Chapter 4
Natural Resources Inventory

Natural resources greatly influence land use in New Garden. This chapter provides an overview of the major natural resources, their importance to the Township, and a summary of municipal regulations currently in place for their protection. A major goal of this chapter is to inventory these resources and examine potential gaps in existing protection measures to determine the best course of action for their protection. Natural resources should serve as a primary determinant in what types and intensities of land uses are appropriate in each area of the Township. As such, they will provide important guidance for the development of the land use plan.

LAND RESOURCES

New Garden Township lies entirely within the Piedmont Province of the Appalachian Highlands, a band of rolling topography that stretches from New York to Georgia. The "fall line" marking the transition between the Piedmont Province and the Coastal Plain Province to the east passes just to the south of New Garden through northern Delaware. Within the Piedmont, most topographic features (ridgelines, rock outcrops) tend to be oriented in a northeast to southwest pattern while the slope of the land and drainage patterns generally dip in a southeasterly direction toward the Coastal Plain. This pattern is evident within Chester County and within the Township.

Within Chester County, New Garden is part of the southern Chester County Lowland, a large band of the Piedmont that is characterized by lower elevations and less alignment of topographic features due to the more complete weathering of the area geology.

Climate

Climate can be defined as the aggregate of day-to-day weather such as precipitation, temperature, humidity, and wind over an extended period of time. Chester County is classified as an area of modified humid continental climate.

The climate is influenced primarily by the prevailing winds that carry many of the major weather systems eastward across the country. Fluctuations in the day-to-day weather are sometimes frequent. Because of the protection of the various mountain ranges through the central portion of the state, temperatures in Chester County are milder than in most parts of the state.

A prime requirement for industry, agriculture, and the general public is an adequate and dependable water supply. New Garden has both, provided by moderate precipitation distributed rather evenly throughout the year. Amounts of precipitation normally total about 45 inches annually. From May through September rainfall is produced principally from rain showers and thunderstorms. These weather occurrences tend to be somewhat localized and may not effect the entire County. During the cooler half of the year, precipitation is produced primarily from more extensive storm systems and infrequent snowstorms.

The growing season is generally about 190 days in length in Chester County, usually falling between April 16 and October 23. This period also receives over 55 percent of the annual rainfall, thereby reducing the need for irrigation and increasing the effectiveness of the land for agricultural production. In most years rainfall is ample for crop growth, but occasionally there are extended periods of drought.

Geology

The type and composition of geologic formations underlying New Garden influence what activities are best suited to take place on the surface. In planning for future land use allocations, geologic information must be considered. Geology influences foundation support, excavation, and stability.

New Garden is underlain by six major rock types: Setter's Quartzite, Cockeysville Marble, Wissahickon Schist, Felsic Gneiss, Mafic Gneiss, and Pegmatite. Each of these formations vary in composition and character, thereby imparting different planning implications. The acreage and percentage of Township land underlain by these formations are shown on **Figure 4-1**, while their locations are shown on **Map 4-1**.

Setter's Quartzite is characterized by a light-gray metamorphic quartzite. This rock is typically coarse grained with thin layers of mica often present. The Setter's Quartzite (a metamorphosed quartz sandstone) is a particularly hard rock, thereby making it highly resistant to weathering and conventional excavation. Stability for foundations and cut-slopes is excellent, but should be excavated to a depth of solid material. Due to its hardness, it was often used in furnace lining and other uses where hardness and resistance properties were valuable. Setter's Quartzite has also seen limited use as crushed stone for a variety of purposes. Setter's Quartzite is found in the northern section of the Township and forms the ridges along the Toughkenamon Valley. Within New Garden, approximately 982 acres representing 9.4 percent of the Township land area is underlain by this formation.

Cockeysville Marble is a white to blue-gray colored metamorphosed limestone. The marble is a pre-cambrian rock formation and is probably one of the oldest rock types in the County. This rock is highly resistant to physical weathering, but moderately susceptible to chemical weathering, therefore occurring generally in low, rolling areas. The stability of this formation for foundations and cut-slopes is good, but investigations for subsidence potential are necessary. Much of the Toughkenamon Valley is underlain by Cockeysville Marble. It has been widely used in the past for buildings and monuments and underlies approximately 957 acres (9.2%) of the Township.

Wissahickon Schist is a moderately hard rock with a low to moderate resistance to weathering. These mica schists were derived from shale that underwent intensive metamorphism. Often, weathered zones in Wissahickon Schist may run as deep as 50 feet before solid bedrock is reached. Due to the susceptibility to weathering, areas underlain by this formation must be studied for foundation stability, especially for heavy structures. The Wissahickon Schist has been frequently used locally as a building stone, especially in the Philadelphia area. The weathered portion of Wissahickon formations has some possible value as a future source of low grade mica for insulation products such as transformers. Most of New Garden is underlain by this formation, with 6,539 acres (62.7%) of the Township.

Felsic Gneiss includes a series of metamorphic rocks with similar properties; granodiorite, Baltimore Gneiss, and quartz monzonite. The rocks of this formation are light buff to light pink in color with a fine to medium grain. Resistance to weathering, abrasion, and rupture is high, but variable. All but the heaviest structure foundations can be accommodated by this rock. In New Garden, erosion and weathering of these rocks have produced a rolling terrain of medium relief in the northern tier of the Township, north of the Toughkenamon Valley. The rocks of the Felsic Gneiss formation are somewhat valuable for use as crushed stone due to their hardness. The Baltimore Gneiss has also been sometimes used as a building stone. Felsic Gneiss rocks occupy approximately 1,104 acres (10.6%) of the Township.

Mafic Gneiss are very similar to the rock types within the Felsic Gneiss formation, the major difference being that Mafic Gneiss formations are mafic in composition and darker in color, being composed chiefly of basalts, while the Felsic Gneiss rocks are felsic and of a lighter color. These formations are highly resistant to weathering, rarely weathering greater than about eight feet in depth. Due to a high degree of hardness, Mafic Gneiss are excellent for foundations involving all but the heaviest construction. Valued for their

hardness and toughness, gneiss is often mined for use as crushed stone. This formation occupies 759 acres (7.3%) of the Township. They are generally found in long bands south of Baltimore Pike.

Pegmatite is essentially an igneous intrusion; small flows of magma that cool and form longitudinal dikes. Pegmatite is often solidified in a fluid-rich environment, thereby forming large crystals of quartz, feldspar, and muscovite that are several centimeters or even a few meters in length. Due to the hardness and coarse grain of the rock, pegmatite weathers somewhat irregularly. They are usually found in areas of rolling topography and because of irregular weathering, soils above these formations can range in depth from a few inches in higher elevations to several feet in valleys. Foundation stability for most construction is good and excavation is generally not difficult. Due to the process of formation and mineral composition of pegmatite, it is often a valuable geologic commodity, especially as a source of feldspar that has several applications in electronics. Pegmatite has been mined in Chester County for feldspar and also for kaolin just over the PA state line in Delaware. Pegmatite only accounts for a small percentage of the geology in New Garden, occurring in only 0.8 percent of the Township (representing 82 acres) and appears mainly in the northwestern and southeastern corners of the Township.

Figure 4-1: **New Garden Township Geology**

Geologic Formation (Abbreviation)	**Acreage of Township Land**	**Percentage of Township Land**
Setter's Formation (Xsq)	982	9.4%
Cockeysville Marble (Xc)	957	9.2%
Wissahickon Schist (Xw)	6,539	62.7%
Felsic Gneiss (gn)	1,104	10.6%
Mafic Gneiss(g)	760	7.3%
Pegmatite (Xpg)	82	0.8%
Total	10,424	100%

Source: Chester County Geology, Chester County Planning Commission, 2004; Chesco GIS.

Slopes

New Garden generally exhibits characteristic topography of the Piedmont Province; broad, rolling terrain with undulating hills of low to moderate relief. The land gently falls in a southeasterly direction, with few areas of sudden changes in relief. The highest point in the Township is just east of the Route 1 and Newark Road interchange with an elevation of 483 feet above sea level, while the lowest point is 140 feet above sea level, occurring in the extreme southern tip of the Township.

The most pronounced areas of abrupt change in topography occur in the vicinities of Landenberg and Toughkenamon villages. In the Landenberg area, the White Clay Creek Valley quickly narrows and becomes quite steep. Slopes here are greater than 25 percent over a considerable area along the White Clay Creek. There is also a steep ridge on the north side of Walnut Run, southeast of Landenberg. North of Toughkenamon, a steep ridge that runs from Avondale to Kennett Square parallel with Baltimore Pike defines the Toughkenamon Valley.

The topography of the Township is shown on **Map 4-2**. Areas are shown with slopes between 15 and 25 percent and areas with slope greater than 25 percent. Slope is a measure of steepness, expressed as a percentage of the ratio between the vertical and horizontal distance between two points. Slopes under 15 percent are suitable for almost all types of land use, contingent upon the presence of other natural constraints.

Topography is an important resource to consider when determining future land use of an area. Development of steep slopes can result in hazardous road conditions, costly excavation, erosion and sedimentation and stormwater runoff problems. These slopes are quite prone to erosion, and protection of them is particularly important for water resource protection when watercourses are nearby, as is often the case in New Garden. Areas between 15 percent and 25 percent slope are generally suitable for low intensity development. Areas in excess of 25 percent slope are best suited for open space uses. Very low density residential development is possible on these steep slope areas, but careful planning and alternative construction methods are necessary to ensure proper development, especially the consideration of sewage disposal, erosion, and stormwater runoff. Intensive development of high density residential, commercial, and industrial uses should be restricted from being built in these slope areas. Problems encountered when areas of steep slope are illogically developed upon include an increase of stormwater runoff, soil erosion, on-site sewage disposal problems, site access, destruction of scenic vistas, vegetation removal, and increased development costs.

Soils

The composition and attributes of soil are important criteria for determining potential land uses. Agricultural and development potential are determined by a number of factors associated with the characteristics and physical properties of the various soil types. Factors to be considered include the depth of the soil, drainage, height of water table, and susceptibility to erosion. Fertility of the soils in New Garden are on average moderate to high, a condition that is accentuated if organic matter is also low. Where adequately fertilized, the soils can be highly productive. Soils found in the Township are suitable for a wide range of crop plants, some of the more typical being corn, tobacco, and small grains.

Within New Garden, the soils are broken down into 22 separate soil types. These soil types have been mapped and studied in the *Soil Survey, Series 1959, No. 19, issued May 1963, Chester and Delaware Counties, Pennsylvania*. Each of the defined soil types share common characteristics and parent materials. Rather than attempting to describe all of these soil types, this section will present a general discussion of soil characteristics.

