

Economic Resources

Beginning about the early 18th century humans began exploiting the rich deposits of iron, zinc and graphite in the Highlands. Within the region's Precambrian rocks, many mines have operated over the last 250 years, extracting materials that have played important roles in American history. The most famous is the role of iron. The presence of magnetite iron ore deposits throughout the Highlands allowed numerous mines to flourish, and at one time New Jersey led the nation in production. Much of the raw material went to producing stoves, steel, guns, and munitions for the Revolutionary War effort.

Iron mines operated throughout the Highlands of Sussex County. Additionally, zinc was mined in Ogdensburg and Franklin. Franklin Mine and Sterling Hill Mine in Ogdensburg are world famous for the minerals extracted there. More than three hundred different minerals were discovered at Franklin and Sterling Hill, of which forty-two were new to science.

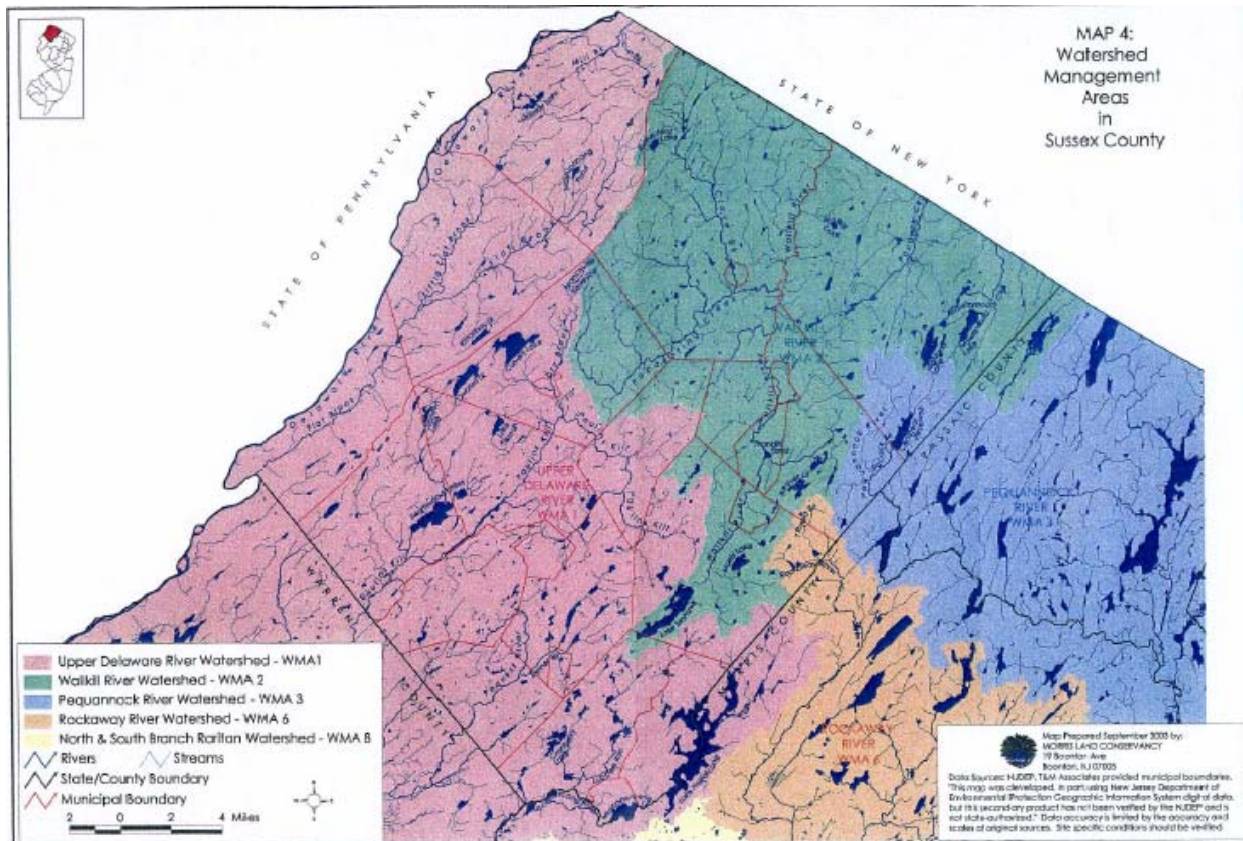
Quarries were also common throughout the Highlands, and to a lesser extent, the Ridge and Valley. Precambrian granite and gneiss were quarried for crushed stone at Hamburg; marble was quarried extensively in the Franklin area north to McAfee. Paleozoic limestone and slate were quarried at numerous locations in the Ridge and Valley. Glacial sand and gravel pits were mined in the Highlands and Ridge and Valley.

