay or rock above it.
- Water table**-the upper boundary of the saturated zone where there is no overlying impermeable layer; the top of an unconfined aquifer.
- Wellhead protection area**-the surface and subsurface area surrounding a public water supply well, wellfield, or spring through which contaminants are reasonably likely to move toward and reach the water source.
- Zone of saturation**-the subsurface area where the pores of the soil and rock are saturated with water; the top of this zone is the water table.

APPENDIX D

Sources of Information and Help

Governmental Agencies	Address	Telephone	Internet Address	E-mail Address
U.S. Environmental Protection Agency	Region 3, 1650 Arch St. Philadelphia, PA 19103-2029	800-438-2474	www.epa.gov	
U.S. Dept. of Agriculture: National Agriculture Library	10301 Baltimore Blvd. Beltsville, MD 20705-2351	301-504-5755	www.nal.usda.gov/search.htm	
U.S. Dept. of Agriculture: Rural Development Administration	Ste. 330, 1 Credit Union Pl. Harrisburg, PA 17110-2996	717-237-2299	www.rurdev.usda.gov	
U.S. Geological Survey: Water Resources Division District Office	840 Market St. Lemoyne, PA 17043-1586	717-730-6900	h2o.usgs.gov	dc_pa@usgs.gov
PA Dept. of Agriculture	2301 N. Cameron St. Harrisburg, PA 17110	717-787-4737	www.pda.state.pa.us	
PA Infrastructure Investment Authority (PENINVEST)	Keystone Bldg., 22 S. Third St. Harrisburg, PA 17101	717-787-8137	www.pennvest.state.pa.us	pmarchetti@state.pa.us
PA Housing Finance Agency	2101 N. Front St., P.O. Box 8029 Harrisburg, PA 17105-8029	717-780-3800	www.phfa.org/index.htm	
PA Dept. of Community & Economic Development	Commonwealth Keystone Bldg. 400 North St. 4th Flr. Harrisburg, PA 17120-0225	717-783-8452	www.dced.state.pa.us	ra-gat@state.pa.us
PA Center for Local Government Services	325 Forum Bldg. Harrisburg, PA 17120	888-223-6837	www.dced.state.pa.us/ PA_Exec/DCED/government/ center-h.htm	
PA Dept. of Environmental Protection: Office of Water Management	P.O. Box 2063 Harrisburg, PA 17105-2063	717-787-4686	www.dep.state.pa.us	ASKDEF@state.pa.us
Bureau of Watershed Management Division of Watershed Protection (includes source water protection & non-point source management)	P.O. Box 8555 Harrisburg, PA 17105-8555	717-787-5259	www.dep.state.pa.us	ASKDEF@state.pa.us
Bureau of Water Supply & Wastewater Management (includes point source discharges & stream classification)	P.O. Box 8467 Harrisburg, PA 17105-8467	717-787-5017	www.dep.state.pa.us	ASKDEF@state.pa.us

APPENDIX D (continued)