All of the soils in New Garden have two special classifications assigned by the United States Department of Agriculture and the Pennsylvania Department of Agriculture: an Agricultural Land Use Capability Unit classification and an Development Suitability Unit classification, both of which are shown on **Figure 4-2**.

Prime Agricultural Soils

The Agricultural Land Use Capability Unit classification is a designation for soils concerning suitability for regular agricultural cultivation. It is based upon a number of physical and chemical soil properties including structure, tilth, composition, and acidity (pH). There are eight Agricultural Land Use Capability classes, with Class I through Class IV most suitable for cultivation. Classes at the lower end of the scale are generally not suitable for agricultural cultivation. Of major importance in New Garden are Class I through Class III soils, which are deemed as Prime Agricultural Soils by the United States Department of Agriculture, Soil Conservation Service.

There are 6,260 acres of Prime Agricultural Soils in New Garden, comprising approximately sixty percent of the total soils (10,423.7 acres). Prime Soils produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment. Class I soils have few limitations that restrict their use for farming. They are deep well drained soils and are level areas found on uplands and silty soils on deep plains. They can be cultivated safely without special conservation treatment. Class II soils have some limitations that reduce the choice of plants or require moderate conservation practices. The soils are found on gently sloping areas, are deep to moderately deep, and well

drained to moderately well drained. There are also shallow soils in this class that are well drained and found on nearly level areas. Class III soils have more severe limitations that reduce the choice of plants, require special conservation practices, or both. A list of Class I through Class III soils is found in **Figure 4-2** and can be viewed on **Map 4-3**. Soils not classified as I, II, or III are generally in areas of floodplains, wetlands, or steep slopes and are not considered suitable for agricultural use. Because Class I, II, and III soils are also often the most suitable for building, many areas of prime soils have already been developed.

Development Suitability of Soils

The Development Suitability Unit classification is a measure of a soil's suitability for building sites and sewage disposal systems. There are seven classifications with varying degrees of suitability. Basic soil properties such as texture, depth to bedrock, depth and variation in water table, slope, and drainage are the more important factors considered in making these interpretations. The seven Development Suitability Units may be subdivided into three development suitability categories; slight development constraints, moderate development constraints, and severe development constraints. Those soils that fit into the slight development constraints category are those of Class 1 and 2 of the Development Suitability Classification and are generally suitable for development and on-site sewage disposal. These soils are generally deep, well drained soils with slight slope (8 percent or less). Soils that may be considered part of the moderate development constraints category, Class 3 and 4 of the Development Suitability Classification, may be categorized as having moderate slopes of 8-15 percent with shallow soils. Generally, development is suitable on soils in this group, but there may be some restrictions concerning on-site sewage disposal because of possible ground water contamination. Soils that are considered as having severe development constraints have an Development Suitability Classification of 5, 6, and 7. These soils may be alluvial or hydric and are often located within floodplain areas or in areas with slope greater than 15 percent. These soils are normally not suitable for any type of development. In order to meet two goals of the Township, Prime Agricultural Soils (Agricultural Suitability Classes I through III) and Severe Developmentally Constrained Areas (Development Suitability Classes 5, 6, and 7) need preservation.

Figure 4-2: New Garden Township Soil Data

Symbol	Soil Type	Slope (%)	Agricultural Land Use Capability	Development Suitability	Hydric Soils	Alluvial Soil
BdA	Bedford silt loam	0-3	II	5	Yes	
BdB	Bedford silt loam	3-8	II	5	Yes	
BdB2	Bedford silt loam	3-8	II	5	Yes	
BrC3	Brandywine loam	8-15	IV	4		
BrD3	Brandywine loam	15-25	VI	7		
BrE	Brandywine loam	25-40	VI	7		
BsB	Brandywine very stony	0-8	VI	4		
BsD	Brandywine very stony	8-25	VI	7		
BsF	Brandywine very stony	25-50	VII	7		
CdA	Chester silt loam	0-3	I	1		
CdB	Chester silt loam	3-8	II	1		
CdB2	Chester silt loam	3-8	II	1		
Ch	Chewacla silt loam	Level	II	6	Yes	Yes
CmA	Conestoga silt loam	0-3	I	3		
CmA2	Conestoga silt loam	0-3	II	3		
CmB2	Conestoga silt loam	3-8	II	3		
CmC2	Conestoga silt loam	8-15	III	3		
CrA	Croton silt loam	0-3	IV	5	Yes	
GeA	Gleneg channery silt	0-3	I	2		
GeA2	Gleneg channery silt	0-3	II	2		
GeB	Gleneg channery silt	3-8	II	2		
GeB2	Gleneg channery silt	3-8	II	2		
GeB3	Gleneg channery silt	3-8	IV	2		
GeC	Gleneg channery silt	8-15	III	2		
GeC2	Gleneg channery silt	8-15	III	2		
GeC3	Gleneg channery silt	8-15	IV	2		
GeD	Gleneg channery silt	15-25	IV	7		
GeD2	Gleneg channery silt	15-25	IV	7		
GeD3	Gleneg channery silt	15-25	VI	7		
GeE	Gleneg channery silt	25-35	VI	7		
GeE3	Gleneg channery silt	25-35	VII	7		
GgA3	Gleneg silt loam	0-3	IV	2		
GgB3	Gleneg silt loam	3-8	IV	2		
GnA	Glenville silt loam	0-3	II	5	Yes	
GnB	Glenville silt loam	3-8	II	5	Yes	
GnB2	Glenville silt loam	3-8	II	5	Yes	
Gu	Guthrie silt loam	Level	IV	5	Yes	
HaB2	Hagerstown silt loam	3-8	II	3		
LaA	Lawrence silt loam	0-3	III	5	Yes	
LaB	Lawrence silt loam	3-8	III	5	Yes	
Ls	Lindside silt loam	Level	II	6	Yes	Yes

(continued)

Symbol	Soil Type	Slope (%)	Agricultural Land Use Capability	Development Suitability	Hydric Soils	Alluvial Soil
MgB2	Manor loam	3-8	II	4		
MgB3	Manor loam	3-8	III	4		
MgC	Manor loam	8-15	III	4		
MgC2	Manor loam	8-15	III	4		
MgC3	Manor loam	8-15	IV	4		
MgD	Manor loam	15-25	IV	7		
MgD2	Manor loam	15-25	IV	7		
MgD3	Manor loam	15-25	VI	7		
MhE	Manor loam and	25-35	VI	7		
MhE3	Manor loam and	25-35	VII	7		
MkF	Manor soils	35-60	VII	7		
MmB	Manor very stony loam	0-8	VII	4		
MmD	Manor very stony loam	8-25	VII	7		
MmF	Manor very stony loam	25-60	VII	7		
Mn	Melvin silt loam	Level	VI	6	Yes	Yes
NaB2	Neshaminy gravelly silt	3-8	II	2		
We	Wehadkee silt loam	Level	VI	6	Yes	Yes
WoA	Worsham silt loam	0-3	V	5	Yes	
WoB	Worsham silt loam	3-8	VI	5	Yes	
WoB2	Worsham silt loam	3-8	VI	5	Yes	

Source: Soil Survey of Chester and Delaware Counties, USDA, 1963

Clean And Green Areas

Pennsylvania Act 319 of 1974, commonly known as *Clean and Green*, is designed to preserve farmland, forestland, and open space by taxing land according to its current use value rather than at its market value for development. There are 127 parcels of land within New Garden enrolled under the Clean and Green tax program, comprising 2,502 acres.

Agricultural Security Districts

The Agricultural Security Area Program, Act 43 of 1981 as amended, is a state program created to help farmers keep their land in agricultural use. Landowners are protected from nuisance lawsuits and certain applications of eminent domain. Agricultural security areas are voluntarily established in a cooperative effort between the Township and farmers within the Township. While indicating an interest of the owners in preserving these areas for agricultural uses, the land can be taken out of agricultural uses by the owners, so it offers no permanent protection for farmland. The program requires no land use restrictions. It is a prerequisite for eligibility in the State and County Agricultural Conservation Easement Purchase Programs. Under Act 43, local government units may create Agricultural Security Areas consisting of at least 250 acres upon petition of interested landowners. These areas comprise over 132,000 acres within Chester County. New Garden adopted its Agricultural Security Area on October 10, 1989. As of 2004, approximately 40 landowners in the Township were included in the District, comprising roughly 2090 acres. (See: **Map 4-3**)

Agricultural Easement Program

The Chester County Agricultural Easement Program purchases the development rights of farms in exchange for permanent agricultural easements. Participation in the program is voluntary. The competitive program is overseen by the Chester County Agricultural Preservation Board and is administered in conjunction with the State Program. Farms applying to be in the program are evaluated using the Land Evaluation Site Assessment developed by the USDA. This system considers soil type, slope, and other features. Farms must also be located within an Agricultural Security District (see above). The program has proven so successful that in most years it is not possible to purchase the easements of all eligible participants. As of April 2004, New Garden Township had two farms preserved under this program. (See: **Map 4-3**)

WATER RESOURCES

Due to the interconnection of surface and subsurface water sources, a review of the total water system is necessary to adequately evaluate the water resource characteristics of an area. The creeks, rivers, and streams throughout Chester County have influenced settlement patterns since before the first colonial settlers arrived. Proper management of this resource to meet growing demands, while protecting water quality and quantity from degradation and depletion, is necessary. (See: **Map 4-4**)

Surface Water Resources

New Garden Township lies within two watersheds, the White Clay Creek Watershed and the Red Clay Creek Watershed. Sixty-five percent of the land area of New Garden drains into the White Clay Creek Watershed while the remaining 35 percent is drained by the Red Clay Creek Watershed. Both watersheds drain into the Christiania River in Delaware, and eventually drain into the Delaware Bay near Wilmington. Each watershed is further divided into minor basins.

In Pennsylvania, water quality standards for all streams and their drainage areas are established by Chapter 93 Water Quality Standards, of the Department of Environmental Protection (DEP). DEP has established mandated standards for all surface waters, regardless of stream classification, which includes 12 specific parameters, including levels of certain metals, nitrates, pH, and total dissolved solids. All streams must also be suitable for the following water uses: aquatic life, water supply for domestic, agricultural, and industrial uses, fishing, and swimming. Included in Chapter 93 are listings of special water uses to be protected for streams as well as specific water quality criteria necessary to protect these uses. The water quality standard for a stream is then determined by the combination of the protected water use and the water quality criteria that matches that use. Special water quality designations are also applied to waters with very high quality.

In New Garden, there are three protected water use designations for surface streams. These designations include the following:

Aquatic Life

CWF Cold Water Fishes - Maintenance and/or propagation of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold water habitat.

TSF Trout Stocking - Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna that are indigenous to warm water habitat.

