Natural Resources

Physiography

Physiography is the study of a location in relation to its underlying geology. New Jersey is characterized by five physiographic provinces (see **Figure 2: The Physiographic Regions of New Jersey**). The rocky terrain of the Appalachian Province is at one extreme and the sands of the coast are at the other.

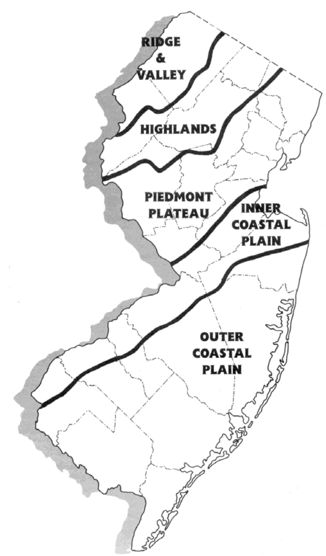


Figure 2: The Physiographic Regions of New Jersey

Source: NJDEP

The Atlantic Coastal Plain landscape extends from Massachusetts to Texas and is divided into Inner and Outer sections. The Coastal Plain generally consists of unconsolidated sands, silts, and clays. As these sediments are prone to erosion, the Coastal Plain is generally characterized by regions of low topographic relief.

Moorestown Township is completely located in the Inner Coastal Plain of New Jersey. In New Jersey, the Inner Coastal Plain is made up of inter-bedded sand and clay. Deposits originating in the breakdown of Appalachian and Catskill sedimentary, metamorphic, and igneous rocks are inter-bedded with layers formed by oceanic (marine) deposition, which occurred as the ocean shoreline advanced and receded over geologic time.

The Inner Plain layers date from the Cretaceous Period, 135 to 65 million years ago. Generally, soils of the Inner Coastal Plain are quite fertile. The Outer Coastal Plain was formed more recently than the Inner Coastal Plain. It was laid down by the ocean and developed during the mid-to-late part of the Cenozoic Era, 65 million years ago to the present. Outer Coastal Plain soils are sandier and less fertile than those of the Inner Coastal Plain and do not hold water as well.

In the general vicinity of the dividing line between the two parts of the Coastal Plain is a belt of low hills called the cuesta belt, which runs northeast and southwest through the southern half of New Jersey. These hills are the youngest of the Cretaceous formations and are largely made up of sand and marl formations. In Burlington County, the hills can be identified between Arney's Mount in Springfield Township and Big Hill in Southampton Township. In Moorestown Township, Main Street courses along the cuesta upland. The Inner Coastal Plain lies to the west of the band of hills and the Outer Coastal Plain lies to the east. A diversity of habitats and natural resources are found along the cuesta, which has long attracted human settlements.

Topography and Surface Landscapes

Topography relates to the surface terrain and features of an area. The vast majority of Moorestown is generally flat, typical of areas in the Inner Coastal Plain. See **Map 5: Elevation** and **Map 6: Steep Slopes**. The highest elevations in the township are found on Main Street, which is located along the cuesta upland on a ridge of high ground composed of upland gravel, as shown in **Map 15: Surface Geology**. Elevations along Main Street exceed 100 feet above sea level. The lowest elevations are located in tidal creek floodplains of the North Branch Pennsauken Creek and Rancocas Creek Main Stem.

Ridges and high points delineate the boundaries of watersheds, seen in **Map 9: Watersheds**. The ridge of Main Street forms the dividing line between land flowing to the Pompeston Creek/Swede Run watershed to the north and the Pennsauken Creek watershed to the south.

Because of its low elevation and relatively flat topography, about 10 percent of Moorestown is located in a floodplain, as shown on **Map 11: Floodplains (1996)**. Floodplains occur exclusively along the creeks and tributaries in the township.

Steep Slopes

Slope is measured as the percent of vertical rise to horizontal distance. The majority of Moorestown has slopes of less than 10 percent. In general, development of areas with steep slopes is inadvisable, as it is likely to result in soil instability, erosion, sedimentation of streams, increased stormwater runoff, and increased flooding. These effects are responsible for habitat destruction, water pollution, and potential damage to property. Erosion on steep slopes is especially prevalent where excessive tree removal has taken place.

Stokes Hill
Source: Chet Dawson

Moorestown's steep slopes are depicted on **Map 6: Steep Slopes**. The eastern area of the township to the east of the Laurel Creek Country Club has some of the steepest slopes in the township. On the other side of Moorestown, upland areas to the west of Strawbridge Lake also have steep slopes. There is another band of steep slopes south of the ridge of Main Street, particularly at Stokes Hill, the location of the first test run of the Flexible Flyer sled in the 1880s.

Soils

Soil is the foundation for all land uses. A region's soil defines what vegetation is possible, therefore influencing agricultural uses. Soil properties also affect the location of wells and septic facilities, often determining development potential in certain areas. Soil is a natural resource that cannot be replenished on the human time scale.

Moorestown's soils consist of 18 series types and 42 variations within those series, as identified by the U.S. Department of Agriculture's Natural Resources Conservation Service. All soil types in the township are listed in **Table 4: Moorestown Soils** and shown on **Map 7: Soils**.

Soil Series

Wigmore Acres

Source: DVRPC

Several soil series appear more frequently in Moorestown than others and are briefly described, as follows, according to the Burlington County Soil Survey and NRCS soil database. The two most commonly found soil series in the township are the Woodstown and Sassafras series, both of which are fine sandy loam. Fine sandy loam refers to soils that have particle sizes slightly larger than clay soils and therefore drain better and are less compactable. However, because it does have a significant percentage of finer particles as well, the soil is capable of retaining nutrients for a longer period of time, making it ideal for agricultural crops.

Woodstown

Woodstown is the most commonly found soil type in Moorestown, covering about 43 percent of the township. Generally associated with Sassafras and Fallsington soils, it is moderately well-drained fine sandy loam. The Woodstown series was formed in alluvial material and usually occurs below Sassafras and above Fallsington soils. The series has a fluctuating water table that can rise to a depth of two feet in winter. Although variations are hydric, the soil is not a wetland indicator and can be developed. The Woodstown series is identified as prime farmland soil.

Sassafras

The Sassafras series, the second most common soil type in Moorestown, covers about 28 percent of the township. This soil series is associated with Woodstown, Freehold, Holmdel, and Downer soils. Sassafras and Woodstown soils developed in material deposited by glacial water on the glauconitic marine deposits in which Freehold and Holmdel soils formed. Sassafras soils are typically found occupying higher positions than Woodstown and Holmdel near the Delaware River. The native vegetation consists of red oak, white oak, black oak, scarlet oak, hickory, beech, yellow poplar, and Virginia pine. Sassafras soils are identified as prime farmland soil.

Holmdel

Holmdel soils are often found in association with Freehold soils and are very similar to them. This series drains slightly less well than Freehold and has a high water table in late winter. Holmdel soils are typically found on slightly steeper slopes. Their native vegetation consists of red, scarlet, and white oaks, yellow poplar, beech, and hickory. Flatter areas with Holmdel soil are dominated by pin and willow oak, and sweet gum. Holmdel soils are identified as prime farmland soil.

Galestown

Galestown soils are high in sand and low in clay, which makes them very highly drained. In Moorestown, this soil series is found near the Rancocas Creek and the Pennsauken Creek. These soils are low in organic matter and fertility, yet they are still identified as a prime farmland soil when located on slopes less than six percent. Natural vegetation for this soil series consists of oak hickory forest, with a strong presence of Virginia pine.

