## NATURAL FEATURES, LAND SUITABILITY FOR DEVELOPMENT AND DEVELOPMENT CONCERNS

## **Introduction**

The residents of East Central Wayne County (ECWC) are fortunate in that most of the area remains undeveloped. The large expanses of agricultural land and private forest land, combined with interspersed residential and limited, small-scale commercial development combine to create the rural character of the Townships and the quality lifestyle. Although the agricultural land and forest land are extensive, the environmental quality of the three Townships and the vitality of the rural working landscape are very fragile. Clean, plentiful water, pure air, open land, vegetation and wildlife can be irreparably damaged by development undertaken without concern for the natural environment and careful planning and land use management. Rivers, streams, lakes, ponds and wetlands are natural features that make an area appealing to development; however, it is also these types of natural areas that tend to be more sensitive to development. To preserve the attractiveness of the

ECWC Planning Area, consistent enforcement of such regulations as sewage, erosion and sedimentation, and storm water management, is vital. The fact that the almost ninety-five percent of the Planning Area currently is forested or is used for agriculture does not diminish the need for careful planning and land use management. Instead, the conservation of these areas are key to preserving agriculture and the community character of the Townships.

Internal and external social and economic factors are the key determinant to the future development of the Planning Area. The area's environment is its major asset for fostering future development. At the same time, the various elements of the natural environment must be conserved because the environment has a finite, limited capacity for development. And, given the interrelationship of all elements of the environment, a change in one element often results in an unexpected effect on another element.



Physiographic Divisions of Pennsylvania



Physiographic Provinces of Eastern PA

### Physiography and Geology

The natural features of ECWC Planning Area are a direct result of its geological past. Bedrock geology and glacial geology are key factors affecting the natural environment and development pattern by providing the base for the formation of soils. The three Townships lie in the Glaciated Low Plateau Section of the Appalachian Plateaus Province, one of the major physiographic divisions of the Commonwealth. See the Physiographic Divisions of *Pennsylvania Figure<sup>1</sup>* and the *Physiographic* Provinces of Eastern Pennsylvania Figure.<sup>2</sup> ECWC and most of Wayne County is underlain primarily by bedrock of the Devonian System which is some 350 to 400 million years old, and comprised of shale, sandstone, limestone and chert. The Soil Survey of Wayne County reports that the Catskill continental

<sup>1</sup>Pennsylvania Geology Summarized, Pennsylvania Topographic and Geologic Survey, B. Willard, 1968. group, which is Upper Devonian in age, is the oldest bedrock underlying glacial drift throughout about 95 percent of Wayne County. It consists chiefly of red to brown sandstone and shale. The Catskill sandstone is used commercially as building stone. The Catskill formation is the most important source of ground water in Wayne County. More wells have been drilled into this formation than into any other bedrock formation.<sup>3</sup>

Geological studies are a vital part of the development process. Will the sewage disposal method considered be adequate? Can mineral resources be extracted while being compatible with current zoning? What are the possible effects of a land development that proposed a large amount of cut and fill for their project? An understanding of the geology of an area will allow the land use planner to answer these important questions. The effect of development on groundwater is largely dependent on the area geology and the soils which developed from the underlying bedrock.

<sup>&</sup>lt;sup>2</sup>Report 65, Groundwater Resources of Pike County, Pennsylvania, Pennsylvania Topographic and Geologic Survey, D. K. Davis, 1989.

<sup>&</sup>lt;sup>3</sup>Soil Survey of Wayne County Pennsylvania, United State Department of Agriculture, 1985, p. 2.



Water Bearing Geology

## **Groundwater**

Groundwater is that subsurface water in the saturated zone - the zone in which all the spaces or interstices in the rocks, ideally, are filled with water under pressure equal to or greater than atmospheric pressure. Rocks that are capable of yielding usable supplies of water to wells or springs are called aquifers.<sup>4</sup> (See the Water Bearing Geology Figure.)