Special Protection

EV Exceptional Value Waters - A stream or watershed that constitutes an outstanding national, state, regional, or local resource, such as waters of national, state, or county parks or forests, or waters which are used as a source of unfiltered potable water supply, or waters of wildlife refuges or state game lands, or waters which have been characterized by the Fish Commission as "Wilderness Trout Streams," and other waters of substantial recreational or ecological significance.

The majority of streams in New Garden are designated as CWF or TSF. The CWF designation is the second ranking in the classification scheme, thereby indicating the stream meets the minimum state criteria and has several additional criteria applied to it for discharges. The TSF designation is a higher designation than the CWF ranking, with additional quality criteria above the CWF classification required.

There are two areas in New Garden for which the Exceptional Value Waters (EV) designation has been applied. These areas are along the White Clay Creek in the northwestern corner of the Township. Existing water quality in EV streams must be maintained and protected because of their outstanding ecological and/or recreational values. Development in the vicinity of EV streams is not prohibits, but additional levels of regulations create more stringent requirements on types and intensity of uses in addition to issues such as sewage storm water discharge.

WHITE CLAY CREEK

The White Clay Creek watershed is located in southern Chester County and northern New Castle County and is in the western portion of New Garden Township. It consists of ten sub-basins covering about 108 square miles. The White Clay Creek is an inter-state stream, because thirteen municipalities of Pennsylvania and Delaware, and unincorporated areas of New Castle County, Delaware, are located within the watershed. The White Clay Creek is part of the Christina River Basin, which flows into the Delaware River Estuary at Wilmington, Delaware. White Clay Creek has three predominant land uses: agriculture (35%), residential (26%), and wooded (24%).

A 16 percent increase in growth is projected for the watershed by 2020, raising concerns about stormwater and pollutant runoff problems and increased flooding. In 1998, estimated impervious cover in the watershed was 15 percent and is estimated to increase to over 16 percent by 2020 due to population growth. Agricultural operations (including mushroom operations) have been a major land use, resulting in non-point source pollutant runoff in several areas of the watershed. On-going efforts by numerous agencies and agricultural operators have made significant progress in reducing agricultural runoff in the watershed, but much more reduction is needed. The watershed serves as a major source of drinking water supplies with an in-stream intake located near the confluence with Red Clay Creek that provides water supply to much of New Castle County. Collectively, the priority management needs and actions must provide source water protection throughout the watershed.

A watershed-wide inter-agency effort is underway to develop estimates of non-point source pollutant loadings that can be assimilated by the streams in the watershed while still achieving the states' designated uses of each stream segment. The development of these loadings (referred to as Total Maximum Daily Loads, or TMDLs) are under development by US Environmental Protection Agency (USEPA), Pennsylvania Department of Environmental Protection (PADEP), Delaware Department of Natural Resources and Environmental Control (DE-DNREC), Delaware River Basin Commission (DRBC), and US Geological Survey (USGS) in conjunction with county agencies, conservation districts, conservation organizations, and other entities, to reduce nutrients and bacteria levels.

In addition to the problems identified, the White Clay Creek watershed has many significant resources that provide benefits to the community and environment that must be protected and preserved. White Clay Creek and its tributaries are afforded federal protections as a Federal Wild and Scenic River. The watershed also has areas that contain or may contain rare and endangered species as noted in the Pennsylvania Natural Diversity Index (PNDI). The headwaters of the East Branch are designated as Exceptional Value. Numerous historic resources dot the watershed, evidence of the economic development of the 18th and 19th centuries as mills were built to utilize the extensive water power found in high gradient streams of the watershed.

Water Quality

The data used for the water quality analyses came from three sources, the Chester County Health Department (CCHD), the USGS, and USEPA's STORET database. Generally, both groundwater and surface water in the White Clay Creek watershed within New Garden have issues with Nitrate/nitrite, lead, zinc, and in some cases, dissolved phosphorus is high. This problem can be attributed to the historical presence of manufacturing, mushroom farming, and other agricultural farming practices.

Federal Wild and Scenic River Designation

In the fall of 2000, a majority of the streams and tributaries of the White Clay Creek were designated as a Federal Wild and Scenic River. The Wild and Scenic River program was established by Congress twenty-six years ago to encourage cooperation between state, local, and federal agencies, non-government organizations and private citizens to protect rivers in a way that is sensitive to the needs and concerns of local people. Presently, 140 rivers have been designated under the program in 33 states.

The process to have the White Clay Creek designated as a Wild and Scenic River began in January 1992 when the initial Study Task Force was established. Later that year, the National Park Service held public meetings to describe the study process and build the foundation for the Task Force. The Task Force then began the preparation of the Watershed Management Plan, which is the first time that the management plan has been developed before the watershed was designated Wild and Scenic by Congress and the President. By developing the management plan first, the Task Force has developed guidelines and management tools to make certain that the first stages of watershed protection are in place.

A total of 191 miles, 24 classified as scenic and 167 miles classified as recreational, of the White Clay Creek and its tributaries received designation into the National Wild and Scenic River System. All portions of the East Branch of the White Clay Creek and its tributaries except for the main stem of the east branch and the Egypt Run and its tributary in the southwest corner of the Township received the National Wild and Scenic River designation.

First Order Streams

First order streams are the "roots" of a watershed. They typically comprise over half of the total stream miles and drainage areas of any watershed. Individually they exhibit very small flows and are highly vulnerable to impacts of pollutants, stormwater flows, and ground water withdrawals. Of the 225 stream miles in the watershed, 45 percent or 101 miles are first order streams. New Garden is within 2 sub-basins of the White Clay Watershed, the Lower East Branch of White Clay Creek and the Upper East Branch of White Clay Creek. First order streams consist of 64.2 percent of the 26 total steam miles for the Lower East Branch while 64.0 percent of 31.5 total stream of the Upper East Branch are first order streams. Over 56 percent of the land area within the White Clay Creek watershed contribute to drainage areas of first order streams. The Upper East Branch has 9,167 total acres of which 5,867 acres or 63.9 percent of the total acres

are first order stream acres. The Lower East Branch has 12,184 total acres of which 7,354 acres or 60.4 percent of the total acres are first order stream acres.

Sources of Water Supplies

Substantial groundwater resources exist within the vast majority of the watershed to serve as a significant source of water supplies to help meet future needs, such as the Cockeysville Aquifer. However, new proposed withdrawals for community water supply systems should be reviewed to mitigate potential impacts to existing users and environmental resources, and be evaluated to maintain the recommended groundwater withdrawal management targets. In addition, several water supply systems exist within the watershed that may represent viable options for meeting future water needs, including:

- Avondale Borough Authority, PA (groundwater supplies).
- London Grove Municipal Authority, PA (groundwater supplies).
- Philadelphia Suburban Water Company, Franklin System, PA (groundwater supplies).
- West Grove Borough Authority, PA (groundwater supplies).
- City of Newark, DE (groundwater supplies).
- United Water Co., DE (surface water supplies).

In addition, Artesian Water Company acquired a groundwater supplied community water supply system in southern New Garden Township.

Non-Point Source Pollutant Loads

A key tool used for looking at surface water quality impacts across the watershed is a pollutant loading model called the Watershed Management Model (WMM). WMM helps to establish an overall "framework" for assessing pollution loading rates under existing and future land use scenarios, and to develop conceptual approaches for control strategies within the watersheds, sub-basins, and municipalities. WMM is also the primary tool used for estimating the percent impervious of each sub-basin and watershed, and for estimating annual average runoff.

White Clay Creek has low total phosphorus (TP) loading, with all the other parameters within normal ranges for all model scenarios. White Clay Creek is one of the watersheds with high levels of mushroom farming. The nutrient loading (nitrites and nitrates ($N_{O2,3}$), total kjeldahl nitrogen (TKN), and total phosphorus (TP)) from these farms can be high since the compost piles impact runoff. Applying the model to project runoff conditions in 2020, yields the following projected changes in pollutant loadings for the watershed (presented as loadings projections for conditions without BMPs, and loadings projections with BMPs, respectively): $N_{O2,3}$ (1%, -0.3%), TKN (5.5%, -10%), and TP (7%, -21%).

Biological Diversity Monitoring

Biological diversity in streams is an excellent indicator of the cumulative impact of watershed influences on stream quality. Since 1969, the USGS, in cooperation with Chester County, has conducted a program to annually evaluate stream ecology and water quality conditions using benthic macroinvertebrates and stream water chemistry. The Stream Conditions of Chester County Program has sampled Chester County streams every fall for over 30 years. The initial goals of the program were to evaluate stream water quality and to further the understanding of changes in the stream ecosystem in response to urbanization. The current goals of the program are to use the data to continue to monitor current conditions in response to changing land uses and to determine long-term trends.

There are two long term sampling sites and one flexible (periodically monitored) site located in the White Clay Creek watershed. Sampling has occurred between the years 1970 and 1997 on an annual basis, except for 1996 when no samples were collected. In order to present a year by year snapshot, the diversity index for all the stations has been averaged on an annual basis. The index indicates that conditions in the White Clay Creek watershed have steadily improved since 1974. Diversity index values have been inconsistent due to the large number of midge larva, which is an indication of organic pollution. Overall the biological community indicates good water quality in the White Clay Creek watershed.

Results of the 1998 and 1999 biological diversity monitoring program indicate that:

- Overall the biological community indicates good water quality in the East Branch White Clay Creek at Avondale, but there are indications that the macroinvertebrates are slightly stressed and that some organic pollution is affecting the benthic macroinvertebrate community.
- Overall the biological community indicates good water quality in West Branch White Clay Creek near Chesterville, but there are indications that some organic pollution is affecting the benthic macroinvertebrate community.
- Overall the biological community indicates good water quality in Middle Branch White Clay Creek near Avondale, but there are indications that some organic pollution is affecting the benthic macroinvertebrate community.

White Clay Creek Priorities

The White Clay Creek watershed has several primary characteristics that lay the foundation for the priority management needs:

- The land use of the watershed is approximately equally represented by wooded, developed, and agricultural lands.
- The watershed is a major source of public drinking water supplies for much of northern New Castle County, Delaware.
- In several areas, surface and ground water quality suffers from current and historic pollutant runoff from developed and agricultural lands, resulting in 136 miles (77% of the total stream miles in the watershed) listed by Delaware and Pennsylvania as “impaired” waters.
- Extensive growth (16% population increase) is projected within the watershed over the next 20 years.
- This is the first watershed to receive protection through Federal Wild and Scenic River designation for the main stem and its tributaries.

Collectively, the priority management needs and actions must provide source water protection throughout the watershed. Priority management objectives for the watershed include:

- Engage and educate individuals, communities and governments in watershed stewardship.
- Enhance recreational and cultural resources.
- Preserve natural resources.
- Improve water quality.
- Reduce stormwater runoff and flooding.
- Protect watershed water balances.
- Integrate utility and municipal planning to meet future water supply and wastewater needs.