Water Resources

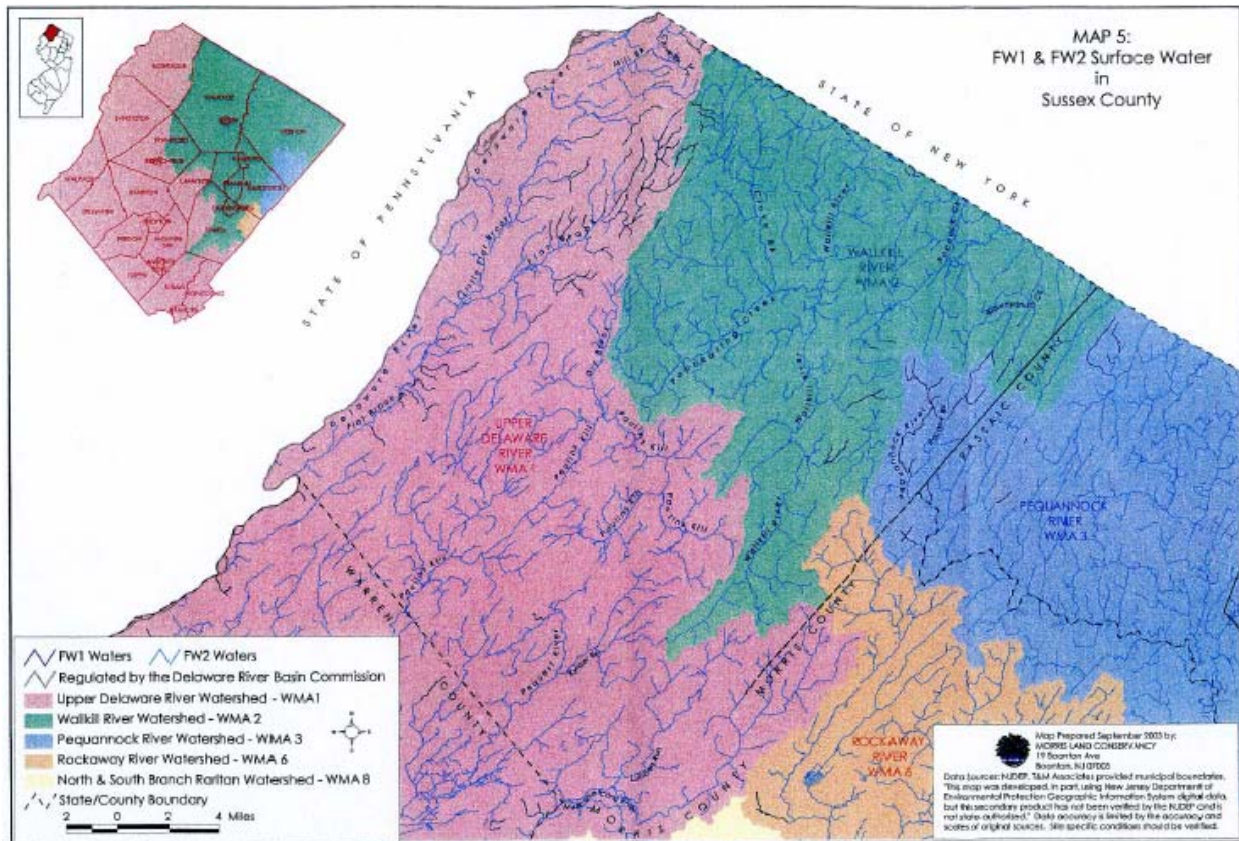
Surface Water

The New Jersey Department of Environmental Protection (NJDEP) has organized New Jersey into 20 Watershed Management Areas (WMA) based on physical characteristics and stream drainage patterns. Each WMA is named for one or more prominent rivers that drain that particular watershed. Each WMA contains several sub-watersheds that highlight the importance of smaller streams in delivering water to the larger waterways of the watershed. The logic of approaching water quality from a watershed perspective is apparent. Only by considering all actions in upstream locations that drain to a common waterway can the impact on the stream from development, wildlife populations and other natural and cultural actors be analyzed.