Groundwater is the source for all potable water in the ECWC Planning Area and its protection is one of the paramount issues facing the community. The Planning Area and all of Wayne County have been blessed with a clean and plentiful supply of this priceless resource. Without clean water, and the healthy environment from which it derives, the quality of life would suffer dramatically. In addition, a clean and plentiful water supply is an immeasurable asset in terms of supporting the local economy. Local officials must take all necessary actions to protect this vital component of the ECWC community. A high majority of community survey respondents in all three Townships support the need for groundwater studies and action to protect quality and promote conservation

The amount of groundwater use will increase in concert with the amount of development. Given the Planning Area's regional location, the long term development pattern is expected to follow much the same path as the last twenty years, although possibly at an accelerated rate. The primary type of development will be residential with a higher proportion of full-time residences and more retail and service businesses. Few industrial or manufacturing facilities using high volumes of water are anticipated in the ECWC Planning Area given the paucity of sites for such development, the high cost of land, the continuing emergence of Wayne County as a bedroom community, and the availability of sites in improved business parks in the greater region.

Prior to the 1960's the highest density residential and commercial development in Wayne County was concentrated in Hawley, Honesdale and Waymart where public water supplies are available to serve the needs of the population. Today, most residential and much commercial development is occurring in areas where groundwater from individual wells is the sole source of potable water. This equates to an increasing demand for groundwater for residences and businesses.

<sup>&</sup>lt;sup>4</sup>Report 65, Groundwater Resources of Pike County, Pennsylvania, Pennsylvania Topographic and Geologic Survey, D. K. Davis, 1989.

## **Groundwater Overview**

- Three often misunderstood facts -
  - Groundwater is part of the hydrologic cycle and is directly linked to lakes and streams.
  - During periods of low flow, much of the water in streams is groundwater.
  - As the amount of stormwater runoff increases, less recharge occurs and stream flow can be affected.
- Groundwater occurs in joints, bedding planes, faults and other fractures in the bedrock.
- In glacial deposits, water is stored and moves through the intergranular openings.
- Rocks that are capable of yielding usable supplies of water to wells or springs are called aquifers.
- Most of the annual groundwater recharge is transmitted through local flow paths and is discharged to nearby streams and lakes.
- Although most groundwater is relatively shallow, there is some deeper flow, and the deeper wells may reach the deeper flow systems.
- Precipitation, evapotranspiration, groundwater discharge to streams, and water withdrawals affect groundwater levels.

### **Groundwater Quantity**

According to the Soil Survey for Wayne County, precipitation in Wayne County, as measured at Hawley, averages just under thirty-nine inches per year. The amount of rainfall, coupled with the rate of aquifer recharge, determines the volume of groundwater. Based on available studies (see the Groundwater Recharge Rates Sidebar), with long term consumption primarily residential and large areas of undeveloped land for recharge, it appears that the overall supply of groundwater in the Planning Area and all of Wayne County will be adequate for quite some time. Using the total open land area of some 130 square miles and a very conservative recharge rate of 750,000 gallons per day, the average groundwater recharge in the Planning Area is estimated at more than 90,000,000 gallons per day.

On-lot sewage disposal systems are typically designed at a wastewater flow of 400 gallons per day per dwelling unit. Applying this factor to the number of dwelling units in the Planning Area yields an estimated 1,400,000 gallons per day in residential Commercial water use would add water use. additional amounts, but the total is well below the estimated recharge rate. While sixteen of the 460 residents who responded to the Manchester and Oregon community surveys reported that their wells have gone dry, there have been no reports of chronic problems with inadequate groundwater yield. Nevertheless, as development occurs, the Townships should stress the importance of on-site groundwater recharge for development projects and water conservation.

#### **Estimated Groundwater Recharge Rates**

In 1989, the Pennsylvania Topographic and Geologic Survey estimates in *Water Resources Report 65, Groundwater Resources* of *Pike County, Pennsylvania*, that in Pike County the average groundwater discharge is estimated to be about 635 (gal/min)/mi<sup>2</sup>, twice the amount estimated for most areas of Pennsylvania. Based on this, groundwater recharge in is about 900,000 gallons per day per square mile of land area.<sup>1</sup> In 1964, the U.S. Geological Survey reported that a conservative estimate for recharge in the Highlands of the Delaware River Basin was 750,000 gpd/sq mi.<sup>2</sup> In 1982, a Delaware River Basin study of the Upper Delaware Basin reported:

- a recharge rate of about 1,000,000 gpd/sq mi for the Upper Pocono Plateau.<sup>3</sup>
- normal year recharge rates in the Upper and Lower Pocono Plateaus range from 900,000 to 1,000,000 gpd/sq mi.<sup>4</sup>
- during a normal year recharge to the Catskill formation which underlies the County is about 930,000 gpd/sq mi.<sup>5</sup> Sources:
- 1. Water Resources Report 65, Groundwater Resources of Pike County, Pennsylvania, Pennsylvania Topographic and Geologic Survey, D. K. Davis, 1989, p. 11.
- 2. *Water Resources of the Delaware River Basin*, Geological Survey Professional Paper 381, U.S. Department of the Interior, Parker, Garald G, et. al., 1964, p. 91.
- 3. Special Groundwater Study of the Upper Delaware River Basin Study Area III, Volume I, Delaware River Basin Commission, Wright Associates, R.E., 1982, p. 3-10.
- 4. Special Groundwater Study of the Upper Delaware River Basin Study Area III, Volume II, Delaware River Basin Commission, Wright Associates, R.E., 1982, p. 8-3.

However, this is not to suggest that residents and local officials should ignore the important issues of localized groundwater supplies and groundwater conservation. This is particularly important as development occurs. Wells near large water uses can be drawn down resulting in inadequate supply. Increases in impervious areas such as buildings, driveways and roads inevitably leads to more stormwater runoff and less groundwater recharge. In addition, given the characteristics of aquifers, development in the region can also effect local groundwater availability. Simply stated, groundwater availability is a regional issue and adequate supply is not a valid reason for postponing or avoiding action to ensure continued adequate supply.

How much groundwater do we have?

Most people are surprised to learn that almost all of the world unfrozen fresh water exists under the ground. Pennsylvania, having a humid climate, has a lot of water in streams, lakes, and wetlands. But Pennsylvania has much more fresh groundwater than surface water – more than thirty times as much. Pumping all of Pennsylvania's groundwater onto the surface would cover the entire state with more than eight feet of water!

### **Groundwater Water Quality**

No less important is the issue of groundwater quality. The potential for groundwater pollution is always present because bacterial contamination can occur from malfunctioning on-lot sewage systems or poor livestock husbandry, hydrocarbons can eventually reach groundwater from oil spills or leaking storage tanks, and nitrates and chloride can infiltrate as run-off from roads and parking lots, sewage systems, and farm fields. Similar to supply conservation, quality protection must be addressed.

Current regulations typically address water issues independently even though surface water and groundwater are one integrated resource. For example, stormwater runoff



## The Hydrologic Cycle in Pennsylvania

Each year on an average, 41 inches of precipitation falls in Pennsylvania. Six inches of that enters streams and lakes directly either as surface runoff or as flow that enters streams from the unsaturated zone under the land surface. Twenty inches returns to the atmosphere through evaporation and transpiration. The remaining fifteen inches infiltrates the soil and moves downward to the zone of saturation to recharge groundwater, a recharge rate of about thirty-seven percent. (See *Hydrologic Cycle Figure.*)

# How Groundwater Moves

Groundwater, like surface water, is constantly on the move. However, groundwater moves much slower-at rates ranging from feet per day to inches per year depending on the type of soil or rock through which it is moving. The natural movement of groundwater is from upland recharge areas to lowland discharge areas -- points where the water table meets the land surface, such as springs, lakes, streams, and wetlands. Most water seeping into the soil moves only a few miles to the point where it is discharged; in most instances it stays within the same watershed. Groundwater discharging into streams provides the water that keeps streams flowing year round. Except for a short time during and after rain storms and snow melt, all the water in a stream is provided by groundwater seeping through stream banks and stream beds. This is called base flow. From points of recharge to points of discharge, groundwater moves slowly through small openings in rocks and soil and usually in parallel paths (i.e., layers). Generally there is little mixing of the water in these layers because the slow movement of groundwater does not create sufficient turbulence for mixing to occur.

Source: *Groundwater: A Primer for Pennsylvania, Pennsylvania Groundwater Policy Education Project*, undated.