RED CLAY CREEK

The Red Clay Creek watershed is located in the northeast portion of New Garden. The watershed covers approximately 54 square miles and flows into the White Clay Creek a few miles upstream from the confluence with the Christina River. The Red Clay Creek is part of the Christina River Basin that flows into the Delaware River at Wilmington, Delaware. Six municipalities of Pennsylvania and unincorporated areas of New Castle County, Delaware, are within the watershed. Land use within the Red Clay Creek watershed includes a mix of agricultural (34%), developed (36%), and wooded (24%) uses. In 2020, the projected population in the watershed is expected to be 50,000 people, an increase of 16 percent. The total length of streams in the watershed is 102 miles, with 61 miles consisting of first order (headwater) streams. The Red Clay Creek is also subject to DEP Water Quality Regulations and, because it is an interstate stream, it is subject to the water quality regulations defined by Delaware River Basin Commission (DRBC).

The US Geological Survey Study for the Red Clay Creek indicated that between 1970 and 1974 stream quality conditions degraded. A Chester County Water Resources Inventory Study for the Clay sub-basin indicated that more recent studies concluded that water quality had shown some improvement, and that in general the biological condition was good.

The East and West Branches of the Red Clay Creek are classified by DEP as trout stocking streams to their confluence. The main stem of the creek is classified as a cold water fish stream. Under the COWAMP/208 Study, the West Branch from Kennett Square and the main stem were designated as water quality limited stream segment, necessitating greater than secondary treatment for discharges.

In calculating the water supply "budget", the Chester County Water Resources Inventory Study indicated that a reserve supply of available water existed, but that the availability of water in the future would depend upon such variables as rate and density of urban development, water consumption, patterns of water supply, and methods of wastewater management. The study concluded that in many cases, concern for water quality imposes limits to urban growth prior to levels where the reserve water supply approaches zero.

The DRBC indicated that the West Branch should be protected for public water supplies, after reasonable treatment, industrial water supplies after reasonable treatment, and agricultural water supplies; maintenance and propagation of resident game fish and other aquatic life, maintenance and propagation of trout, and wildlife; and recreation. The DRBC has established standards for dissolved oxygen, temperature, pH, phenols, threshold odor number, synthetic detergents, radioactivity, fecal coliform, total dissolved solids, turbidity, and effluent quality requirements.

A 16 percent increase in growth is projected for this watershed by 2020, raising concerns about additional stormwater and pollutant runoff problems and increased flooding. In 1998, estimated impervious cover in the watershed was 12 percent and is estimated to increase to 14 percent by 2020 due to population growth. Agricultural operations have been a major land use, resulting in non-point source pollutant runoff in several areas of the watershed. On-going efforts by numerous agencies and agricultural operators have made significant progress in reducing agricultural runoff in the watershed, but much more reduction is needed. The watershed serves as a source of drinking water supplies with one reservoir and several public water supply wells that provide water supply to parts of Chester and New Castle Counties.

A watershed-wide inter-agency effort is currently underway to develop estimates of non-point source pollutant loadings that can be assimilated by the streams in the watershed while still achieving the states' designated uses of each stream segment. The development of these loadings (referred to as Total Maximum Daily Loads, or TMDLs) are under development by US Environmental Protection Agency (USEPA),

Pennsylvania Department of Environmental Protection (PADEP), Delaware Department of Natural Resources and Environmental Control (DE-DNREC), Delaware River Basin Commission (DRBC), and US Geological Survey (USGS) in conjunction with county agencies, conservation districts, conservation organizations, and other entities, to reduce nutrients and bacteria levels.

In addition to the problems identified, the Red Clay Creek watershed has many significant resources that provide benefits to the community and environment that must be protected and preserved. The one reservoir, Hoopes Reservoir, is a regional public drinking water supply reservoir for Northern New Castle County. Four (4) surface water intakes and numerous wells are located within the watershed for commercial and community water supplies. The watershed also has areas that contain or may contain rare and endangered species as noted in the Pennsylvania Natural Diversity Index (PNDI). Burrows Run is designated as cold water fish waters. A number of historic resources dot the watershed, evidence of the economic development of the 18th and 19th centuries.

Water Quality

The data used for the water quality analyses came from three sources, the Chester County Health Department (CCHD), the USGS, and EPA's STORET database. Generally, both groundwater and surface water in the Red Clay Creek watershed within New Garden have issues with Nitrate/nitrite, lead, zinc, and in some cases, dissolved phosphorus is high. This problem can be attributed to the historical presence of manufacturing, mushroom farming, and other agricultural farming practices.

First Order Streams

Of the 102 stream miles in the watershed, 66 percent or 67 miles are first order streams. New Garden is within one sub-basin of the Red Clay Watershed, the West Branch of Red Clay Creek. The West Branch has 32.1 total stream miles, of which 21.2 miles or 66.2 percent of the total miles are first order stream miles.

Over 56 percent of the land area within the White Clay Creek watershed contribute to drainage areas of first order streams. The Upper East Branch has 9,167 total acres of which 5,867 acres or 63.9 percent of the total acres are first order stream acres. The Lower East Branch has 12,184 total acres of which 7,354 acres or 60.4 percent of the total acres are first order stream acres. Over 56 percent of the land area within the Red Clay Creek watershed drains to first order streams. The West Branch has 11,277 total acres, of which 6,367 acres or 56.0 percent of the total acres are first order stream acres.

Sources of Water Supplies

Substantial ground water resources exist within the watershed to serve as a significant source of water supplies to help meet future needs. Groundwater is used as the source for several community water supply systems.

In addition, one surface water intake for public supplies exists in the Red Clay Creek watershed and is used to maintain Hoopes Reservoir as part of the City of Wilmington's water supply system. This is the intake for Hoopes Reservoir (City of Wilmington, DE; current average daily withdrawal volume is approximately 1 MGD).

The Chester Water Authority system also traverses Red Clay Creek Watershed as it extends from the Octoraro Reservoir and provides service to some areas in the watershed. Such sources may offer opportunities for future supplies both within and adjacent to their corresponding sub-basins. Typically,

these systems are designed and permitted with specific planning areas and needs in mind. However, as new needs arise, they should be evaluated to determine if they can be used or expanded to help meet those needs.

Similarly, the collection areas for wastewater treatment plants connect areas from various watersheds and sub-basins for transport, treatment, and disposal. Numerous municipalities and municipal authorities collect wastewater for treatment and disposal at a central location. Near the mouth of the Red Clay Creek watershed, the City of Wilmington's wastewater system collects wastewater from areas within the watershed for treatment and disposal into the Delaware River estuary. In addition, two community wastewater systems (Kennett Square Borough and New Garden Municipal Authority) are in operation within the watershed.

Surface Water Withdrawals and Discharges

The Red Clay Creek watershed has four surface water withdrawals for public water supply, commercial, and industrial uses. A total of four surface water withdrawals are inventoried in the watershed, and in 1998, it was estimated that there were approximately 1 million gallons withdrawn from the watershed.

There are nine known discharges with NPDES permits in the watershed as of 1998. The total volume discharged to the watershed in 1998 is estimated to be 1.1 billion gallons.

Non-Point Source Pollutant Loads

A key tool used for characterizing surface water quality impacts across the study area is a pollutant loading model called the Watershed Management Model (WMM). WMM helps to establish an overall "framework" for assessing pollution loading rates under existing and future land use scenarios, and to develop conceptual approaches for control strategies within the watersheds, sub-basins, and municipalities. WMM is also the primary tool used for estimating the percent impervious of each sub-basin and watershed, and for estimating annual average runoff.

Red Clay Creek has a high percentage of land in agriculture (34%), wooded (24%), and residential – single family (36%). For this reason, in the 1998 WMM calculations, the chemical oxygen demand (COD) and biological oxygen demand (BOD) loadings were relatively low, and in the 2020 worst case scenario these increased by 4 percent and 3 percent, respectively. In all three scenarios of the model run, all other parameters are within the normal loading ranges. For the 2020 scenario, with Best Management Practices (BMPs), all parameters decrease with total suspended solids (TSS) having the greatest drop of 81 percent.

Biological Diversity Monitoring

Biological diversity of streams is an excellent indicator of the cumulative impact of watershed influences on stream quality. Since 1969, the USGS, in cooperation with Chester County, has conducted a program to annually evaluate stream ecology and water-quality conditions using benthic macroinvertebrates and stream-water chemistry. The Stream Conditions of Chester County Program has sampled Chester County streams every fall for the past 32 years. The initial goals of the program were to evaluate stream-water quality and to further the understanding of changes in the stream ecosystem in response to urbanization. The current goals of the program are to use the data to monitor conditions in response to changing land uses and to determine long-term trends.

There are two long term sampling sites and one flexible (periodically monitored) site located in the Red Clay Creek watershed. Sampling has occurred between the years 1970 and 1997 on an annual basis, except for 1974 when no samples were collected. In order to present a year by year snapshot, the

diversity index for all the stations have been averaged on an annual basis. The index indicates that conditions in the Red Clay Creek watershed steadily improved between 1980 and 1997, and have been holding steady since then. Brillouin's diversity values below 1 are associated with waters receiving heavy levels of organic wastes. Brillouin's diversity values between 1 and 3 are associated with waters receiving moderate levels of organic wastes and Brillouin's diversity values between 3 and 5 are associated with waters receiving little or no organic wastes. The biological community in Red Clay Creek indicates a history of organic and toxic pollution. Overall, the biological community indicates fair water quality in the Red Clay Creek watershed.

Results of the 1998 and 1999 biological diversity monitoring program indicate that:

- Overall the biological community indicates fair water quality in East Branch Red Clay Creek near Five Point with indications that some nutrient enrichment and urban influences are stressing the benthic macroinvertebrate community.
- Overall the biological community indicates very good water quality in West Branch Red Clay Creek above Kennett Square, but there are indications that some organic pollution is slightly affecting the benthic macroinvertebrate community.
- Overall the biological community indicates poor water quality in West Branch Red Clay Creek near Kennett Square with indications that nutrient enrichment and urban influences are stressing the benthic macroinvertebrate community.

Pennsylvania Natural Diversity Index (PNDI)

There are a number of sensitive natural areas that are listed in the Natural Areas Inventory of Chester County, Pennsylvania (1994 with 2000 Update). Within the Red Clay Creek watershed, there are five areas that contain or may contain rare and endangered species as noted in the PNDI. Regional land and habitat preservation efforts should be directed towards these areas, which include the Red Lion Woods in the East Branch Red Clay sub-basin. There is one PNDI location in the Red Clay Creek watershed in New Garden, Site SP 517: Bucktoe Creek Woods.