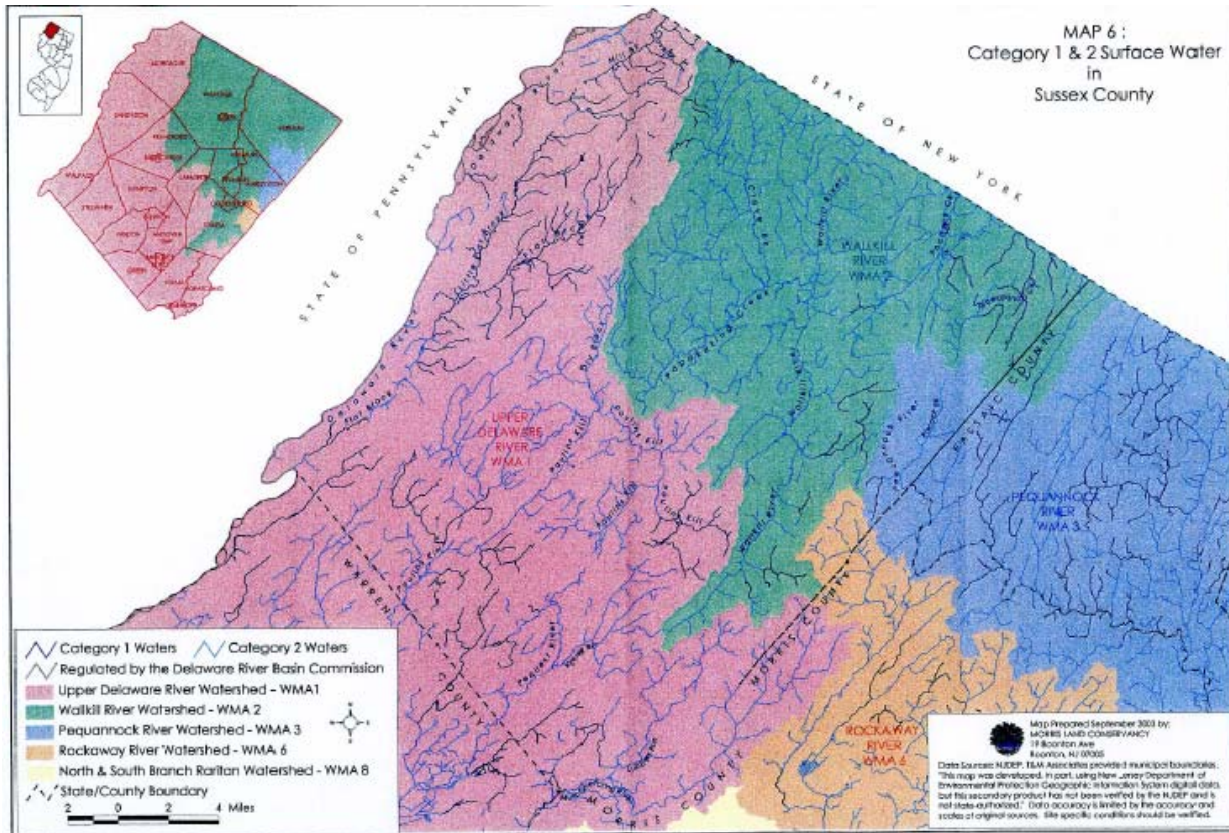
There are four WMAs within Sussex County. These areas delineate the principal stream systems that drain the county's land area. The largest watershed in the county by area is WMA 1, the Upper Delaware River Watershed. The waters of WMA 1 drain west and southwest to the Delaware River. Second in area in Sussex County is WMA 2, the Wallkill River Watershed. The Wallkill, which flows north into Orange County, New York, drains the north-central and northeastern section of Sussex County. WMA 3 (Pequannock River Watershed) and WMA 6 (Rockaway River Watershed) both drain to the southeast, and comprise small parts of the County. **Map 4: Watershed Management Areas in Sussex County** shows the location of Sussex County's four WMAs.