Fallsington

Consisting of nearly level fine sandy loams, gray in color and distinctly mottled, Fallsington soils are alluvial soils deposited in lower elevations. They typically remain saturated for six to eight months of the year, and in summer the water table may drop below three feet, but this depends greatly on seasonal rain fall. These soils are indicators of freshwater wetlands and severely limit development.

Keyport

Keyport soils are found in limitation in the Northwest corner of Moorestown. They have a high available water capacity and are slowly permeable. Erosion is high on slopes exceeding two percent and can be a hazard. These soils are very acidic and contain moderate organic matter. Keyport is a prime farmland soil. Native vegetation is hardwood forest, characterized by yellow poplar, red oak, willow oak, ash, beech, and hickory.

Donlonton

Donlonton soils are poorly draining and located in nearly level areas. The soil series contains small amounts of glauconite. Typically found below Keyport soils and above Colemantown and Shrewsbury soils, Donlonton soils are slowly draining and have high water-holding capacity, causing severe shrink and swell, making the soil highly unsuitable for development. Donlonton soils are characterized as prime farmland. Native vegetation includes hardwood forest, pin oak, willow oak, and swamp white oak.

Freehold

Freehold soils are sandy and well drained. The series is typically dark grayish-brown in color and low in glauconite. Freehold soils contain iron among the finer particles, which gives the soils a reddish color at lower horizons. The soils are very acidic and occupy higher horizons. The natural vegetation on this series is typically a red oak, beech, and yellow poplar hardwood forest. They are identified as prime farmland soils.

Soil Characteristics

Hydric Soils

Less than half (45 percent) of Moorestown’s land area consists of hydric soils. Hydric soils, as defined by the NRCS, are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic (oxygen-free) conditions in their subsurface. These soils have unique soil properties and are an important element of wetland areas. If a soil is classified as “hydric,” land use may be restricted due to the relationship of hydric soils to the definition of wetlands and to laws regarding wetland preservation. Soils that have limitations, such as a high water table or flooding, can qualify as Prime Farmland and Soils of Statewide Importance when the limitations are overcome by measures such as drainage or flood control.

Depth to Water Table

The water table refers to a saturated zone in the soil that occurs during certain months. The depth to the water table is the distance between this zone and the ground surface. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table. Development can be severely constrained on soils with a depth to water table of less than one foot. A depth to water table between one and three feet can also impede development.

Flood Frequency Class

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent. "None" means that flooding is not probable, or the chance of flooding is less than once in 500 years. "Very rare" means that flooding is very unlikely but possible under extremely unusual weather conditions, or the chance of flooding is less than one percent in any year. "Rare" means that the chance of flooding is one to five percent in any year. "Occasional" means that the chance of flooding is five to 50 percent in any year. "Frequent" means that flooding is likely to occur often under normal weather conditions. In this case, the chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year. "Very frequent" means that the chance of flooding is more than 50 percent in all months of any year under normal weather conditions.

Potential Frost Action

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, saturated hydraulic conductivity (Ksat), content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Drainage Class

"Drainage class" refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized: excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained.

Table 4: Moorestown Soils

Soil Type	Description	Area (Acres)	% of Moorestown Township	Ag. Quality*	Hydric?	Depth to Water Table (centimeters)	Flood Frequency Class	Potential Frost Action	Drainage Class
CoeAs	Colemantown loam, 0 to 2 percent slopes, occasionally flooded	19.45	0.20%	N/A	Y	15	Occasional	High	Poorly drained
ComB	Collington fine sandy loam, 2 to 5 percent slopes	12.61	0.13%	P-1	Y	>200	None	Moderate	Well drained
DoaA	Donlonton fine sandy loam, 0 to 2 percent slopes	9.81	0.10%	P-1	Y	54	None	High	Somewhat poorly drained
DobA	Donlonton loam, 0 to 2 percent slopes	174.83	1.83%	P-1	Y	54	None	High	Somewhat poorly drained
FanA	Fallsington fine sandy loam, 0 to 2 percent slopes	388.73	4.06%	S-1	Y	30	None	Moderate	Poorly drained
FmhAt	Fluvaquents, loamy, 0 to 3 percent slopes, frequently flooded	138.56	1.45%	N/A	Y	38	Frequent	High	Somewhat poorly drained
FrmD	Freehold fine sandy loam, 10 to 15 percent slopes	13.82	0.14%	U-1	N	>200	None	Moderate	Well drained
FrmB	Freehold fine sandy loam, 2 to 5 percent slopes	16.70	0.17%	P-1	N	>200	None	Moderate	Well drained
FrmkB	Freehold fine sandy loam, clayey substratum, 2 to 5 percent slopes	16.77	0.18%	P-1	N	>200	None	Moderate	Well drained
FrfB	Freehold loamy sand, 0 to 5 percent slopes	52.28	0.55%	P-1	Y	>200	None	Moderate	Well drained
FrfC	Freehold loamy sand, 5 to 10 percent slopes	25.54	0.27%	S-1	N	>200	None	Moderate	Well drained
FrkC3	Freehold sandy loam, 5 to 10 percent slopes, severely eroded	25.39	0.27%	S-1	N	>200	None	Moderate	Well drained

Soil Type	Description	Area (Acres)	% of Moorestown Township	Ag. Quality*	Hydric?	Depth to Water Table (centimeters)	Flood Frequency Class	Potential Frost Action	Drainage Class
GabB	Galestown sand, 0 to 5 percent slopes	424.04	4.43%	U-1	N	>200	None	Low	Somewhat excessively drained
GakB	Galloway fine sand, 0 to 5 percent slopes	6.60	0.07%	N/A	Y	54	None	Moderate	Moderately well drained
GahhB	Galloway sand, loamy substratum, 0 to 5 percent slopes	14.20	0.15%	N/A	Y	54	None	Moderate	Moderately well drained
HodA	Holmdel fine sandy loam, 0 to 2 percent slopes	24.10	0.25%	P-1	Y	69	None	High	Moderately well drained
HodB	Holmdel fine sandy loam, 2 to 5 percent slopes	151.10	1.58%	P-1	N	69	None	High	Moderately well drained
HodkA	Holmdel fine sandy loam, clayey substratum, 0 to 2 percent slopes	260.29	2.72%	P-1	Y	69	None	High	Moderately well drained
HodkB	Holmdel fine sandy loam, clayey substratum, 2 to 5 percent slopes	136.25	1.42%	P-1	N	69	None	High	Moderately well drained
HoaB	Holmdel loamy sand, 0 to 5 percent slopes	46.60	0.49%	P-1	Y	69	None	High	Moderately well drained
HofB	Holmdel-Urban land complex, 0 to 5 percent slopes	109.70	1.15%	N/A	N	69	None	High	Moderately well drained
KeoA	Keyport loam, 0 to 2 percent slopes	26.39	0.28%	P-1	Y	76	None	Moderate	Moderately well drained