Red Clay Creek Priorities

The Red Clay Creek watershed has several primary characteristics that lay the foundation for the priority management needs:

- The land use of the watershed is approximately equally represented by wooded, developed, and agricultural lands.
- The watershed is a source of public drinking water supplies for parts of southern Chester County and northern New Castle County, Delaware.
- In several areas, surface and ground water quality suffers from current and historic pollutant runoff from developed and agricultural lands, resulting in 93 miles (or 91% of total stream miles) listed by Pennsylvania and Delaware as "impaired" waters.
- Extensive growth (16% population increase) is projected within the watershed over the next 20 years.
- The watershed includes an assembly of natural, historic, cultural and recreational features, making the watershed and all of its resources collectively a significant and important regional resource.

The overall goals for watershed management of the Red Clay Creek watershed are:

- Engage and educate individuals, communities and governments in watershed stewardship.
- Enhance recreational and cultural resources.
- Preserve natural resources.

- Improve water quality.
- Reduce stormwater runoff and flooding.
- Protect watershed water balances.
- Integrate utility and municipal planning to meet future water supply and wastewater needs.

Sub-Minor Watersheds

Sub-minor watersheds are indicated for Broad Run, Egypt Run, Bucktoe Creek, Trout Run, South Brook, and other unnamed tributaries within the White Clay and Red Clay Watersheds. The Bucktoe and South Brook sub-minor basins and several other sub-minor basins are in the West Branch of the Red Clay Creek minor basin. The Broad, Egypt, and Trout sub-minor basin, as well as additional sub-minor basins, are within the East Branch of the White Clay Creek minor basin. The sub-major basin division between the Red Clay Creek and White Clay Creek roughly bisects the Township from north to south. The entire Township is within the Clay Major Basin.

Broad Run: The Broad Run watershed covers a large area in the southern portion of the Township, roughly extending to Saw Mill Road and Walnut Run Road to the west, Laurel Heights Road, Sunny Dell Road and Sheehan Road to the north, the Township boundary to the east, and Southwood Road, the Township boundary, and Yeatmans Station Road to the south.

Egypt Run: The Egypt Run watershed is another large watershed, which is north of the Broad Run watershed in the central portion of the Township. The Egypt Run watershed extends to New Garden Road on the north and east, Sunny Dell Road on the east, Laurel Heights Road on the south, and Penn Green Road on the west.

Bucktoe Creek: The Bucktoe Creek watershed is also a substantial watershed, located northeast of the Egypt Run watershed. The Bucktoe Creek watershed is roughly bounded by Hillendale Road to the north, New Garden Road and Newport Pike to the west, Sheehan Road to the south, and the Township boundary to the east.

West Branch Red Clay Creek: The watershed of the West Branch Red Clay Creek is also substantial, and is found north of the Bucktoe Creek watershed. The West Branch Red Clay Creek watershed extends close to Newark Road to the west, near Line Road and Pemberton Road to the north, to the Scarlett Road area to the east, and to the Hillendale Road area to the south.

Trout Run: The Trout Run watershed is found west of the West Branch Red Clay Creek watershed. The Trout Run watershed extends from the New Garden Road area to near Polo Road and from east of Newark Road to Avondale Borough.

GROUNDWATER

Due to the reliance upon groundwater as the major source of water for New Garden Township, whether through private or public wells, characteristics of the local geology involving groundwater is of vital importance. Structural and chemical qualities of the rock types underlying the Township determine the quantity and quality of water drawn from these formations. Quantity of groundwater in geologic aquifers is generally a function of several physical characteristics of rock, such as permeability, porosity, fracturing properties, and position within the sequence of geologic layers underlying the earth's surface. The quality of groundwater is determined by the type and amount of substances dissolved within it. These dissolved substances may come from several sources. Precipitation may dissolve gases and solid particles in the atmosphere and carry them to the land surface, where they are transported to groundwater aquifers. Mineral

constituents may be dissolved by solution and chemical breakdown during the weathering process as water percolates through soil and rock.

The activities of man, especially in a growing area such as New Garden, may alter the natural quantity and quality of groundwater in many ways. Increasing withdrawals can reduce underground supplies. Land development and increases in impervious surface coverage reduces the amount of precipitation able to penetrate into the subsurface aquifers. Chemical elements may be added to the aquifers from fertilizers, septic tank effluent, surface and subsurface waste disposal, and surface runoff. Man may also induce changes in water quality by changing land use.

The following is a discussion of the groundwater aquifers present in New Garden Township.
(See: **Map 4-1**)

Setter's Quartzite generally holds adequate supplies of groundwater for domestic use (up to a maximum of 100 gallons per minute), but may be inadequate for large water use activities. Water drawn from Setter's Quartzite tends to be acidic, moderately hard, and low in dissolved solids.

Cockeysville Marble is generally an excellent but inconsistent aquifer with yields of a 1000 gallons a minute or more possible. When a large solution channel is tapped, very large water yields may result. Otherwise yields are average at best. Quality characteristics of water from this formation include alkalinity, hard to very hard, and a moderate amount of dissolved solids. Although the marble has the potential to be a very productive water supplier in terms of yield, the formation also carries with it several potential liabilities that require special procedures and extensive site analysis if they are to be avoided. Among the hazards is the susceptibility of subsidence in the form of sinkholes and solution channels. These hazards have a high degree of probability in carbonate rock formations, although marble is one of the strongest carbonate rocks and thereby has a lower probability for subsidence problems than pure limestone areas. New Garden Township is close to two of the most outstanding areas of sinkhole occurrence in Pennsylvania (the Valley Forge area and central Lancaster County) and has similar geology, so the Township is susceptible to these hazards. A more widespread danger experienced by this formation is the prospect of extensive groundwater pollution. Where the soil mantle is thin, underground channels and caverns can permeate the geologic strata, pollutants can reach the water table readily, becoming widely dispersed with little likelihood for self-purification. Careful analysis must be given to the acceptability of any subsurface sewage disposal system within or adjacent to areas of carbonate geology before the siting of a well and septic system on a lot are even considered. Safeguards also should be given to sludge application, spray irrigation disposal systems, and stormwater runoff infiltration over this formation.

Wissahickon Schist geology is characterized by average groundwater supplies between a few gallons up to 400 gallons per minute. The rather high yields from this formation can be credited to its weathering characteristics, which allow surface water to easily penetrate into the soil. Water from Wissahickon Schists tends to be acidic, soft, and very low in dissolved solids.

Areas of the Township underlain by Felsic Gneiss and Mafic Gneiss can generally be expected to be among the worst providers of groundwater yield, due mainly to their hardness and denseness. These formations generally provide yields in the 2-60 gallons per minute range, with an average yield usually in the 5-10 gallons per minute range. Higher yields can be found, but only where intensive weathering has occurred. In these areas, groundwater is usually acidic, moderately hard, and low in dissolved solids.

Pegmatite yields are usually very low, generally under 35 gallons per minute, with typical wells averaging between 5 and 8 gallons per minute. Groundwater tends to be acidic, soft, and low in dissolved solids. These areas should not be depended upon as reliable sources of water, except for possibly single residences.

Well data from the U.S. Geological Survey report titled *Selected Hydrologic Data Chester County, Pennsylvania, (1976)* contained well data on selected wells throughout New Garden Township. Data on wells sampled is included in **Figure 4-3** below:

Figure 4-3: New Garden Township Selected Well Data

Formation	# of Wells Sampled	Range of Yields (GPM)	Average Yield (GPM)	Range of Depth (Feet)	Average Depth (Feet)
Setter's Formation (Xsq)	6	20-110	41.6	30-343	167
Cockeysville Marble (Xc)	10	5-1800	354.6	34-260	125
Wissahickon Formation (Xw)	48	5-80	21.6	60-610	178
Felsic gneiss (gn)	4	5-40	18.0	63-124	91
Mafic gneiss (g)	6	5-30	17.5	28-135	70
Note: No wells were sampled in Pegmatite (Xpg)					

Source: Selected Hydrologic Data, Chester County, Pennsylvania - U.S. Geologic Survey, 1976

In *Ground Water Resources of Chester County, Pennsylvania*, prepared by the US Geological Survey in 1977, eight generalized water quality areas were assigned countywide by three parameters, water Ph, specific conductance, and hardness. The Ph value is a measure that describes acidity or alkalinity of a substance. A measure of 7 is neutral, with lower measurements being acidic and higher measurements being alkaline. Specific conductance is a measure of the ability of a liquid to conduct an electrical current, that measure being in proportion to the amount of dissolved solids within the liquid. Measures of 0-150 signify very low dissolved solids, 151-250 low dissolved solids, 251-750 moderate dissolved solids, and a measure above 750 indicates a high degree of dissolved solids. The Pennsylvania Safe Drinking Water Act (Chapter 109) enforces the Federal standards for water quality. The Federal standards recommend a limit of 500 in total dissolved solids (TDS) for drinking water. Since a limit of total dissolved solids is mainly a degree of taste, water above this value may be safe to drink. Other factors would have to be considered to determine potability. Hardness in water is caused by the presence of alkaline minerals, chiefly calcium and magnesium. Although hard water is not generally a quality problem, it can create problems by leaving behind deposits and incrustation on plumbing hardware or other items in contact with it. Soft water generally has a value between 0 and 60, moderately hard water between 61 and 120, hard water between 121 and 180, and very hard water has a hardness value above 180.

The water quality areas generally coincide with the geologic formations of the Township. A description of the water quality areas are shown on **Figure 4-4**.

Figure 4-4: New Garden Township Water Quality Areas

Area Number	pH		Specific Conductance		Hardness	
	Range	Median	Range	Median	Range	Median
4	5.6-8.3	6.3	50-600	170	9-210	60
5	5.4-8.0	7.3	120-1100	425	30-520	210
6	4.8-7.9	6.1	20-150	120	9-420	40
8	5.7-6.0	6.0	600-980	725	210-350	260

Source: Ground Water Resources of Chester County, Pennsylvania - U.S. Geological Survey, 1977.

Water quality area designations are only generalizations of water quality based on only a few parameters. The numbers do not necessarily represent any scale or degree of quality, although areas 7 and 8 tend to be

either highly acidic or highly alkaline and generally are higher in dissolved solids. The water quality area number 8 in New Garden Township is an area in which abnormally high specific conductance has been measured in relation to the surrounding area. A well in this area was sampled and the chemical analyses showed both nitrate and dissolved solids above recommended limits.

FLOODPLAINS AND ALLUVIAL SOILS

Associated with the watersheds and drainage basins of New Garden are the areas of floodplain and wet, or alluvial soils. These areas are predominantly located along the streams that drain the Township. Floodplain and areas of alluvial soils are other factors to be considered when examining development potential.