The Department of Environmental Protection has classified each of the state’s freshwater bodies as either FW1 (Fresh Water 1) or FW2 (Fresh Water 2). FW1 waters are those that possess exemplary natural significance, aesthetic value or water supply significance and are to be “maintained in their natural state of quality and not subjected to any manmade wastewater discharges.” These waters are all located wholly within publicly preserved lands. FW1 designation confers upon a water body the highest level of protection currently available in New Jersey. All other freshwater in New Jersey, with the exception of Pinelands waters, is classified as FW2. See **Map 5: FW1 and FW2 Surface Water in Sussex County.**



The designation of Category One (C1) and Category Two (C2) waters further defines surface water quality priorities. Surface waters can be named Category One based on a number of criteria including, but not limited to, scenic setting, recreational amenities, ecological significance, water supply significance and water clarity or color. Once established, Category One waters are protected from measurable decreases in water quality. Unlike FW1 waters, however, Category One waters can, and often do, contain wastewater discharges. Category Two waters include all “waters not designated as Outstanding National Resource Waters (FW1 and Pinelands waters) or Category One” waters. See **Map 6: Category 1 & 2 Surface Water in Sussex County**.

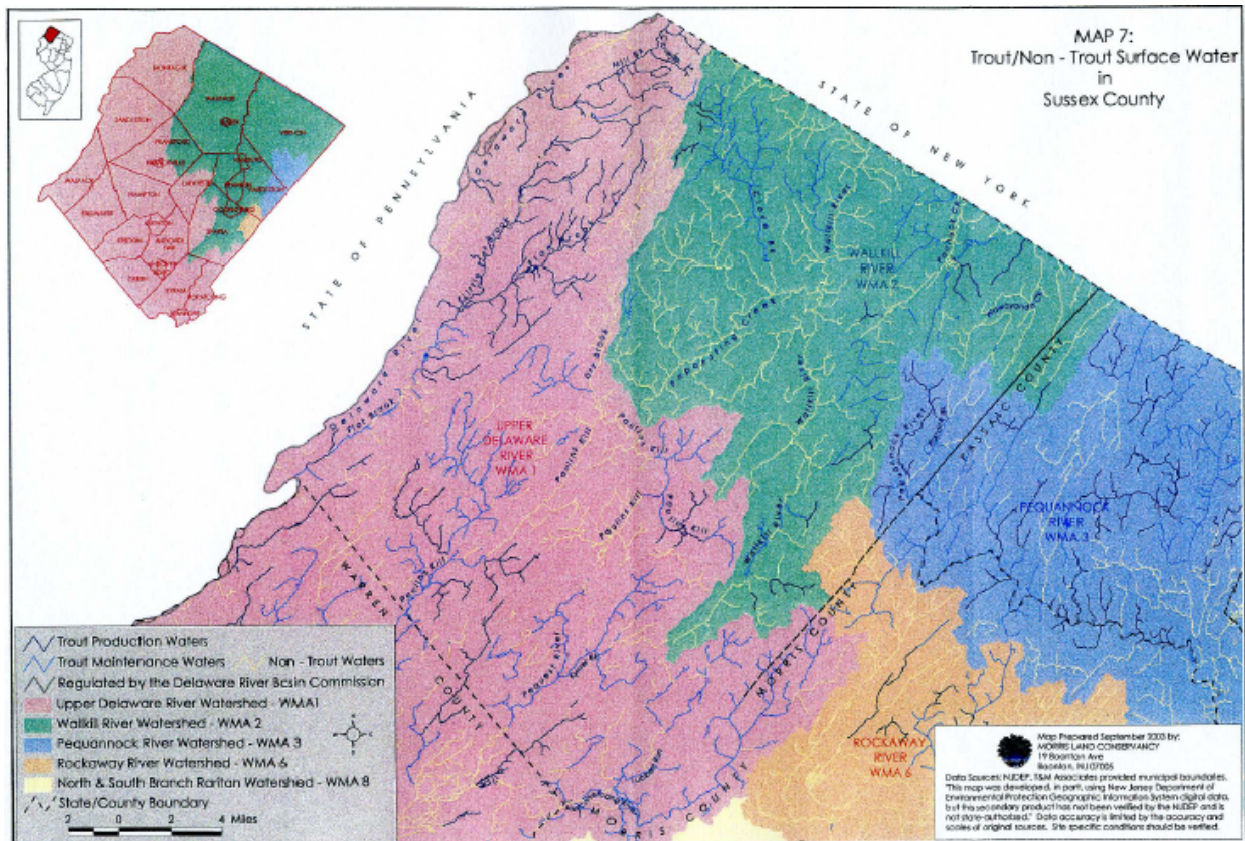


NJDEP has also classified all freshwater bodies in New Jersey as either “non-trout,” “trout maintenance” or “trout production.”

- “Non trout” waters are those that do not support trout because of physical, biological or chemical characteristics.
- “Trout-maintenance” waters are those that support trout throughout the year.
- “Trout production” waters are used by trout “for spawning or nursery purposes during their first summer.”