Soil Type	Description	Area (Acres)	% of Moorestown Township	Ag. Quality*	Hydric?	Depth to Water Table (centimeters)	Flood Frequency Class	Potential Frost Action	Drainage Class
KeoB	Keyport loam, 2 to 5 percent slopes	220.20	2.30%	P-1	N	61	None	High	Moderately well drained
KeoC	Keyport loam, 5 to 10 percent slopes	31.90	0.33%	S-1	N	76	None	Moderate	Moderately well drained
MamnAv	Mannington-Nanticoke complex, 0 to 1 percent slopes, very frequently flooded	171.24	1.79%	N/A	Y	0	Very frequent	High	Very poorly drained
PHG	Pits, sand, and gravel	64.84	0.68%	N/A	N	>200	None	NA	Well drained
SaeA	Sassafras fine sandy loam, 0 to 2 percent slopes	1,145.49	11.96%	P-1	N	183	None	Moderate	Well drained
SaeB	Sassafras fine sandy loam, 2 to 5 percent slopes	638.28	6.66%	P-1	N	183	None	Moderate	Well drained
SaeC	Sassafras fine sandy loam, 5 to 10 percent slopes	169.06	1.76%	S-1	N	183	None	Moderate	Well drained
SaekA	Sassafras fine sandy loam, clayey substratum, 0 to 2 percent slopes	336.79	3.52%	P-1	N	127	None	High	Moderately well drained
SaekB	Sassafras fine sandy loam, clayey substratum, 2 to 5 percent slopes	311.03	3.25%	P-1	N	127	None	High	Moderately well drained
SabB	Sassafras loamy sand, 0 to 5 percent slopes	14.43	0.15%	P-1	N	>200	None	Moderate	Well drained
SapkB	Sassafras-Urban land complex, clayey substrata, 0 to 5 percent slopes	52.23	0.55%	N/A	N	127	None	High	Moderately well drained
UdrB	Udorthents, refuse substratum, 0 to 8 percent slopes	31.50	0.33%	N/A	N	>200	None	NA	Well drained

Soil Type	Description	Area (Acres)	% of Moorestown Township	Ag. Quality*	Hydric?	Depth to Water Table (centimeters)	Flood Frequency Class	Potential Frost Action	Drainage Class
URSACB	Urban land, sandy over clayey, 0 to 8 percent slopes	27.95	0.29%	N/A	N	>200	None	High	Somewhat poorly drained
URSAAB	Urban land, sandy, 0 to 8 percent slopes	115.07	1.20%	N/A	N	>200	None	Low	Excessively drained
WATER	Water	79.17	0.83%	N/A	Y	>200	None	NA	NA
WofA	Woodstown fine sandy loam, 0 to 2 percent slopes	1,513.04	15.80%	P-1	Y	77	None	Moderate	Moderately well drained
WofB	Woodstown fine sandy loam, 2 to 5 percent slopes	416.89	4.35%	P-1	N	77	None	Moderate	Moderately well drained
WofkA	Woodstown fine sandy loam, clayey substratum, 0 to 2 percent slopes	1,382.36	14.43%	P-1	Y	46	None	High	Moderately well drained
WofkB	Woodstown fine sandy loam, clayey substratum, 2 to 5 percent slopes	763.42	7.97%	P-1	N	46	None	High	Moderately well drained
Total		**9,578.66**	**100.00%**		**45.10%**				

Source: USDA NRCS, 2012

***Agricultural Quality Designations**	
P–1	Prime Farmland
S–1	Statewide Importance
U-1	Unique Importance
N/A	Soil not rated for agricultural use by NRCS, but may be suitable or currently used for such use.

Agricultural Quality Classification

Flying Feather Farm Market
Source: DVRPC

The upland areas of Moorestown are characterized by high quality soils suitable for farming. There are still a number of active agricultural operations in the township, although many farms are leased to farmers and are susceptible to development. The agricultural heritage of the township is still evident in the farm markets that provide fresh, local produce in a rustic setting. See **Table 5: Agricultural Values for Moorestown Soils** for the acreage of each of these classes of farmland. See also **Map 8: Agricultural Quality of Soils** for a visual depiction.

Prime Farmland Soils

Approximately 80 percent (7,655 acres) of all soils in Moorestown are classified as Prime Farmland (P-1). Prime Farmlands are lands that have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. They can sustain high yields of crops when managed with correct farming methods. Prime Farmlands are not excessively erodible or saturated with water for long periods of time and do not flood frequently. Prime Farmland is located throughout the township.

Swede Run Fields
Source: DVRPC

The NRCS outlines specific criteria for Prime Farmland classification. For example, according to Prime and Unique Farmlands federal regulation, soil horizons (layers) within a depth of 40 inches must have a pH between 4.5 and 8.4 (mildly acidic to mildly basic). In addition, the soils must have an average temperature above 32 degrees Fahrenheit at a depth of 20 inches. The USDA outlines additional Prime Farmland requirements for mean summer soil temperature, erodibility factor, water table depth, permeability rate, and more. However, many of the lands containing Prime Farmland soils have been developed and are no longer in agricultural use.

Soils of Statewide Importance

About seven percent (650 acres) of soils in Moorestown are classified as Soils of Statewide Importance (S-1). These soils are close in quality to Prime Farmland and can sustain high yields of crops when correctly managed under favorable conditions. Criteria for establishing Soils of

Statewide Importance are determined by state agencies. These soils are located throughout Moorestown, generally on slopes greater than five percent.

Soils of Unique Importance

About six percent (595.28 acres) of soils in Moorestown are soils considered to be of Unique Importance (U-1). The USDA outlines specific Unique Farmland criteria that support particular food or fiber crops, including temperature, humidity, air drainage, elevation, aspect, or proximity to market. In order for lands to be classified as Unique Farmland, the land must also be used for a specific high-value food or fiber, and have an adequate moisture supply for that crop. Soils of Unique Importance are located on the northeastern edge of the township along the Rancocas Creek, and along the northwestern corner along the north branch of the Pennsauken Creek. These soils are mostly associated with wetland areas and riparian corridors.

Soils Not Rated

Approximately seven percent of Moorestown soils have not been rated for agricultural use by the NRCS and are therefore labeled “N/A.” These soils are not appropriate for agricultural use and may be best suited for other uses, or they may not yet have been assessed for quality by NRCS. NRCS created all of the Soil Quality Classifications in 1990, although several new subtypes of soils were created in 2005 are are not yet rated for agricultural use. Soils that are not rated are not necessarily limited for agricultural use.

Table 5: Agricultural Values for Moorestown Soils

Designation	Type/Farm Classification	Area (Acres)	% of municipality
P-1	All areas are Prime Farmland	7,655.25	79.92%
S-1	Farmland of Statewide Importance	650.46	6.79%
U-1	Farmland of Unique Importance	595.28	6.21%
N/A	Not Prime Farmland	677.67	7.07%
	Total	**9,578.66**	**100.00%**

Source: USDA NRCS, 2004

Soil Limitations for Development

Certain soil characteristics can severely restrict the use of sites for construction and development. **Table 6: Soil Limitations for Development** lists the soils in Moorestown and their possible limitations for building foundations and septic systems. As indicated in the table, the township has some soils that are severely limited for on-site septic systems. Septic systems require soils that have a low water table (five feet or more from the surface) and high permeability to allow for proper drainage of wastewater. Soils with high water tables (five feet or less from the surface) create the potential for erosion, wet basements, and low permeability, often allowing wastewater to collect near the surface. Because the suitability of a soil for a septic disposal field is very site specific and relies on many factors, including soil type, there is not an accurate source of soil information regarding this subject. The best way to determine soil suitability for a septic system is to request a site survey by a professional.