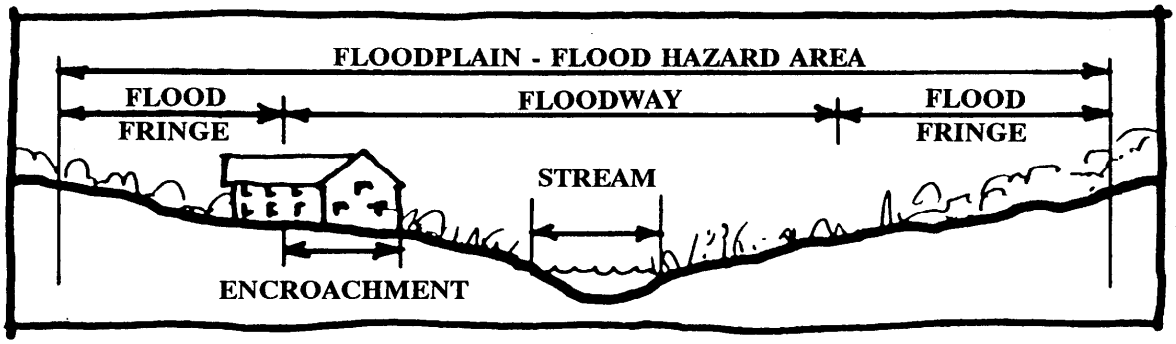
Floodplains

Floodplain areas, when undisturbed and open, not only provide for the conveyance of floodwaters with little risk of loss of life or property, but also offer temporary "storage" of floodwaters, slowing them down to further minimize downstream flood damage while promoting groundwater recharge. Naturally vegetated floodplain areas help catch and filter sediments from floodwaters and reduce the velocity of sediment laden water. The natural vegetation of floodplains also filters water runoff by collecting and holding nutrients, chemicals, and other natural and man-made pollutants. Floodplains left in their natural state provide valuable wildlife habitat.

The floodplain areas of New Garden have been mapped by the Federal Emergency Management Agency (FEMA) as part of the National Flood Insurance Program. Floodplains are areas adjacent to watercourses that are covered by flood water during times of flooding. A 100-year floodplain is the area which has a 1 percent chance of being flooded during any one year, and which is typically used for regulatory purposes. Approximate 100-year floodplains are shown from the FEMA Flood Insurance Rate Maps. Detailed studies have not been performed to establish, through calculation, the extent of the 100-year floodplains. Approximate floodplains have not been indicated for all watercourses. Because of this, any development proposed in the area of watercourses by developers would require a calculated study of the 100-year floodplain by the developer until such time as detailed studies are performed by FEMA. This program must be implemented by municipalities in order to be eligible for insurance for their flood prone citizens. The floodplains within New Garden are shown on **Map 4-5.**

Development within the floodplain may constrict the area over which flood waters flow, resulting in increased flood damage downstream because of resultant increased flood velocities downstream while land disturbance within floodplain zones cause siltation in adjacent streams and threatens wildlife habitats. Increases in impervious surfacing, a result of development, increases the danger of flooding and contributes to stream pollution since stormwater flows directly into the waterway without filtering through soil. For these reasons floodplains are regulated in order to restrict development within the floodplain. Land uses, types of agriculture, removal of vegetation, placement of and types of sewage systems, and impervious coverage are examples of items that receive more stringent regulation within floodplains.

Figure 4-5: Floodplain Cross Section



Source: Chester County Planning Commission, 2003

Alluvial Soils

Alluvial soils are soils that have been transported and deposited in an area through the action of water. Most often, alluvial soils are deposited when surface water sources such as streams overflow their banks. The sediment in the water is then deposited in the area covered by the storm overflow. Most areas of alluvial soils are narrow and found immediately adjacent to streams, largely due to the presence of very steep slopes along most of the subsequent floodways. Because few first order streams have FEMA-mapped floodplains, the presence of alluvial soils can be used to define the extent of the floodplain in these unmapped areas. While alluvial soils may fall outside defined floodplain areas, these areas are also subject to flooding and should be treated with the same care as floodplain areas. Similar land controls of floodplain areas should be considered where alluvial soils are present. Soils classified as alluvial are listed in **Figure 4-2** and shown on **Map 4-5**.

Wetlands and Hydric Soils

Wetlands

Wetlands are unique natural components of the landscape that provide special functions and values. Areas classified as wetlands can help control flooding, increase recharge of groundwater aquifers, decrease pollution of water sources, along with providing special wildlife habitat and aesthetic qualities. Due to this array of valuable functions, wetlands should be considered a valuable part of the natural environment. Wetlands are also protected under federal and state law, so their consideration is of vital importance to municipalities.

Wetlands are defined by three distinct properties; the presence of typical "wetland" soils (often referred to as hydric soils), the presence of a hydrologic condition, and the ability to support vegetation suited to life in saturated soil conditions. Due to the complexity of determining the presence of these characteristics, wetlands can only be legally delineated by a site specific survey. Because of this, actual wetlands can not be mapped in an inventory such as this. However, there are several features which only indicate the possibility of wetlands, but are still useful in determining areas where wetlands are likely to occur.

One indicator source of the presence of wetlands is the National Wetland Inventory (NWI), prepared by the US Fish and Wildlife Service. Despite the title, this series of maps is not a source of delineated wetlands, only an indicator of potential wetland areas. These maps were prepared using stereoscopic analysis of high-altitude photography and show potential wetland areas which are generally larger than 1 or 2 acres in size. Since wetlands can certainly be smaller in area than two acres, this is not a complete indicator. A detailed on the ground and historical analysis of any site may result in a revision of the wetland boundaries, and it is

possible that small wetlands and those obscured by dense forest cover may not be identified. According to the NWI maps covering New Garden, potential wetlands are fairly well scattered throughout the Township, but generally are located next to or in close proximity to surface water resources. In most cases, wetlands are confined to the area abutting the watercourse, as indicated by a linear wetland designation along Broad Run, Walnut Run, White Clay Creek, Egypt Run, Red Clay Creek, Bucktoe Creek, Trout Run, and tributaries to those streams. (See: **Map 4-5**)

Hydric Soils

Another wetland indicator source is hydric soils. These soils were formed under saturated conditions. The presence of hydric soils is a good, but not absolute indicator that an area is a wetland. They can easily be mapped and provide a preliminary indicator of possible wetland presence. Hydric soils are generally found along watercourses within the Township, though there are isolated areas of hydric soils. In some cases, the hydric soils overlap with wetlands and/or floodplains. The areas of hydric soil are more extensive than the wetland areas. Hydric soils existing in New Garden are shown in **Figure 4-2** and on **Map 4-5**. Hydric soils have been mapped from the *Soil Survey, Chester and Delaware Counties, Pennsylvania* and *Hydric Soils of Pennsylvania* by the US Department of Agriculture Soil Conservation Service, and indicate areas of potential wetlands.

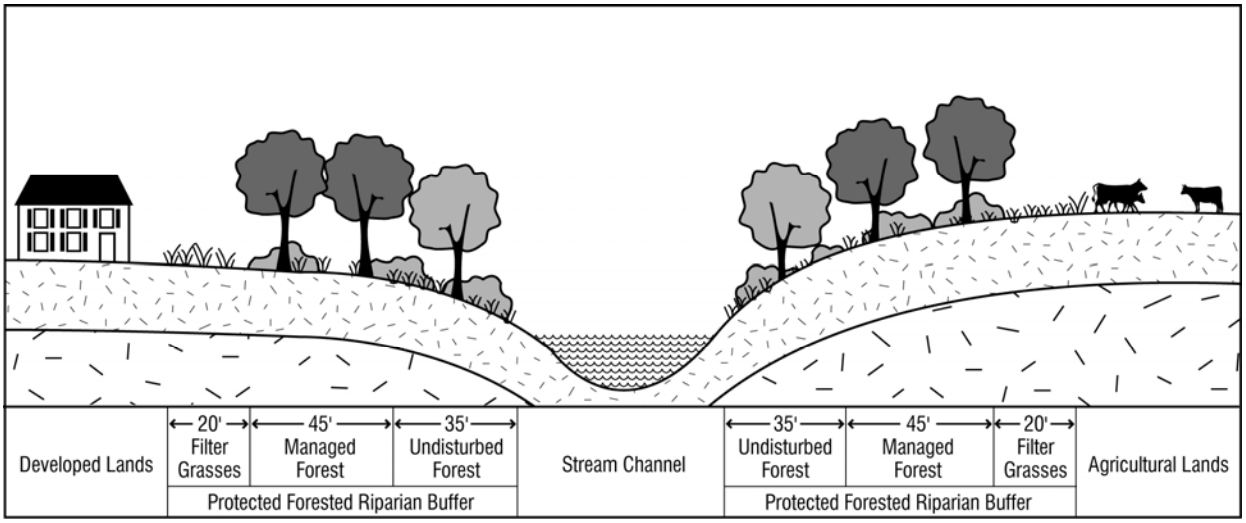
Hydric or wet soils contain high amounts of moisture, are very poorly drained, and are typically found within floodplain and wetland areas. Hydric soils are typically associated with headwater areas, are found in low-lying areas, at the fringes of floodplains, and sometimes in upland depressions. These soils have occasional standing water and a generally shallow depth to the underground water table. Lacking detailed wetlands mapping, hydric soils are an indicator of where wetlands are likely to be located. The hydric soils shown on **Map 4-5**, though generalized in nature, offer a mapped “pointer” for potential wetlands investigation sites.

Hydric soils provide a rich habitat for a diversity of plants and animals. Naturally vegetated areas with wet soils provide a critical filter for sediments and pollutants. Hydric soils are a significant indicator of locations where chronic or occasional wetness may weaken foundations or otherwise inhibit construction. Potential development problems associated with hydric soils include failed on-lot septic systems, flooded basements, poor foundation stability, disturbance of natural drainage and groundwater recharge areas, and the risk of surface and ground water contamination. With these problems in mind, development should be limited on hydric soils or precluded if a given location is determined to be a wetland. Where development is permitted, precautions should be taken to avoid negative impacts to drainage patterns on and off a development site. In addition, appropriate construction techniques should be employed that avoid damage to foundations and water seepage into dwellings.

Riparian Buffers

Riparian buffers are extremely important for protecting water quality. A continuous and inter-connected network of riparian buffers is essential to stream quality and the health of the ecosystem. Forested buffers along stream banks protect their waters from direct sunlight and resulting high temperatures, provide materials in the stream that serve as food and shelter for aquatic species, and stabilize stream banks, stream channels, and floodplains from the scour and erosion of high velocity flows. Riparian vegetation also serves to filter sediment and pollutants from overland runoff and stormwater.