Trout is used as an indicator species for water quality because of its sensitivity to certain water quality factors, such as water temperature and dissolved oxygen. Trout presence in a stream, or its use of that stream for reproduction directs the state’s water quality goals for that particular stream segment.

The state has set three baseline water quality standards for the three “trout” classes. “Non-trout” waters are the least stringent and “trout production” waters are the most stringent. Criteria for the baselines include: dissolved oxygen; ammonia; temperature; and suspended solids. All waters must meet at least the minimum standards for its classification. See **Map 7: Trout/Non-Trout Surface Water in Sussex County** for the location of trout waters throughout the county.



The Delaware River is managed outside of the above-mentioned scheme, by the Delaware River Basin Commission (DRBC). The DRBC was established in 1961 to consolidate the management of the Delaware River and its drainage basin, which span 330 miles and four states. Roles of the Commission include: “water quality protection, water supply allocation, regulatory review (permitting), water conservation initiatives, watershed planning, drought management, flood control, and recreation.” The Delaware River is the longest un-dammed river east of the Mississippi.

Watershed Management Area 1 – Upper Delaware River

Located in the western and southern sections of Sussex County, the Upper Delaware River Watershed comprises greater than half of the county’s land area. All precipitation that falls within WMA 1 drains to the Delaware River. Principal waterways in Sussex County’s portion of WMA 1, listed north to south in the order in which they meet the Delaware River, include: the Flat Brook; the Paulins Kill; the Pequest River and a short stretch of the Musconetcong River. All of these waterways run southwesterly, roughly parallel to one another. See **Map 4**.

Montague and Sandyston contain the largest number of FW1 waterways. These streams are part of the Big and Little Flat Brook systems. The upper half of the Big Flat Brook flows through High Point State Park and Stokes State Forest. Clove Brook, and Mill

Brook also contain FW1 stretches. Further south in Walpack Township, tributaries of the Flat Brook draining the west slope of the Kittatinny Ridge have been designated FW1. See **Map 5**.

Category 1 freshwater bodies are located throughout WMA1. Almost the entire Flat Brook system is designated C1, as well as Mill Brook and Clove Brook in Montague Township. In addition, several stretches and tributaries of the Paulins Kill, Pequest River and Musconetcong River in Stillwater, Fredon, Green and Byram Townships have been designated as C1 waters. See **Map 6**.

The western slope of the Kittatinny Ridge is also where the highest concentration of trout waters can be found. Upstream of the confluence of the Big and Little Flat Brooks, both rivers are classified trout production waters. Other trout production waters include Clove Brook, which flows north into New York near Port Jervis, and branches of the Paulins Kill. Trout maintenance waters of WMA 1 include several stretches of the Flat Brook below the confluence of the Little Flat Brook and the Flat Brook, as well as parts of Pequest River, Kymer Brook, Lubbers Run and the Paulins Kill. See **Map 7**.

Watershed Management Area 2 – Wallkill River

The Wallkill River watershed occupies the northern and northeastern parts of Sussex County, extending south through Sparta and northern Byram Townships. The Wallkill River flows northeast into New York State, where it empties into the Hudson River near Kingston.

Major tributaries of the Wallkill River include Papakating Creek, which begins its run in Frankford Township, and Clove Brook, which flows south from northern Wantage Township. Pochuck Creek, which drains parts of Vernon and Hardyston Townships east of Pochuck Mountain, enter the Wallkill several miles into New York State. See **Map 4**.

Hamburg Mountain Wildlife Management Area in Vernon and Hardyston Townships contains FW1-classified streams. Small sections of Waywayanda Creek and the headwaters of Pochuck Creek also contain FW1 waters. The upper reaches of Clove Brook in Wantage Township are classified as FW1. See **Map 5**.

Clove Brook in Wantage also has C1 classifications in the northwestern corner of the Township. In Vernon, parts of Pochuck Creek and Waywayanda Creek have been designated C1 waters. Additionally, tributaries of the Wallkill River draining Sparta and Hamburg mountains are designated C1. See **Map 6**.

The Wallkill River and the majority of its tributaries are non-trout streams. The exceptions are those tributaries that drain forested, hilly areas. Clove Brook and its tributaries in Wantage are trout maintenance waters. Several branches of Black Creek in Vernon are also trout maintenance waters. Several branches of Waywayanda Creek are trout production waters. See **Map 7**.