Table 6: Soil Limitations for Development

Name	Symbol	Dwellings with Basements	Dwellings Without Basements	Septic Systems
Colemantown loam, 0 to 2 percent slopes, occasionally flooded	CoeAs	Very limited	Very limited	Very limited
Collington fine sandy loam, 2 to 5 percent slopes	ComB	Not limited	Somewhat limited	Very limited
Donlonton fine sandy loam, 0 to 2 percent slopes	DoaA	Very limited	Somewhat limited	Very limited
Donlonton loam, 0 to 2 percent slopes	DobA	Very limited	Somewhat limited	Very limited
Fallsington fine sandy loam, 0 to 2 percent slopes	FanA	Very limited	Very limited	Very limited
Fluvaquents, loamy, 0 to 3 percent slopes, frequently flooded	FmhAt	Very limited	Very limited	Very limited
Freehold fine sandy loam, 10 to 15 percent slopes	FrmD	Somewhat limited	Somewhat limited	Very limited
Freehold fine sandy loam, 2 to 5 percent slopes	FrmB	Not limited	Not limited	Very limited
Freehold fine sandy loam, clayey substratum, 2 to 5 percent slopes	FrmkB	Not limited	Not limited	Very limited
Freehold loamy sand, 0 to 5 percent slopes	FrfB	Not limited	Not limited	Very limited
Freehold loamy sand, 5 to 10 percent slopes	FrfC	Not limited	Not limited	Very limited
Freehold sandy loam, 5 to 10 percent slopes, severely eroded	FrkC3	Somewhat limited	Somewhat limited	Very limited
Galestown sand, 0 to 5 percent slopes	GabB	Not limited	Not limited	Very limited
Galloway fine sand, 0 to 5 percent slopes	GakB	Very limited	Somewhat limited	Very limited
Galloway sand, loamy substratum, 0 to 5 percent slopes	GahhB	Very limited	Somewhat limited	Very limited
Holmdel fine sandy loam, 0 to 2 percent slopes	HodA	Very limited	Somewhat limited	Very limited
Holmdel fine sandy loam, 2 to 5 percent slopes	HodB	Very limited	Somewhat limited	Very limited

Name	Symbol	Dwellings with Basements	Dwellings Without Basements	Septic Systems
Holmdel fine sandy loam, clayey substratum, 0 to 2 percent slopes	HodkA	Very limited	Somewhat limited	Very limited
Holmdel fine sandy loam, clayey substratum, 2 to 5 percent slopes	HodkB	Very limited	Somewhat limited	Very limited
Holmdel loamy sand, 0 to 5 percent slopes	HoaB	Very limited	Somewhat limited	Very limited
Holmdel-Urban land complex, 0 to 5 percent slopes	HofB	Very limited	Somewhat limited	Very limited
Keyport loam, 0 to 2 percent slopes	KeoA	Somewhat limited	Somewhat limited	Very limited
Keyport loam, 2 to 5 percent slopes	KeoB	Very limited	Somewhat limited	Very limited
Keyport loam, 5 to 10 percent slopes	KeoC	Somewhat limited	Somewhat limited	Very limited
Mannington-Nanticoke complex, 0 to 1 percent slopes, very frequently flooded	MamnAv	Very limited	Very limited	Very limited
Pits, sand, and gravel	PHG	Not rated	Not rated	Not rated
Sassafras fine sandy loam, 0 to 2 percent slopes	SaeA	Not limited	Not limited	Very limited
Sassafras fine sandy loam, 2 to 5 percent slopes	SaeB	Not limited	Not limited	Very limited
Sassafras fine sandy loam, 5 to 10 percent slopes	SaeC	Somewhat limited	Somewhat limited	Very limited
Sassafras fine sandy loam, clayey substratum, 0 to 2 percent slopes	SaekA	Somewhat limited	Not limited	Very limited
Sassafras fine sandy loam, clayey substratum, 2 to 5 percent slopes	SaekB	Somewhat limited	Not limited	Very limited
Sassafras loamy sand, 0 to 5 percent slopes	SabB	Not limited	Not limited	Very limited
Sassafras-Urban land complex, clayey substrata, 0 to 5 percent slopes	SapkB	Somewhat limited	Not limited	Very limited
Udorthents, refuse substratum, 0 to 8 percent slopes	UdrB	Not limited	Not limited	Somewhat limited
Urban land, sandy over clayey, 0 to 8 percent slopes	URSACB	Somewhat limited	Somewhat limited	Very limited
Urban land, sandy, 0 to 8 percent slopes	URSAAB	Not limited	Not limited	Very limited

Name	Symbol	Dwellings with Basements	Dwellings Without Basements	Septic Systems
Water	WATER	Not rated	Not rated	Not rated
Woodstown fine sandy loam, 0 to 2 percent slopes	WofA	Somewhat limited	Not limited	Very limited
Woodstown fine sandy loam, 2 to 5 percent slopes	WofB	Somewhat limited	Not limited	Very limited
Woodstown fine sandy loam, clayey substratum, 0 to 2 percent slopes	WofkA	Very limited	Somewhat limited	Very limited
Woodstown fine sandy loam, clayey substratum, 2 to 5 percent slopes	WofkB	Very limited	Somewhat limited	Very limited

Source: USDA NRCS, 2004

Climate

Geographically situated approximately halfway between the Equator and the North Pole, New Jersey's climate is extremely variable. The state's temperate, continental climate is influenced by hot, cold, dry, and humid airstreams that create highly variable local weather conditions. From May through September, New Jersey is dominated by moist, tropical air originating in the Gulf of Mexico and carried by prevailing winds from the southwest. In winter, winds generally prevail from the northwest, bringing cold, polar air masses from subarctic Canada.

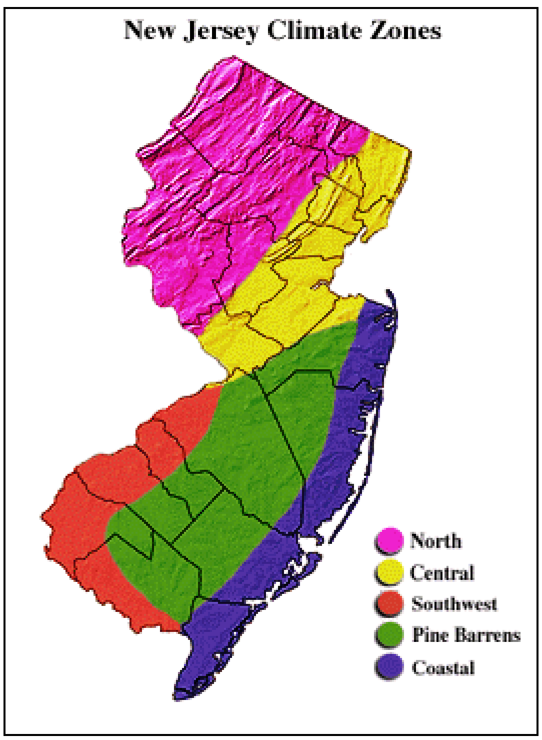


Figure 3: The New Jersey Climate Zones

Source: Office of the New Jersey State Climatologist

Although New Jersey is one of the smallest states in the country, it has five distinct climate regions. The state's climate varies across these five regions: North, Central, Southwest, Pine Barrens, and Coastal. Distinct variations between these climate regions is due to a combination of factors, including geology, distance from the Atlantic Ocean, and prevailing atmospheric flow patterns.

Moorestown is completely located within the Southwest Climate zone.

The Southwest has the highest average daily temperatures in the state and, without sandy soils, tends to have higher nighttime minimum temperatures than in the neighboring Pine Barrens. This region receives less precipitation than the Northern and Central regions of the state since it is farther away from the Great Lakes-St. Lawrence storm track. It is also far enough inland to avoid the heavier rains from some coastal storms, and so the Southwest Region receives less precipitation than the Coastal Region.

The National Climate Data Center (NCDC) operates over 4,000 stations in the United States, including a station in Moorestown. Based on NCDC data collected between 1981 and 2010, the mean annual temperature in Moorestown is 54.9 degrees Fahrenheit. January is the coldest month, with a mean temperature of 32.9 degrees, and July is the hottest month, with a mean temperature of 76.5 degrees.