Figure 4-6: Riparian Stream Buffer



Source: **Watersheds**: An Integrated Water Resources Plan for Chester County, Chester County Water Resources Authority, May 2002

New Garden does not require riparian buffers in the zoning or subdivision and land development ordinances. As part of the NPDES Phase II program, New Garden will need to consider riparian buffer protection standards within these regulations. See page 11-7 for more information.

BIOTIC RESOURCES

Biotic resources consist of the plant and wildlife of the Township and their habitats. This section discusses the importance of maintaining natural diversity and describes the major habitat areas as well as significant plants and animals that have been identified for special protection.

Woodlands

Several large expanses of woodlands occur within New Garden Township, predominantly in the southern portion of the Township. Major woodland areas are located on the southern edge of Broad Run Road and western edge of Buttonwood Road, near the Somerset Lakes development. Others are found near the intersection of Bucktoe and Sharp Road, the western side of Penn Green Road above Auburn Road, and west of Cedar Spring Road and south of Pemberton Road. Woodlands are also found along many of the stream corridors within the Township. (See: **Map 4-2**)

Woodlands perform many valuable functions important to soil, water, and climate resources. Wooded areas slow the velocity of stormwater thereby allowing water to filter into the soil and recharge groundwater supplies. Plants use water pollutants for nutrients while organic debris is caught by forest floor vegetation. Trees also help stop erosion by securing soil and reducing the impact of falling precipitation upon the earth. The micro-climate of a small localized area is immensely effected by vegetation. Trees and other vegetation act as a buffer to help diffuse extremes in temperature and moisture. Woodlands often act as transition zones between open areas and provide valuable habitat for a variety of plants and animals, as well as an aesthetic character for the overall landscape. To retain woodlands and these functions as a critical part of New Garden Township, land use controls on land disturbance and tree removal are important considerations.

Woodlands are also critical in maintaining natural diversity and provide vital habitat for native vegetation and wildlife. Large and mature forest stands, even though greatly altered by humans over time, are likely to support a considerable variety of species which would not occur in other habitats. Certain species of forest plants and wildlife depend specifically on the unique conditions of a healthy forest ecosystem. Many species of songbirds, particularly the colorful warblers, are specifically adapted to forest interior conditions and will not nest elsewhere. In addition, numerous species of wildflowers will only bloom on the rich, moist soils of the forest floor. These are only two examples of the critical role forest stands play in sustaining the natural diversity of the landscape.

Currently, two serious problems that affect the long term health and quality of woodland ecosystems are infestations of invasive, non-native plant species and high white tailed deer populations. Like much of Chester County, woodlands are being overrun by aggressive, introduced non-native species. Because of their rapid growth, adaptability, propensity to reproduce, and a lack of control mechanisms found in the environment, species such as Norway Maple, Multi-flora Rose, Autumn Olive, Oriental Bittersweet, Japanese Honeysuckle, and Mile-a-Minute Weed are out-competing many native species and becoming the dominant species of the area. While providing cover and food for some wildlife, introduced invasive species have supplanted much of the native vegetation, resulting in a reduction of plant and wildlife diversity.

Non-native species impair forest regeneration by creating such dense masses that tree species will not grow or their growth is retarded. They replace native understory species by creating such dense growth that nothing can grow underneath it. Multi-flora rose, where it grows along streams, is detrimental to the stream ecosystem because its foliage is unsuitable as a food source and it limits the amount of suitable leaf litter reaching the stream.

The white tail deer population has exploded for several reasons relating to human activities. Agriculture and suburbanization have provided excellent deer habitat in the form of “edge” conditions and browse areas. Several of the introduced, invasive plant species provide an excellent food source and natural deer predators have been eliminated. The increased deer population threatens the lands carrying capacity because of increased browsing in forests for the buds, seedlings, and shoots of native species. This browsing prevents the forest from being able to regenerate itself. While this problem will likely correct itself through the eventual starvation of deer, it presents a long term problem for forests because it favors further establishment of aggressive, non-native plant species, further reducing biodiversity.

Hedgerows

Hedgerows are one of the most important features in a farm landscape and, while decreasing in quality and quantity, they do exist. Hedgerows and thickets are often found defining property lines, lining roads, protecting small streams and drainage ways, and defining pastures or fields within a single property. Hedgerows provide important habitat areas in the form of cover and food for many small birds and mammals. Fields and meadows possessing hedgerows support a more varied and higher population of wildlife than those which do not have hedgerows. Hedgerows are also effective in moderating local climate by reducing wind speeds and interrupting wind currents. Wind-chill and quick frost problems can be significantly reduced by hedgerows. Wind reduction also slows wind erosion of soil and slows the evaporation of water from soil, crops, and landscaping. Finally, hedgerows are even more threatened by non-native invasive species than are woodlands. Because the invasive species thrive in high light conditions, the understory is almost exclusively dominated by invasive species such as multi-flora rose, oriental bittersweet, japanese honeysuckle, and mile-a-minute weed. The tree component of hedgerows remains dominated by native species such as black cherry, red mulberry, tulip poplar, and sassafras. Because of the valuable habitat and climate control hedgerows offer, the preservation of the Township's remaining hedgerows should be encouraged.

Open Lands

Open lands, including fields, meadows, and pastures, are also an important habitat for plants and animals. While these are the only habitats created through regular maintenance, they add to the overall bio-diversity of New Garden. Meadows often have a variety of native grass, sedge, and wildflower species providing a source of seeds, herbaceous material, and insects for local wildlife. Where fields and meadows are situated next to woodlands, the edge between the habitat types provides a unique combination of food and cover for wildlife. Fields provide food and habitat for browsers, rodents, and many species of birds. Many species of wildlife pick over the stubble of fields in search of lost seeds and grains. This is a particularly important food source in the fall and winter when other sources of food are scarce.

PNDI Sites

The Pennsylvania Natural Diversity Index (PNDI) provides site specific information describing significant natural resources of the Commonwealth. The inventory contains information on the locations of rare, threatened, and endangered species and of the highest quality natural areas in the County. A detailed study of these sites was compiled and written by the Pennsylvania Science Office of the Nature Conservancy and published by the Chester County Planning Commission in a document entitled *Chester County Natural Areas Inventory* (1994). (See: **Map 4-2**)

Although there are several PNDI sites located in the White Clay Creek and Red Clay Creek watersheds, only one PNDI site was identified in New Garden, Site SP 517: Bucktoe Creek Woods. However, the Township does contain a number of small, but special habitats that are worthy of protection. Locally important vegetation which has been identified by the Township includes the mature hardwood woodland along Penn Green Road north of Landenberg, a beech tree located at a bend on Sharp Road, and an oak tree located at the intersection of Buttonwood Road and Newark Road. This vegetation is important as visual resources to the Township residents, who enjoy viewing the woodland and trees. The woodland along Penn Green Road also serves the functions noted above for woodland. Such habitats are both natural and historic resources and are worthy of preservation.

There are a wide variety of plants and animals specific to each of these areas. Although the habitats are not rare to Pennsylvania, the bio-diversity of species they represent make them important natural resources in the Township. Many of these special habitats can be preserved through the protection of a full range of natural resources (streams, floodplains, wetlands, woodlands, etc.) that, in combination, comprise the majority of the habitats.

SCENIC RESOURCES

Scenic resources are those areas of New Garden that offer scenic vistas or have scenic value, such as: natural or cultural features (churches, trees, fields, mountains, stream corridors, scenic roads, vista points), and parts of the community that contribute to its general character (covered bridge, cultural and historic sites). Scenic resources are important for maintaining the character, uniqueness, and local heritage of the Township. The preservation of scenic resources is closely interrelated with the protection of open space, forestland, natural resources, and cultural resources as many of these features also create the scenic quality of the Township.

Scenic Vistas

The overall impression of New Garden is one of a rural, open community composed of rolling hills. Points of high elevation provide vistas over lower areas and lower elevations provide views of the rolling hills. Roadways are the primary means of visually accessing scenic resources and open space. In the urban area of the Township, where natural features and open space are limited, scenic resources can still be found in the built environment. New Garden is a community with respect for heritage and the land. Within the valleys are enclaves of development. Many of the older homes have historical value. The open, sloping nature of much of the Township provides numerous opportunities to view areas both inside and outside of New Garden. From the ridge tops, there are panoramic views of other ridges and long vistas of distant communities. As a practical matter, not every view can be preserved, however, efforts should be made to identify the most important views and vistas for possible preservation.

A number of scenic vistas in the Township have been identified by the Township:

- Looking northward from Line Road east of Newark Road, farm fields and wooded hillsides can be viewed.
- From Church Road, near Sherwood Drive, a landscape of farm fields, fields, and wooded hillsides can be viewed to the north.
- A view of farm fields and woods is available looking west from Church Road, south of Polo Road.
- Looking west from Sharp Road, south of Hillendale Road, woodland and farm fields can be viewed.
- To the north, from Sharp Road near a bend north of Gap-Newport Pike, a view of woods, hills, and fields is available.
- Pleasing countryside of farm fields, fields, woods, and hillside can be seen to the north from Starr Road west of Newark Road.
- Wooded hillside and fields can be viewed looking west from Ellicott Road near Starr Road.
- An extensive view of wooded hillsides with interspersed farm fields is available looking to the north from Laurel Heights Road between Walnut Run Road and Skyline Drive.
- To the west, from the area of the intersection of Newark and Broad Run Roads, a landscape of farm fields, fields, hillsides, and wooded areas can be viewed.
- A landscape similar to that noted above can be seen looking south from Buttonwood Road between Broad Run Road and Newark Road.
- The final scenic vista is located along Mercer Mill Road, outside the Township. Looking northeast toward Landenberg, the village can be viewed where not blocked by trees.

Scenic Roads

Scenic roads are predominant in New Garden where they, by necessity, follow the strong natural features of the land along streams or over the hillsides. Roads derive their scenic qualities from the curves, rises, dips, adjacent natural features, and an ever-changing point of perspective of the roads that give them definition. In many instances, it is a combination of a graceful path and roadside scenery that give a road its scenic value. Scenic roads and their associated vistas should be preserved because they provide texture

to the Township, as well reflect a quality of life and sense of place. New development can easily impact or obstruct the viewshed. Development may occur in these areas, but sensitive siting and alternative lot configurations should be pursued. For example, the clearing of forested ridgelines should be discouraged, and buildings should not extend above ridge lines.

The following scenic roadways have been identified by the Township:

- Broad Run Road, a local road, between Newark Road and Southwood Road has been designated as a scenic road. Initially, attractive farm area is found along the road. Then, tree rows line the road closely. Driving the road provides a particularly pleasant rural experience.

- Penn Green Road, a local road, from Laurel Heights Road to the southern Township boundary provides a variety of views. It is bordered by mature hardwood woodland and streams south to Chesterville Road. Then one comes upon the historic village of Landenberg. South of Landenberg, woodland, streams, and meadows are viewed.