Watershed Management Area 3 – Pequannock River

The Pequannock River Watershed occupies a small area of eastern Sussex County. Flowing south out of Vernon Township, the Pequannock River continues into Hardyston Township where it turns southeast, forming the border between Morris and Passaic Counties. The Pequannock's confluence with the Passaic River occurs at the eastern end of Great Piece Meadows, where Morris, Passaic and Essex counties meet. For most of its run in Sussex County the Pequannock River flows through Newark's water supply management lands. Although these lands are not protected in perpetuity, there is a current state moratorium on the sale of water supply management lands. The Pequannock contains relatively few tributaries in Sussex County. See **Map 4**.

A stretch of the upper Pacack Brook and almost the entire main stem of the Pequannock River in Sussex County are classified as FW1 streams. A tributary to the Pequannock, located in Hardyston Township, has been designated a C1 stream. The entire main stem of the Pequannock contains trout production waters. Its few tributaries in Sussex County are mostly classified as trout production and trout maintenance waters, except for the waters that flow into Canistear Reservoir. See **Map 5, 6 and 7**.

Watershed Management Area 6 – Rockaway River

Although the Rockaway River itself begins in Jefferson Township, the river system's upper reaches are in eastern Sparta Township, where several streams merge to form Russia Brook. Russia Brook flows into Jefferson where it meets the Rockaway below Lake Swannanoa. From there the Rockaway River flows to the Passaic River. See **Map 4**.

None of the Rockaway River's tributaries in Sussex County contain a C1 or FW1 designation. Additionally, they are all classified as "non-trout." See **Maps 5, 6 and 7**.

Reservoirs and Lakes

Sussex County's lakes are found generally in two areas of the county: along the eastern slope of the Kittatinny Ridge and in the Highlands province of eastern Sussex County. It is here that topography and geology support the development of lakes.

Most of Sussex County's lakes serve recreational purposes, and were developed as vacation areas in years past. The most prominent lakes in the county are Lake Hopatcong, Culvers Lake, Lake Owassa, Big Swartswood Lake, Lake Mohawk, Highland Lake, and Wawayanda Lake. Lake Hopatcong is the largest lake in New Jersey.

In addition to the larger recreational lakes just mentioned, the five following surface water bodies are used for potable water supply purposes. See **Map 4**.

- Morris Lake, in Sparta – used by Newton.
- Lake Rutherford, in Wantage – used by Sussex Borough.
- Branchville Reservoir, in Frankford – used by Branchville.
- Franklin Pond, in Franklin – used by Franklin as an emergency water supply.
- Lake Hopatcong - an emergency water supply for several towns.
- Canistear Reservoir, in Vernon – contained on the Newark water supply management lands.
- Heaters Pond, in Ogdensburg – an emergency water supply

Groundwater

Groundwater is any precipitation that percolates into the soil. Groundwater recharge is water that moves as subsurface runoff to wetlands, springs, streams etc., or into water filled layers of porous geologic formations called aquifers. In New Jersey, aquifers might be a few feet below the surface of the Earth, or several hundred feet underground, depending on underlying geologic formations. The rate at which groundwater reaches an aquifer is influenced by natural features such as soil type and bedrock geology. Human influence also has an affect; impervious surfaces, for example, will change the way water flows or will prevent storm water from soaking directly into the ground to become groundwater.

Approximately 95% of Sussex County residents rely on groundwater for consumption. Groundwater is pumped to County residents from aquifers through either private on-site wells, community wells, or municipal wells. The long-term sustainability of the county's groundwater supply will depend on safeguarding water quality and quantity by employing the proper land use practices in areas with high groundwater recharge and aquifer productivity. Safeguarding community and municipal well heads is also an important component of long-term sustainability.

Groundwater Recharge

Groundwater recharge has been estimated by the New Jersey Geological Survey using 1995/97 Landuse/Landcover data, soils data, and local climatological data. This information was combined to generate an estimated groundwater recharge in inches per year, which was then converted to a ranking system of eight categories (A-E, L, W and X).

The highest estimated recharge occurs in two parallel belts through the county. See **Map 8: Groundwater Recharge in Sussex County**. The first runs northeasterly through the western margin of the county, in Walpack Valley and the Upper Delaware Valley. The largest areas of that belt are located in northwestern Sandyston and western Montague Townships. The second belt runs northeasterly through the east-central region of the county, along the base of Sparta, Hamburg and Wawayanda mountains. This belt is