Precipitation and Storm Events

The Southwest climate zone, where Moorestown is located, receives less precipitation than the North, Central, and Coastal regions, but more than the Pine Barrens region. The region's lack of orographic features (elevated terrain) and its greater distance from the Great Lakes-St. Lawrence storm track may explain the lower precipitation. However, Moorestown Township's location on the Inner Coastal Plain does make it more susceptible to the heavy rains associated with coastal storms than parts of the North and Central Regions. The normal average annual precipitation for Moorestown between 1981 and 2010 was 48.22 inches. Moorestown receives the most precipitation in July, with a mean of 5.00 inches, and the least in February, with an average of 2.76 inches.

Snowfall typically occurs in New Jersey when moist air from the south converges with cold air from the north. In Moorestown, snowfall may occur from November to mid-April, but is most likely to occur from December to March. From data gathered between 1981 and 2010, the average monthly snowfall is greatest in February.

Growing Seasons

Swede Run Fields
Source: DVRPC

Moorestown is located within U.S. Department of Agriculture (USDA) Plant Hardiness Zone 7A, where annual minimum temperatures are typically between 0°F and 5°F. Hardiness zones are based on average annual minimum temperatures and are helpful in indicating which plant species are able to survive the winter in each area.

Moorestown's agricultural growing season is approximately six months, or 180 days, from mid-April through mid-October. The growing season is generally defined as the period between the last spring frost and the first autumn frost. However, the harvest of grain crops typically continues throughout November, and winter crops, such as broccoli, cauliflower, and cabbage, are grown until the first hard freeze, usually in early January. The frost-free growing season in Moorestown is about 60 days longer than in northern New Jersey, where frosts generally end in May and begin in October. The main crop grown in Moorestown is soy beans.

Surface Water Resources

The land in Moorestown drains to the Rancocas Creek, Pompeston Creek/Swede Run, or the Pennsauken Creek. These waterways then flow to the Delaware River. Moorestown contains the headwaters of both the Pompeston Creek and Swede Run. There is a total of nearly 22 miles of streams located within or on the borders of Moorestown.

Susan Stevens Halbe Preserve

Source: DVRPC

Watersheds

A watershed is all the land that drains to a particular waterway, such as a river, stream, lake, or wetland. The high points in the terrain, such as hills and ridges, define the boundaries of a watershed. Large watersheds are made up of a succession of smaller ones, and smaller ones are made up of the smallest area, down to the catchment area of a local site. So, for example, the Delaware River watershed is made up of many smaller watersheds, such as the Rancocas Creek watershed, which itself consists of smaller subwatersheds.

Each watershed corresponds to a hydrological unit code, or HUC, as delineated by the United States Geological Survey (USGS). A HUC 11 watershed (identified by an 11-digit code) contains a number of HUC 14 subwatersheds (each identified by a 14-digit code). The State of New Jersey has 152 HUC 11 watersheds and over 900 HUC 14 subwatersheds. Moorestown lies within three HUC 11 watersheds: Rancocas Creek, Pennsauken Creek, and Pompeston Creek/Swede Run. All watersheds eventually empty into the Delaware River, which itself flows into the Atlantic Ocean. These HUC 11 watersheds are then further divided into eight smaller HUC 14 subwatersheds, shown in **Table 7: Watersheds and Subwatersheds in Moorestown**. See also **Map 9: Watersheds** and **Map 10: Surface Water, Wetlands, and Vernal Pools**.

Table 7: Watersheds and Subwatersheds in Moorestown

WMA	Watershed (HUC 11)	Subwatershed (HUC 14) ID	Subwatershed (HUC 14) Name	Acres	% of Moorestown
Rancocas (19)	Rancocas Creek (02040202080)	02040202080010	Parkers Creek (above Marne Highway)	74.69	0.78%
		02040202080020	Rancocas Creek (Martins Beach to NB/SB)	908.40	9.48%
		02040202080040	Rancocas Creek (Rt 130 to Martins Beach)	1,085.74	11.33%
Lower Delaware (18)	Pompeston Creek / Swede Run (02040202090)	02040202090010	Swede Run	2,442.33	25.50%
		02040202090020	Pompeston Creek (above Rt 130)	2,086.34	21.78%
	Pennsauken Creek (02040202100)	02040202100010	Pennsauken Ck NB (above NJTPK)	184.37	1.92%
		02040202100020	Pennsauken Ck NB (incl StrwbrdgLk-NJTPK)	1,286.11	13.43%
		02040202100030	Pennsauken Ck NB (below Strawbridge Lk)	1,510.74	15.77%
Total acres				**9,578.70**	**100.00%**

Source: NJDEP, 2010

Watershed Management Areas

The New Jersey Department of Environmental Protection manages natural resources on a watershed basis. As shown in **Figure 4**, the state has been divided into 20 Watershed Management Areas (WMAs), which are larger in size than HUC 11s. Moorestown Township is located partially within WMA 18: Lower Delaware Tributaries and WMA 19: Rancocas.

Watershed Management Area 18: Lower Delaware Tributaries

WMA 18 includes the Cooper River, Big Timber, Manuta, Newton, Oldmans, Pennsauken, Pompeston, Raccoon, Repaupo, and Woodbury creeks, as well as Baldwin Run, Swede Run, and Maple Swamp. This management area includes all or part of 68 municipalities in Burlington, Camden, and Gloucester counties, encompassing 391 square miles. In general, industrial and urban development is concentrated downstream closer to the Delaware River and the upstream headwaters have more forested and agricultural land uses. The upstream areas are more influenced by suburban and agricultural runoff problems, whereas the downstream portions are influenced by both past and present industrial and urban uses.

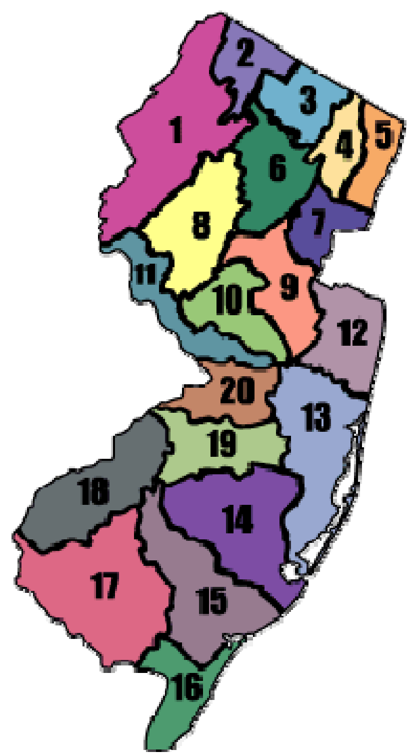


Figure 4: Watershed Management Areas in New Jersey

Source: NJDEP

Moorestown is located within the Pompeston and Swede Run watersheds within this larger WMA and contains the headwaters for both streams.

The Pompeston Creek forms a confluence with the Delaware River at Riverton. Two other confluences occur in its six-mile run from its headwaters in Moorestown to its mouth. Swede Run flows north and forms a confluence with the Delaware River at Dredge Harbor in Delran. The Pennsauken Creek joins the Delaware River near Palmyra. The North Branch of the Pennsauken Creek forms the southern border of Moorestown, while the South Branch forms the border between Burlington and Camden counties.

The Pompeston Creek Watershed Association, formed in 1963, has conducted stream monitoring since 1998. The watershed association has also performed many stream cleanups, provided educational programming, established streambank and habitat restorations, and other activities. Save the Environment of Moorestown (STEM) conducts a Natural Care Program, and four of its annual 12 work projects are scheduled within the Moorestown portion of the Pompeston Creek watershed.