- Laurel Heights Road, a local road, between Walnut Run Road and Skyline Drive is bordered by attractive farm areas.

- Bucktoe Road, a local road, from west of Sharp Road to the eastern Township boundary presents views of woodland, stream, and meadow.

- Hillendale Road, a minor collector, from Sharp Road to Chambers Road is bordered by woodland and rural homesteads. The road is nicely paved and pleasant to drive.

- Polo Road, a local road, presents views of farmland, polo fields, and woodland, as one travels from Newark Road to Church Road.

The above-listed scenic roads provide pleasant driving experiences for people in the Township. If the woodlands, stream corridors, and farmlands along the roads can be maintained, these roads will continue as scenic roads in the future.

REGIONAL EFFORTS

Kennett Area Regional Planning Commission

The Kennett Area Regional Planning Commission (KARPC) includes the Townships of Kennett, Pocopson, Pennsbury, East Marlborough, and New Garden and the Borough of Kennett Square. Although New Garden Township is a member of the Kennett Area Region, they chose not to participate in the regional planning effort and the data presented in the plan did not include New Garden. The KARPC was formally established in 1988 to discuss common problems and foster multi-municipal cooperation. As a step towards better overall coordination of regional land use planning, the KARPC determined that a common set of regional policies was needed. To address that need, a policy plan was developed by the KARPC and endorsed by its participating members. Following the completion of that effort, the KARPC embarked on the establishment of a Regional Comprehensive Plan to look in more depth at the multitude of planning and growth management issues facing the Region and to determine how to best address those issues and achieve common goals through mutual cooperation.

Christina River Basin Study, (1998)

The Phase I and II Report of the Christina River Basin Water Quality Management Strategy was published in May 1998. The purpose of the study is to improve the water quality of the Christina Basin streams which provide drinking water for over a half-million people in Pennsylvania, Maryland, and Delaware. The Phase I and II Report includes a number of recommendations that are considered "interim" pending the completion of the 5-year water quality strategy that is expected to culminate with the completion of a watershed management plan and the adoption of "Total Maximum Daily Loads" of the major streams of the Christina River Basin. Once the Total Maximum Daily Load Model sets specific goals in point and non-point source loads, a specific strategy of Best Management Practices (BMPs) can be established and implemented in the Christina Basin.

Watersheds**:** *An Integrated Water Resources Management Plan for Chester County, Pennsylvania and Its Watersheds*, (2002)

The Chester County Board of Commissioners adopted ***Watersheds****: An Integrated Water Resources Management Plan for Chester County, Pennsylvania and Its Watersheds* in 2002. This plan will serve as a functional element of the County's policy plan, ***Landscapes***. The purpose of the Plan is to assist local governments and other entities in more effectively integrating water resources and land use decisions. It provides scientifically sound goals, objectives, and strategies for accommodating existing land uses and planned growth while maintaining the integrity of Chester County's watershed resources. The Plan includes extensive background information to provide a better understanding of how watersheds work and the current state of water related issues in the County. Most importantly for New Garden, the Plan includes numerous implementation strategies for municipalities to more effectively protect and manage water resources while accommodating planned growth.

Linking Landscapes**:** *The Plan for the Protected Open Space Network in Chester County, PA*

The Chester County Commissioners also adopted ***Linking Landscape****s* in 2002 that serves as the Open Space Element of the Chester County Policy Plan, ***Landscapes*** (1996). ***Linking Landscapes*** provides a vision for multi-municipal open space planning on a countywide basis. It presents a set of actions to coordinate the activities of various County government departments as well as providing municipalities with general guidelines they can use to responsibly protect open space. Open spaces function best if they are linked together and do not become isolated islands surrounded by development. The Plan focuses not only on planning and protecting open spaces, but also on restoring and maintaining them so as to ensure that they will retain their ecological and recreational qualities in perpetuity. ***Linking Landscapes*** includes several elements that are designed specifically to assist municipalities in their local planning efforts. For example, it includes language intended to assist municipalities and local organizations in filling out applications for state and federal grant programs. The Plan also provides guidance on open space protection techniques, trail planning and development, protection of sensitive resources, municipal park planning, and many other open space and resource protection related topics.

Red Clay Creek Groundwater Studies, (1993 and 1996)

Extensive studies of the Red Clay Creek Basin have been undertaken by the US Geological Survey in cooperation with the Red Clay Valley Association and the Chester County Water Resources Authority. The first study, published in 1993, described the geohydrology of the aquifer in the Red Clay Creek basin in Pennsylvania and Delaware. The report presents a simulation of groundwater flow in the basin and summarizes water quality data. Although the results of the groundwater flow simulation from this study was questionable, the collected data can be used as a baseline for continuing assessment of groundwater quality in the basin. The second Red Clay Creek study was published in 1996 and describes the

relationship between groundwater quality and hydrogeologic and land use factors and surface water quality. The study found that concentrations of nitrate, sodium, and chloride and the frequency of pesticide detection was related to differences in land uses and human activities. For example, nitrate concentrations were generally greatest in agricultural and in industrial and commercial areas. An observed increase from 1970 to 1995 in nitrate concentration in base flow at the long-term monitoring station on the West Branch Red Clay Creek may be due to increases in nitrate concentrations in the groundwater. Because groundwater discharges to streams, the chemical composition of base flow is related to groundwater quality. The study concluded that changes in land use may result in changes to the groundwater system and ultimately in changes in base flow water quality. Based on the results of these previous studies, the Red Clay Valley Association has developed a pc-based groundwater flow model. This tool is suitable for use by local planners to evaluate the potential impacts of proposed withdrawal and land application projects.

Red Clay Valley Association

The Red Clay Valley Association, the second oldest small watershed organization in America, was founded in 1952 by a group of Delaware and Pennsylvania residents for the purpose of protection and conservation of the natural resources in the Red Clay Watershed. The Red Clay Valley, through which 43 million gallons of water flow daily, encompasses fifty-five square miles of rolling hills, woodlands, and farms in Chester County, Pennsylvania and New Castle County, Delaware. The valley is the home of nearly 50,000 people who live in small towns and suburban and rural settings, as well as to businesses, parks, recreation sites and many of the world's famous mushroom farms.

White Clay Creek Watershed Association

The White Clay Watershed Association is a non-profit community organization dedicated to the protection and improvement of the environmental quality of the White Clay Creek and valley. The Association works to improve water quality in local streams, conserve open space, woodlands, wetlands and geological features; protect rare native plant and animal species; aid in the preservation of cultural, historical and archaeological sites; increase outdoor recreation opportunities; and conducts educational programs relating to the environment. The Association encourages municipalities, through planning, zoning and innovative waste and storm water management, to minimize practices and uses of land that harm the watershed's natural resources, or reduce its environmental quality. The Association strives to increase public awareness of environmental issues in the watershed. It works with local government and community leaders to secure changes needed to maintain high standards of natural resource management in the watershed. It seeks to make the area a better place to live and work. The work of the White Clay Watershed Association is done by volunteers. Technical assistance is obtained from local experts in science, education, law and government. The breadth of the Association's work accommodates a heterogeneous membership. Generally, the common thread of interest among members is in preserving and improving the area as a desirable place to live and work.

PLANNING IMPLICATIONS

The natural resources of New Garden Township as they relate to planning have been thoroughly explored in this section of the Plan. The following are key issues that will be addressed throughout the recommendation sections of the Plan:

- **Water Resources -** Planning and management of water resources is most effectively carried out at the watershed level. New Garden will need to monitor the watershed studies currently being

conducted to determine the implications for water resource protection and follow through with recommendations where appropriate.

- **Riparian Buffers -** The regulation of riparian buffers provides a number of important functions such as storage and filtering areas for surface waters, preventing and controlling water pollution, protecting aquatic life, and protecting buildings and lands from flooding and accelerated erosion. The Township needs to develop regulations for riparian buffers along the waterways, as well as, encourage the use of conservation management practices (CMPs) on lands adjacent to waterways.

- **Headwaters -** Protection of headwater areas is important for maintaining the overall quality of the watershed. Consideration will be given to how these areas can best be protected consistently throughout the Township.

- **Floodplains and Alluvial Soils -** Because disturbance of the floodplain creates a high potential for detrimental environmental impacts and threats to life and property, floodplains and areas of alluvial soils will need to remain undeveloped to the greatest extent possible. Floodplains should also be conserved for their potential scenic, public access, habitat, and recreational value in terms of the creation of trails and greenways, and as a means to control and manage erosion, sedimentation, and stormwater.

- **Wetlands and Hydric Soils -** Wetlands and areas of hydric soils are important ecosystems, providing both wildlife habitat and storage and filtering areas for ground and surface water. While regulated at the state and federal level, local requirements for identification and protection of wetlands is the most effective method for preserving this valuable resource.

- **Cockeysville Marble -** Because of its susceptibility to contamination and its high potential for groundwater yields, special protection measures are needed for the Cockeysville Marble formation. Standards for the protection of groundwater will need to be adopted.

- **Steep Slopes -** Limiting and controlling development of steep and very steep slopes is important for preventing erosion and sedimentation of streams. Standards for limiting the disturbance of steep slopes need to be adopted into all land use ordinances.

- **Prime Agricultural Soils -** Prime Agricultural Soils (Class I, II, and III), once developed, are lost forever for production. Unfortunately, the characteristics of these soils also make them most suitable for building. Measures for protecting this valuable economic and natural resource will need to be implemented, particularly in areas with continued active farming.

- **Habitats -** Protecting the variety of habitats in New Garden is vital to maintaining the natural diversity of plants and animals found here. Areas of contiguous woodlands, wooded stream corridors, wetlands, fields and pastures, and hedgerows are the primary vital habitats that need to be protected if the Township is to continue to maintain healthy ecosystems. Actions for addressing the issues of non-native invasive plant species and white tailed deer over-population will need to be considered.

- **Resource Protection -** To most effectively protect sensitive environmental resources, resource protection standards will need to be made consistent and include specific disturbance limits. The identification and protection of natural resources should be the primary determinant for the location of appropriate development.

- **Scenic Resources -** New Garden is blessed with a wide array of scenic resources. Scenic resource protection measures have not been implemented through land use regulations. The plan needs to consider protection measures for these scenic resources.

- **Education -** Consistent enforcement of natural resource protection standards and education of the public as to their existence is an important element of effective resource protection. Efforts need to be made to ensure residents know the reasons for and the basic regulations governing the use and disturbance of natural resources.

- **Regional Coordination -** Regional coordination for resource protection is essential. There is a need to coordinate the management of natural resources on a multi-municipal basis and adoption of a full range of natural resource protection standards to maximize the benefit for all communities in the region. Areas related to natural resources, where regional coordination will need to be considered, include stormwater management, water supply planning, and sewage facilities planning.