

NATURAL RESOURCES

GROUNDWATER RESOURCES

The future of growth and development in Centre County depends on the quantity and quality of our groundwater resources. While growth and development bring vitality to Centre County, new residential, commercial and industrial development all have costs associated with them particularly as it relates to the County's groundwater. If not managed properly, these costs, i.e, impervious surface coverage, urban runoff, highway development, fertilizers, and on-lot septic systems, will continue to have a negative effect on this resource.

The increasing urbanization of Centre County, as well as recent droughts, force us to look at ways to best balance our future growth needs with the protection of this resource. Improving or sustaining the vitality of our communities while protecting this resource presents an enormous challenge for local officials and regulatory agencies. Balancing these needs requires thoughtful planning and a willingness to work together since the flow of water does not stop at municipal boundary lines.

On a statewide level, the Commonwealth of Pennsylvania recognizes that our economy, the health of the state's residents and that of our natural systems are dependent on water and is taking a leadership role in bringing water to the forefront of departmental policies and legislative initiatives. The most comprehensive initiative is the proposed Water Resources Conservation and Protection Act. This legislation includes provisions for updating the 1979 State Water Plan, identifying Critical Water Planning Areas (areas where the demand for water exceeds or is expected to exceed available supplies), promoting voluntary water conservation, improving stormwater management and establishing private water-well construction and licensing standards.

To date, these bills are pending and have not received final passage.

In addition, the *Pennsylvania Municipalities Planning Code* (MPC) which serves as the legal framework for planning in the state requires county, multi-municipal and municipal comprehensive plans to, "...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 resources." Another provision in the MPC requires counties throughout Pennsylvania to adopt a comprehensive plan and update it every ten years. Having water supply plans for each of the state's counties as part of each county's long-range planning efforts will tie in with the state's new initiatives.

Centre County's Water Supply Plan will be developed by combining this section of the Natural Resources planning element of the Comprehensive Plan with the water facilities component of the Communities Facilities and Services Plan. This component of the Natural Resources Plan will address the County's physiographic and geographic settings as they relate to groundwater, groundwater as a resource, threats to our groundwater, and protection strategies. Protection of the County's groundwater resources will be a priority as the Comprehensive Plan's growth management strategies are developed.

What is groundwater?

Groundwater is "water found underground that completely fills the open spaces between particles of sand, gravel, clay, silt, and consolidated rock fractures. The zone of materials filled with groundwater is called the "zone of saturation"¹.

Groundwater and surface water are inter-connected with groundwater providing a source of water for the base flow of streams in the County. This inter-connection becomes evident during extreme climate conditions. Droughts lower the underground water table which in turn slows or even stops the flow of water from the ground to the surface streams. Just the opposite occurs during long periods of wet weather conditions when the water table rises, increasing the flow of water to our surface

¹ *A Glossary of Zoning, Development, and Planning Terms*, American Planning Association, Planning Advisory Service, Report Number 491/492

streams. These conditions are part of the hydrologic cycle. The hydrologic cycle is a process whereby water falls to the earth as rain or snow, much of which immediately evaporates back to the atmosphere, but some is taken up by plants for their use, some runs across the land to streams, lakes and eventually the ocean, and the rest goes to the groundwater reservoir.

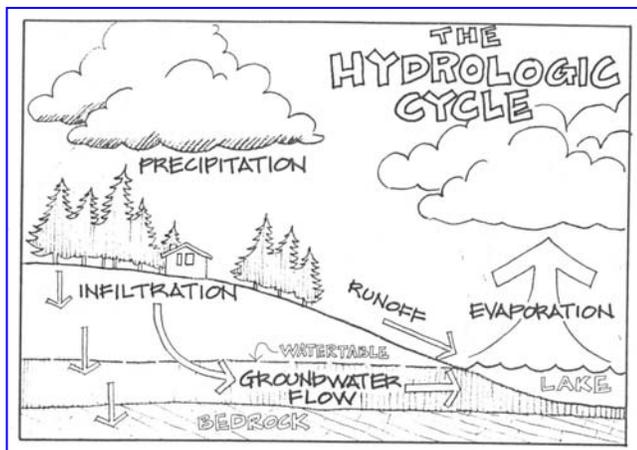


Figure 1: HYDROLOGIC CYCLE, Centre County Comprehensive Plan 1979

Physiography of Centre County

Two major physiographic areas, the Appalachian (Allegheny) Plateau Province and the Ridge and Valley Province meet to divide Centre County into nearly equal halves (See Map). Each Province has its own distinct appearance due to individual geologic features formed millions of years ago and due to the subsequent effects of time and erosion.