Rancocas Watershed Management Area 19

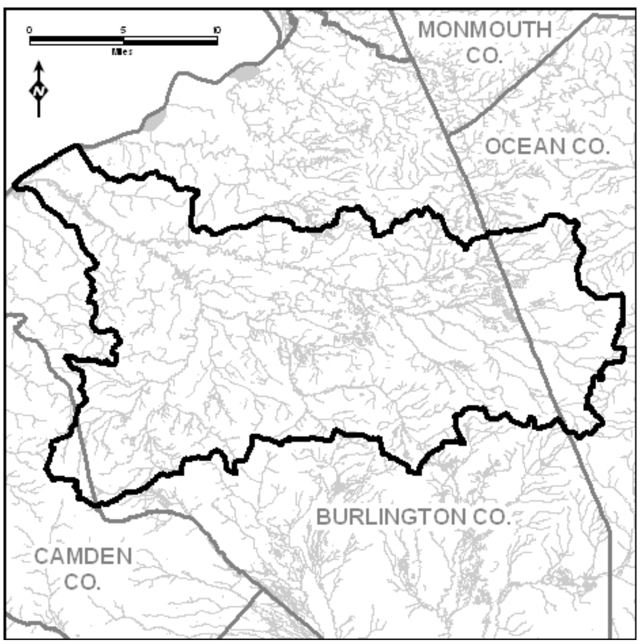


Figure 5: The Rancocas Creek Watershed

Source: NJDEP

Moorestown Township is also located partly in WMA 19, the Rancocas Creek watershed. WMA 19 is the largest watershed in south central New Jersey and is comprised of the North Branch, South Branch and Main Stem of the Rancocas Creek, including Mill Creek.

The Rancocas, which means “many kinsmen” in the Lenni Lenape language, is the largest watershed in south central New Jersey, and was also the first watershed in New Jersey to have a management plan. The entire watershed drains 360 square miles, covering 30 municipalities in Burlington, Camden, and Ocean counties. Most watersheds in the Pinelands drain either east to the Atlantic Ocean or south to the Delaware Bay, although the Rancocas Creek watershed is an exception to this in that it drains west to the Delaware River. Approximately 68 percent of the Rancocas Creek watershed is within the Pinelands Management Area, which is regulated by the Pinelands Commission.

The Main Stem, which flows for approximately eight miles, drains 49 square miles between the confluence of the North and South Branches at Hainesport and the Delaware River. The mouth of the Rancocas Creek is located between Riverside and Delanco on the Delaware River. The Main Stem of the Rancocas Creek forms Moorestown’s northeast boundary. The Parkers Creek tributary forms part of Moorestown’s boundary with Mount Laurel to the east, and Boundary Creek forms part of Moorestown's boundary with Delran to the west. The subwatersheds of Kendle's Run and Little Run are entirely within Moorestown and flow to the Rancocas Creek.

The Rancocas Conservancy, a nonprofit land trust that has preserved approximately 2,000 acres in the Rancocas watershed, had its origins as a watershed association established in 1989. It is dedicated to protecting the natural and historical resources of the watershed.

Boundary Creek Natural Area
Source: DVRPC

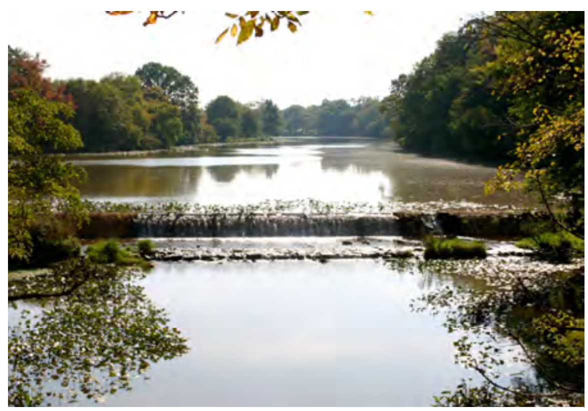
Lakes

There are 106 acres of lakes in Moorestown, which are nearly all artificial lakes formed by impoundments of waterways. The largest lake is Strawbridge Lake, detailed below, which is formed by three impoundments of the North Branch of the Pennsauken Creek and covers 33 acres. The second largest lake covers eight acres and is located behind the estates at Tom Brown Road and New Albany Road. There are a number of small lakes ranging between less than half an acre and five acres located around the Laurel Creek Golf Course east of Hartford Road. There are also many small lakes of less than three acres in size located adjacent to new developments and estates. These lakes were likely to have been built as stormwater management devices.

Strawbridge Lake

Strawbridge Lake is a 32.9-acre lake formed by three impoundments. Dams on Hooten Run form the upper and middle basins. The lower basin is formed at the confluence of Hooten Run and the North Branch of the Pennsauken Creek. Construction on the impoundments that formed the tri-basin lake began in the 1920s and was completed between 1931 and 1937.

Strawbridge Lake is surrounded by Strawbridge Lake Park, an active park owned by Moorestown and maintained by the Moorestown Township Department of Public Works. The lake is accessible via Haines Drive and Route 38. Although no longer stocked, Strawbridge Lake is still a popular recreational non-food fishing spot used by local residents.


Dam at Strawbridge Lake Park
Source: DVRPC

Strawbridge Lake has been severely impacted by nonpoint source pollution and shoreline erosion. Sediment deposition from upstream soil disturbances, including new construction and small landscape projects, as well as stream bank erosion within its watershed, gives the lake a muddy appearance and has reduced the average water depth to less than three feet. Nutrient runoff into the lake causes an overabundance of algae and aquatic weeds. The lake's ecologically degraded condition causes habitat loss for aquatic species and limits recreational opportunities.

The lake has exceeded the state criterion for phosphorus and fecal coliform since at least the early 1990s. A diagnostic-feasibility study was conducted in 1993, and the lake was listed as a water-quality limited water by the state in 1998. The sources of fecal bacteria are both animal and human and are likely due to failing septic systems, waterfowl, and farm animals. Sediment core sampling of the lake found total nitrogen and total phosphorus to be relatively high and several heavy metals, including arsenic, lead, mercury, and selenium, were detected in the lake sediment.

A major lake restoration project was constructed in the late 1990s that involved over 4,000 feet of shoreline stabilization using soil bioengineering techniques and the planting of a vegetative buffer. Much of the planting was done by volunteers under the leadership of the Delaware Riverkeeper Network. Shoreline access areas were created using red gravel bordered by large flat stone. Biofilter wetlands were also constructed around the lake at the locations of seven stormwater discharges. Three of the discharges were also retrofitted with sedimentation chambers to remove coarse sediment from Route 38 runoff. Between 1997 and 2000, all three basins of Strawbridge Lake were dredged of tens of thousands of cubic yards of sediment.

The Canada goose population at Strawbridge Lake continues to be in overabundance, contributing to fecal bacteria contamination. The "no mow" vegetated buffer established as part of the lake restoration project has only been partially effective and is often violated in response to requests from residents and visitors for neatness and water visibility. Prior to events at the lake, the township contracts with a firm that utilizes teams of border collies to chase away the geese, a temporary control measure.