Sources of Information and Help

Governmental Agencies	Address	Telephone	Internet Address	E-mail Address
PA Dept. of Conservation & Natural Resources:	7th Flr., Rachel Carson State Ofc. Bldg., P.O. Box 8767 Harrisburg, PA 17105-8767	717-787-2869	www.dcnr.state.pa.us	
Bureau of Topographic & Geologic Survey	P.O. Box 8453 1500 N. 3rd St., 2nd Flr. Harrisburg, PA 17105-8453	717-787-5828	www.dcnr.state.pa.us/ topogeo/about.htm	jzipperer@ dcnr.state.pa.us
National Drinking Water Clearinghouse	West Virginia University P.O. Box 6064 Morgantown, WV 26506-6064	800-624-8301	www.ndwvc.wvu.edu	
<i>NOTE: Many of the state agencies listed above also have offices that can provide assistance in each county or region</i>				
Academic Institutions	Address	Telephone	Internet Address	E-mail Address
Penn State University: Publication Distribution Center	112 Agricultural Administration Bldg University Park, PA 16802.	814-865-6713 fax 814-863-5560	pubs.cas.psu.edu	AgPubsDist@psu.edu
Cooperative Extension Water Programs	246 Ag Engineering Bldg. University Park, PA 16802	814-865-7685	server.age.psu.edu/dept/ extension/Factsheets/f/ index.html	mxh16@psu.edu
Dept. of Agricultural Economics & Rural Sociology Environmental Resources	Armsby Bldg. University Park, PA 16802 125 Land & Water Bldg. Research Institute	814-865-2562 814-863-0291 University Park, PA 16802	www.aers.psu.edu www.research.psu.edu/ erri/publications.html	CAbdalla@psu.edu plc103@psu.edu erri/
Groundwater Education in Michigan Program	Institute of Water Research Michigan State University 115 Manly Miles Bldg. East Lansing, MI 48823-5243	517-353-3742	www.iwr.msu.edu	klineror@msue.msu.edu
Environmental/Educational Organizations	Address	Telephone	Internet Address	E-mail Address
Alliance for the Chesapeake Bay	600 N. 2nd. St., Ste. 300B Harrisburg, PA 17101	717-236-8825	www.acb-online.org	acbpa@acb-online.org
Chesapeake Bay Foundation	Old Water Works Bldg. 614 Front St., Ste. C Harrisburg, PA 17101	717-234-5550	www.cbf.org	chesapeake@cbf.org

APPENDIX D (continued)

Sources of Information and Help

Environmental/Educational Organizations	Address	Telephone	Internet Address	E-mail Address
Water Resources Education Network, League of Women Voters of PA	226 Forster St. Harrisburg, PA 17102-3220	717-234-1576 800-692-7281	http://pa.lwv.org/wren	wren@pa.lwv.org
Community Foundation for the Alleghenies	U.S. Bank Bldg., Ste. 606 216 Franklin St. Johnstown, PA 15901	John Dawes at 814-669-4847 or main off. at 814-536-7741	members.aol.com/cfdinbcs/ index.htm	rjdawes@aol.com
PA Environmental Council	117 S. 17th St., Ste. 2300 Philadelphia, PA 19103	215-563-0250	www.greenworks.tv/pec	ajohnson@pecphila.org
PA Organization for Watersheds & Rivers	25 N. Front St., P.O. Box 765 Harrisburg, PA 17108-0765	717-234-7910	www.pawatersheds.org	info@pawatersheds.org
PA Resources Council	25 W. 3rd St., P.O. Box 88 Media, PA 190063	610-353-1555	www.prc.org	
PA Rural Water Association	138 W. Bishop St. Bellefonte, PA 16823	814-353-9302	www.prwa.com	prwa@prwa.com
Sierra Club, PA Chapter	600 N. 2nd St., P.O. Box 663 Harrisburg, PA 17108-0663	717-232-0101	www.sierraclub.org/chapters/pa	pennsylvaniachapter@ sierraclub.org
Groundwater Foundation	P.O. Box 22558 Lincoln, NE 68542-2558	800-858-4844	www.groundwater.org	infor@groundwater.org
National Ground Water Association	601 Dempsey Rd. Westerville, OH 43081	800-551-7379	www.ngwa.org	ngwa@ngwa.org
American Groundwater Trust	16 Centre St. Concord, NH 03301	603-228-5444	www.agwt.org	
Center for Watershed Protection	8391 Main St. Ellicott City, MD 21043	410-461-8323	www.cwp.org	center@cwp.org
American Farmland Trust	1200 18th St. NW, Ste. 800 Washington, DC 20036	202-331-7300	www.farmland.org	infor@farmland.org
Natural Lands Trust	1031 Palmers Mill Road Media, PA 19063	610-353-5587	www.natlands.org	infor@natlands.org
10,000 Friends of Pennsylvania	1117 South 17th Street Philadelphia, PA 19103-5022	215-568-2225	www.10000friends.org	info@10000friends.org