The Appalachian (Allegheny) Plateau Province traverses the northwestern portion of the County and is characterized by deep, narrow valleys drained by fast moving streams. Approximately 50 percent of the County falls within this area which is underlain by nearly horizontal rock strata of primarily shale, sandstone, clay, and coal.

The second major physiographic area, the Ridge and Valley Province, covers the remaining southeastern portion of Centre County. It is

characterized by a prominent northeast-southwestern alignment of narrow, steep-sided ridges separated by broad valleys. This province consists of numerous folded and faulted layers of shale, sandstone, limestone, and dolomite which have been eroded by wind and water into their present shapes. During geologic history, these rock strata were subjected to tremendous mountain building forces. Softer shale, limestone, and dolomite bedrock, exposed to the weathering process, eventually eroded into the broad, fertile valleys while the more resistant sandstones remained as steep ridges.²

Centre County's Geology and Its Relationship to Groundwater

While physiography defines the County's land forms, geologic features provide the setting for our groundwater resources. These settings have been broken down into four aquifer³ types, three of which are present in Centre County. The two primary aquifer types in Centre County are sandstone, shale, and coal; and carbonate rock. In addition, a linear sand and gravel aquifer cuts across the center of the County running in an eastern to southwesterly direction. See Figure 3: Pennsylvania's aquifers (Source: League of Women Voters of Pennsylvania Citizen Education Fund, Water Resources Education Network Project, *Groundwater Protection and Management in Pennsylvania*, June 2001 Third Edition)

The aquifers listed in Figure 4 provide a range of water yields for each aquifer type as well as general water characteristics. Special considerations for carbonate rock are the potential for surface collapse (formation of

² Source: *Centre County Groundwater Resources Study*, June 1980

³ Aquifers are layers of rock and soil within the zone that can readily store and transmit usable amounts of water. Aquifers may be as large as several states combined or as small as a few acres and may be found a few feet or hundreds of feet below the surface. The vertical thickness may vary from a few feet to hundreds of feet. (Source: *Groundwater: A Primer for Pennsylvanians*, Pennsylvania Groundwater Policy Education Project)

Aquifer Characteristics		
AQUIFER	YIELD	WATER
Sand and gravel	100 gpm are common	Quality is good to excellent.
Sandstone, shale and coal	<i>Sandstone</i> -5-60 gpm <i>Shale</i> -5-20 gpm	<i>Sandstone</i> -Soft water or low in calcium and/or magnesium. <i>Shale</i> -Hard water, or high in calcium or magnesium.
Carbonate rock	Up to thousands of gpm	Contains large amounts of dissolved solids and is described as 'hard'.

Figure 4: AQUIFER CHARACTERISTICS

sinkholes or caves) and groundwater contamination through rapid movement of pollutants through sinkholes or shallow soil cover. Mine drainage and brine from natural gas well drilling in the sandstone, shale and coal aquifer have a potential for contaminating groundwater in the north and northwest portions of the County where there is an abundance of mineral extraction.

Figure 5 shows the mapped geologic formations in Centre County. Rock and water bearing characteristics for the individual bedrock units shown on the Geologic Formations Map of Centre County are listed in Figure 6. These characteristics serve as an important tool in determining appropriate areas for development within Centre County. A more simplified version of the water-bearing characteristics is shown in Figure 7, Estimated Median Yield of Bedrock Units (gallons per minutes).

Drinking Water and Potential Threats

When the well's dry, we know the worth of water. -Ben Franklin

The quality and quantity of our drinking water is not something that should be taken for granted.

For example, recent droughts forced communities to impose water restrictions and owners of domestic wells to drill deeper wells. Surface water influence has resulted in the Pennsylvania Department of Environmental Protection (PADEP) issuing 'boil water' notices to those served by several affected public water supplies in the County. Pollutants from industrial uses have rendered water unsafe to drink. These examples illustrate the fragile nature of our underground water resource.

Protection of our drinking water comes under Pennsylvania's Safe Drinking Water Act. However, new state requirements for public water systems under the reauthorization of the Federal Safe Drinking Water Act of 1996 mandates states to assess all ground and surface water sources serving public water systems. In accordance with this requirement, Pennsylvania has developed the state's Source Water Assessment Program (SWAP). The intent is to protect public health and safety and reduce or maintain water treatment costs and to support the development of voluntary source water protection programs at the local level. The deadline to submit these assessments to the US Environmental Protection Agency is mid- 2003.