Wetlands

Wetlands support unique communities that serve as natural water filters and as incubators for many beneficial species. The term "wetland" is applied to areas where water meets the soil surface and supports a particular biological community. The source of water for a wetland can be an estuary, river, stream, lake edge, or groundwater that rises close to the land surface. Under normal circumstances, wetlands are those areas that support a prevalence of defined wetland plants on a wetland soil. The U.S. Fish and Wildlife Service designates all large vascular plants as wetland (hydric), non-wetland (non-hydric) or in-between (facultative). Wetland soils, also known as hydric soils, are areas where the land is saturated for at least seven consecutive days during the growing season. Wetlands are classified as either tidal (coastal) or nontidal (interior). Tidal wetlands can be either saline or freshwater. There are also special wetlands categories to denote saturated areas that have been altered by human activities.

Railroad Crossing the North Branch Pennsauken Creek
Source: DVRPC

New Jersey protects freshwater wetlands under the New Jersey Freshwater Wetlands Protection Act Rules: N.J.A.C. A 7:7A. The law also protects transition areas, or "buffers," around freshwater wetlands. The New

Jersey freshwater wetlands maps provide guidance on where wetlands are found in New Jersey, but they are not the final word. Only an official determination from DEP, called a “letter of interpretation (LOI),” can legally determine for sure if there are freshwater wetlands on a property. An LOI verifies the presence, absence, and boundaries of freshwater wetlands and transition areas on a site. Activities permitted to occur within wetlands are very limited and usually require a permit. Additional information on wetlands rules and permits is available through NJDEP.

More information on the wetlands in Moorestown is located in the **Natural Vegetation** section.

Vernal Pools

Vernal pools are bodies of water that appear following snowmelt and during spring rains, but disappear or are dry during the rest of the year. They are highly important sites for certain rare species of amphibians. Particular types of frogs and salamanders will only breed in vernal pools (obligate breeders), which provide their offspring with a measure of protection because the pool’s impermanence prevents the residence of predators of the eggs and young, especially fish. Other species may use vernal pools, but are not limited to them for breeding. They are called facultative breeders.

Vernal pools are so intermittent that their existence as wetlands has frequently not been recognized. Consequently, many of them have disappeared from the landscape, or have been substantially damaged. This, in turn, is a principal cause of the decline of their obligate amphibian species.

The New Jersey Division of Fish and Wildlife has been conducting a Vernal Pool Survey project since 2001 to identify, map, and certify vernal pools throughout the state. A certified vernal pool is one that occurs in a confined basin without a permanently flowing outlet, has habitat documented for one obligate or two facultative herptile (reptile and amphibian) species, maintains ponded water for at least two continuous months between March and September, and is free of fish populations throughout the year.

Once a vernal pool is certified, regulations require that a 75-foot buffer be maintained around the pool. NJDEP’s division of Land Use Regulation oversees this designation and restricts development around vernal pools by denying construction permits. Local municipalities can provide additional protection by negotiating conservation easements on the land surrounding the pool or by instituting restrictive zoning, such as passing a stream corridor protection overlay ordinance that specifically includes the vernal pools. A township can also include the pools in its official map. The South Jersey Land and Water Trust provides training sessions every March to teach volunteers how to identify, survey, and certify vernal pools.

The state has identified eight potential vernal pools in Moorestown, which are listed in **Appendix A: Vernal Pools in Moorestown Township** and shown on **Map 10: Surface Water, Wetlands, and Vernal Pools**. Surveys of each pool are needed to determine if the pool is still in existence as a natural habitat, and if it is, what species are present. At least one other vernal pool remains to be listed. Once surveyed, the New Jersey Division of Fish and Wildlife will review the data and those pools that meet the criteria will be certified.

Floodplains

Areas naturally subject to flooding are called floodplains, or flood hazard areas. Floodplains encompass a floodway, which is the portion of a floodplain subject to high velocities of moving water, and the adjacent flood fringe, which helps to hold and carry excess water during overflow of the normal stream channel. The 100-year floodplain is defined as the land area that will be inundated by the overflow of water resulting from a 100-year flood (a flood that has a one percent chance of occurring in any given year).

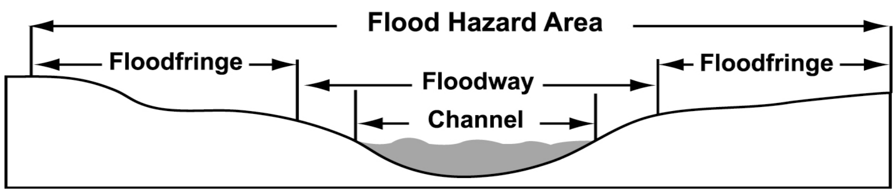


Figure 6: Parts of a Flood Hazard Area

Source: NJDEP

Although the terms “flood hazard area” and “100-year floodplain” refer to similar concepts, NJDEP defines them in slightly different ways. New Jersey’s regulations define the flood hazard area as the area inundated by a flood resulting from the 100-year discharge increased by 25 percent. This type of flood is called the “flood hazard area design flood” and it is the flood regulated by NJDEP.

Floodplains require protection in order to prevent loss to residents, especially within the boundaries of the floodway. Equally important is the preservation of the environmentally sensitive aquatic communities that exist in floodplains. These communities are often the first link in the food chain of the aquatic ecosystem. In addition, floodplains serve the function of removing and mitigating various pollutants through the uptake by their vegetation of excess chemical loads in the water and by the filtering of sediments generally. All efforts to keep development out of floodplains will help to preserve the flood-carrying capacity of streams and their water quality.

In New Jersey and throughout the country, building in areas subject to flooding is regulated to protect lives, property, and the environment. New Jersey regulates construction in the flood hazard area under the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq., and its implementing rules at N.J.A.C. 7:13. Activities that are proposed to occur in a flood hazard area will require issuance of a flood hazard area permit or a letter of non-applicability from the NJDEP. Additional information on floodplain activities is available from NJDEP and from its web site under “Land use.”

Moorestown also has a municipal ordinance that regulates development in the floodplain. Chapter 83: Flood Damage Prevention was adopted in 1995, and replaced a previous floodplain regulation from 1971. The Flood Damage Prevention ordinance aims to reduce flood losses in five ways:

1. Restricting or prohibiting uses that may increase erosion or flooding.
2. Requiring flood damage protection at the time of construction.
3. Controlling the alteration of natural floodplains, stream channels, and natural protective barriers.

4. Controlling filling, grading, dredging and other development that may increase flood damage.
5. Preventing or regulating flood barriers that may divert floodwaters and increase flood hazards.

According to Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) data, 823 acres of Moorestown Township's land is within the 100-year floodplain, and an additional 173 acres are within the 500-year floodplain. The floodplains in Moorestown are located adjacent to nearly all creeks and tributaries in the township. See **Map 11: Floodplains (1996)** and **Table 8** below. These floodplain areas were identified by FEMA to administer the National Flood Insurance Program and do not necessarily represent all areas in the township subject to flooding. These maps were revised in 1996 and digitized in 2008. When available, updated flood maps may be obtained through the FEMA Map Service Center.

Table 8: Floodplains in Moorestown

Flood Plain	Area (Acres)	% of Moorestown Township in Flood Plain
100-Year Flood Plain	822.99	8.59%
500-Year Flood Plain	172.58	1.80%
Total	**995.56**	**10.39%**

Source: FEMA, 1996

Surface Water Quality

Water quality standards are established by federal and state governments to ensure that water is suitable for its intended use. The ultimate objective of the Federal Clean Water Act (P.L. 95-217) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Standards are intended to restore the quality of the nation's waters to provide for the protection and propagation of fish, shellfish, and wildlife and to provide for recreation in and out of the water, wherever attainable.