Pennsylvania's program is underway. The delineation of drinking water protection areas for ground and surface sources, listing of potential contaminant sources and susceptibility analysis will be conducted by an independent contractor or the PADEP. Both point and non-point sources of contamination will be inventoried and a susceptibility analysis conducted. The potential source contaminate source inventory is developed based on existing data bases and input from water suppliers and local stakeholders. The sustainability analysis defines the sensitivity of the source to contamination.

Assessing groundwater sources will entail well head protection area delineation, identification of potential threats to drinking water supplies located within the wellhead protection area, and susceptibility analysis of groundwater sources to contamination.

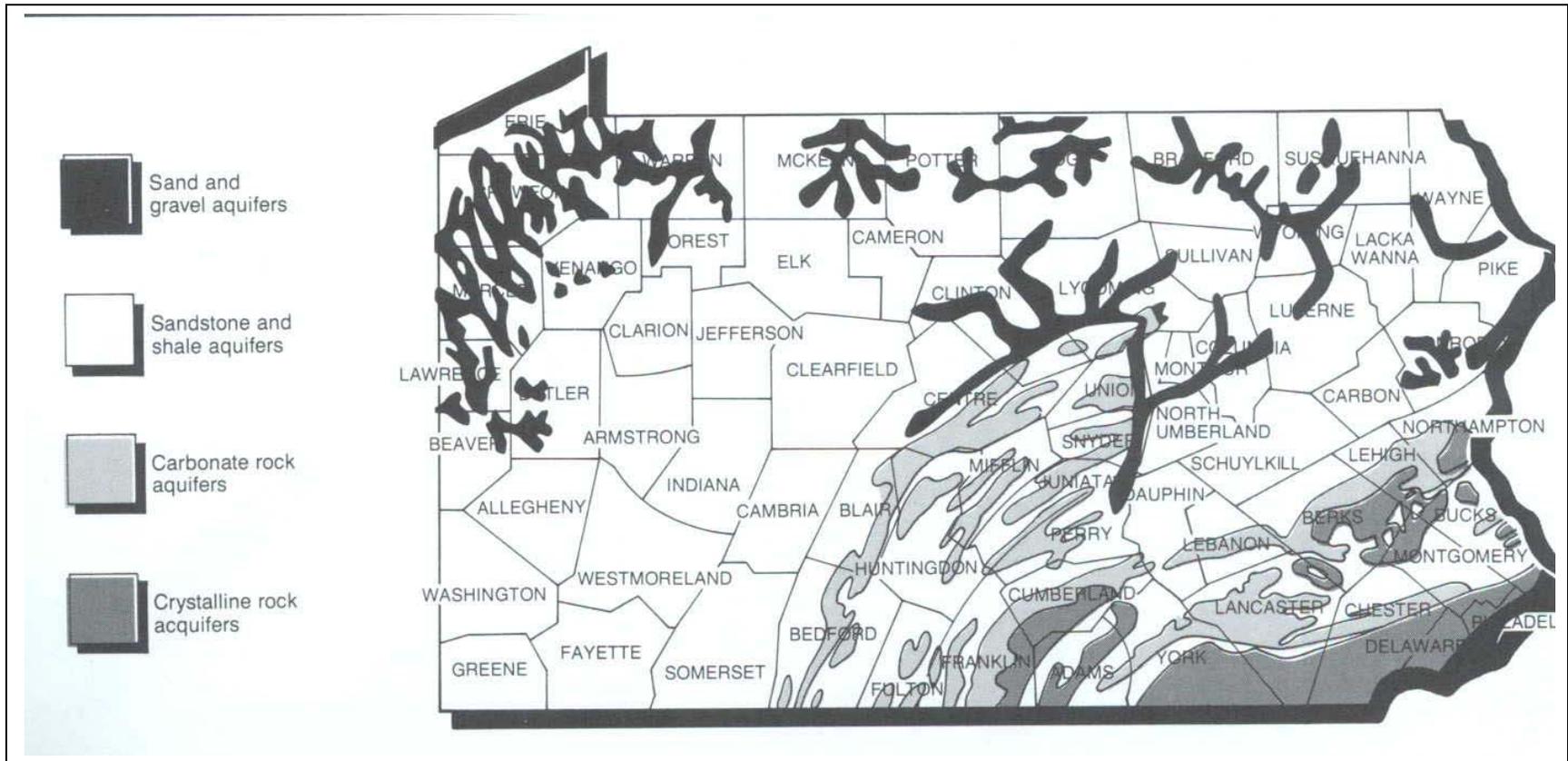


Figure 3: PENNSYLVANIA'S AQUIFERS

Source: *Groundwater Protection and Management in Pennsylvania, An Introductory Guide for Citizens and Local Officials*, League of Women Voters of Pennsylvania Citizens Education Fund, June 2001 Third Edition.

Potential threats to this resource include:

On-lot septic systems-Malfunctioning or improperly maintained septic systems release nitrates into groundwater. Nitrate levels exceeding 10ppm (parts per million) pose health threats to newborns and the elderly. Other contaminants include: harmful micro-organisms, household chemicals and pesticides.

Storage tanks-Leaking above and below ground storage tanks release hazardous substances into the groundwater which can render drinking water non-potable. Federal and state regulations require that all existing tank systems be upgraded, replaced, or closed by December 1998. Of concern are old tanks for agricultural and personal use with little or no records.

Agriculture-Improper application, management and/or disposal of pesticides, herbicides or manure may result in contamination of a drinking water source.

Abandoned oil and gas drilling wells or poorly constructed operating wells-These wells serve as a path for contaminants to reach the groundwater. Improperly plugged and sealed wells may be used for illegal dumping.

Industrial production sites and retail sites (dry cleaners and gas stations)-Lack of emergency contingency planning, improper management and disposal of wastes, leaking storage tanks all pose threats.

Coal mining-Release of iron, manganese and sulfates from acid mine drainage into groundwater poses a threat.

Poorly constructed domestic wells-Improperly constructed residential wells provide a conduit for pollutants to reach groundwater.

Road deicing-Salt that is spread on roads or inadequately stored may pollute our waters.⁴

⁴ Source: *Groundwater Protection and Management in Pennsylvania, An Introductory Guide for Citizens*

Drinking Water Protection Strategies

Protection of our drinking water sources can be accomplished by water providers, municipal officials and the served community working together to make certain that recharge areas are appropriately managed. This can be done through either a regulatory and/or non-regulatory approach. The Drinking Water Protection Strategies matrix (Figure 8) provides a list of strategies as well as local examples of each.

Protection of this resource in light of ongoing development trends will be one of our most important challenges for the future. Managing new growth and development in a way that protects the quantity and the quality of our groundwater supply will be a critical component of the Comprehensive Plan's growth management strategies. A cooperative effort between the County, municipalities, and water providers will help to meet this challenge. The future of our land use depends on it.

and Local Officials, League of Women Voters of Pennsylvania Citizens Education Fund, June 2001 Third Edition.

GOAL

Identify, preserve, and monitor Centre County's environmental natural resources for the benefit of present and future generations.

OBJECTIVES

Promote the wise use and management of the County's natural resources that include prime agricultural lands, forested areas, and mineral resources.

Protect watershed features such as surface and underground water supplies, streams, floodplains, wetlands, fish and wildlife habitats, and aquifer recharge areas.

Use identified natural resource areas and public open spaces to provide guidance with land development activities.

Reduce air, water, land, noise, and visual pollution.

RECOMMENDATIONS

Educate residents of Centre County on the importance of water conservation and effective methods for conserving this resource.

Cooperate with governmental and non-profit entities to develop water budgets for each of the County's watersheds.

Expand the role of the Centre County Water Authority to work cooperatively with water providers and municipalities in protecting source water protection areas and in developing water resource inventories.

Educate on the importance of the proper construction or abandonment of wells.

Identify and protect groundwater recharge areas in each of the County's watersheds.

Identify significant hydrogeologic settings.

Implement the Nittany and Bald Eagle Greenways Study countywide and aim to preserve environmentally sensitive open space for groundwater recharge.

Encourage the proper handling and disposal of all wastes to prevent groundwater pollution of this resource.

Promote watershed and sinkhole cleanup activities.

Modify the County's Subdivision and Land Development Ordinance to provide for conservation design options for the subdivision or land development which provide for groundwater recharge.

Encourage retention of stormwater as part of the site development plan process.

Encourage Centre County communities to:

Adopt zoning regulations to limit impervious surface coverage in environmentally sensitive areas.

Adopt sewage management districts to maintain existing and proposed septic systems and to prevent groundwater pollution from malfunctioning septic systems.

Adopt conservation design zoning regulations to complement the proposed modifications to the County's Subdivision and Land Development Ordinance.

Promote Zone I and Zone II source water protection area management.

Manage development in critical groundwater recharge areas identified in each of the planning regions.

Conduct an inventory and maintain well data in the municipality.