All waterbodies in New Jersey are classified by NJDEP as either freshwater (FW), pinelands water (PL), saline estuarine water (SE), or saline coastal water (SC). Freshwater is further broken down into freshwater that originates and is wholly within federal or state parks, forests, or fish and wildlife lands (FW1), and all other freshwater (FW2). The water quality for each of these groups must be able to support designated uses that are assigned to each waterbody classification (see Surface Water Quality Standards N.J.A.C. 7:9B-1.12). In addition to being classified as FW1 and FW2, fresh waterbodies are classified as trout producing (TP), trout maintaining (TM), or nontrout waters (NT). Each of these classifications may also be subject to different water quality standards. All streams in Moorestown are FW2-NT.

According to NJDEP rules, FW2-NT waters must provide for (1) the maintenance, migration, and propagation of the natural and established biota; (2) primary and secondary contact recreation (i.e., swimming and fishing); (3) industrial and agricultural water supply; (4) public potable water supply after conventional filtration and disinfection; and (5) any other reasonable uses.

The determination of whether or not water quality is sufficient to meet a body of water's designated use(s) is based on an analysis of certain surface water quality parameters, including fecal coliform, dissolved oxygen, pH, phosphorous, and toxic substances. NJDEP also evaluates water quality by examining the health of aquatic macroinvertebrate life in a stream.

New Jersey's Integrated Water Quality Monitoring and Assessment Report

The Federal Clean Water Act mandates that states submit biennial reports to the U.S. Environmental Protection Agency (EPA) that describe the quality of their waters. States must submit two reports: the first is the Water Quality Inventory Report, or 305(b) Report, which documents the status of principal waters in terms of overall water quality and support of designated uses; the second is the 303(d) List, which lists the water bodies that are not attaining water quality standards. States must also prioritize the impaired water bodies on the 303(d) List for Total Maximum Daily Load (TMDL) analyses and identify those high-priority water bodies for which they anticipate establishing TMDLs in the next two years.

In 2006, NJDEP began reporting water quality data on a HUC-14 subwatershed basis, and so the assessments of portions of rivers and streams are reported by the subwatershed that they fall within. Subwatersheds (assessment units) are assessed on their attainment of eight different designated uses, although not all uses are applicable to all subwatersheds. The designated uses are as follows:

- Aquatic life (general);
- Aquatic life (trout);
- Recreation;
- Drinking water supply;
- Industrial water supply;
- Agricultural water supply;
- Shellfish harvesting;
- Fish consumption.

As none of the waters in Moorestown support trout or shellfish, these designated uses are not applicable.

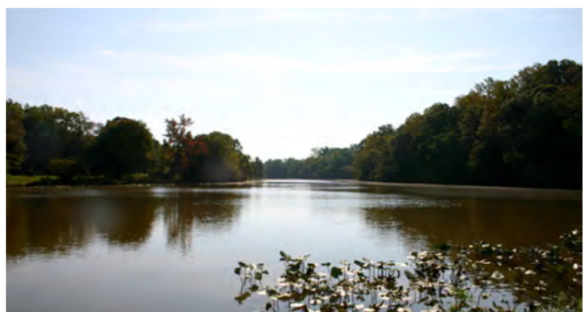
For aquatic life, the most general and encompassing parameter of water quality, five subwatersheds in Moorestown are impaired, one has insufficient data, and one is attaining. For agricultural water supply quality, a rating slightly below drinking water supply quality, three subwatersheds have insufficient information and four are attaining. For fish consumption, four subwatersheds have insufficient information and three are not supporting because of chemical pollution. For industrial water supply, five are attaining and three subwatersheds have insufficient information. For primary contact recreation, such as swimming, four subwatersheds are impaired and four have insufficient information. For public water supply, three subwatersheds are attaining, two are impaired, and two have insufficient information. See **Map 12: Surface Water Quality (2010)** and **Table 9: Integrated Water Quality Monitoring and Assessment Report, 2010** and **Table 10: TMDLs for Impaired Waters in Moorestown, 2010,** which follow.

The eight subwatersheds in Moorestown that do not attain one or more designated uses are each impaired due to one or more parameters for that use, as shown in **Table 9: Integrated Water Quality Monitoring and Assessment Report, 2010**.

Of the impaired subwatersheds, pH was a cause of impairment in one subwatershed, phosphorus in six subwatersheds, and copper, lead, or pathogens in four subwatersheds. Other contaminants included mercury, arsenic, total suspended solids (TSS), polychlorinated biphenyls (PCBs), and dissolved oxygen.

The pH, or acidity, of waters is very important, as it affects most chemical and biological reactions. Acidity is determined by a number of complex interactions and is affected by an area's geology. With increased acidity, water is more able to carry and dissolve substances. Acidity impairments may be due to pH levels that are too high or too low, depending on the natural level for the particular habitat.

Phosphorus exists naturally at low levels within the environment, although excess phosphorus can lead to harmful algae blooms that can lead to "dead zones," where no aquatic life can survive. Typical causes of phosphorus pollution include over-fertilization of lawns and agricultural areas; runoff from impervious surfaces like parking lots, lawns, rooftops, and roadways; discharge from waste-water treatment plants; and overflow from septic systems. Soil erosion is a major contributor of phosphorus to streams, and streambank erosion occurring during floods can transport high quantities of phosphorous into the water system.



Strawbridge Lake
Source: DVRPC

Copper, lead, mercury, and arsenic are all considered heavy, or toxic, metals. Trace amounts of some of these elements are essential to maintain the metabolism of the human body, although consuming them in larger doses can be toxic or poisonous. Heavy metals bioaccumulate, meaning they accumulate in the body and are not easily broken down, and become concentrated in predators after they consume large amounts of contaminated prey. The consumption of heavy metals can cause kidney and liver failure, bone defects, stomach and intestinal irritation, fetal deformities, acute or chronic damage to the nervous system, and various cancers. Heavy metals usually enter the water system through industrial processes, such as the manufacture of electronics, paint, batteries, bullets, metal, or lamps.

Pathogens are disease-causing bacteria, viruses, and protozoans that derive from the intestinal tracts of humans and animals. The consumption of pathogens can cause serious damage to the digestive system and can cause serious illness, or even death. Sources of pathogens include leaking septic tanks, wastewater-treatment discharge, and animal wastes.

E. coli (Escherichia coli) bacteria inhabit the intestinal tract of humans and other warm-blooded animals and enter waterways through human and animal waste. Levels of E. coli in water may increase after periods of flooding, when stormwater runoff may carry manure or animal waste into streams. Elevated levels of E. coli may be attributed to waste from Canada geese, among other sources. E. coli itself is not necessarily a health hazard, but it serves is an indicator of the presence of sewage or animal waste, which may contain other more harmful microbes that are not as easily monitored.

Polychlorinated biphenyls (PCBs) are considered a highly toxic persistent organic pollutant (POPs) and have been outlawed worldwide. POPs have long half-lives, bioaccumulate in the fatty tissue of animals, and are transmitted up the food chain. PCBs are byproducts of industrial processes used to make electrical, heat transfer, and hydraulic equipment; paints, plastics, and rubber products; pigments, dyes, and bleached paper; herbicides and pesticides; and many other industrial applications. Exposure to PCBs causes cancer and damages the immune, reproductive, nervous, and endocrine systems.

Dissolved oxygen (DO) is necessary for almost all aquatic life, so its concentration provides a good indicator of the health of an aquatic ecosystem. Under low DO conditions, fish are more susceptible to the effects of other pollutants, such as metals and toxics, and at very low DO levels, trace metals from sediments are released into the water column. Summer algal bloom die-off has been implicated as a cause of low DO concentrations.

Chlordane is a man-made chemical that was used as a pesticide from 1948 to 1988, when it was banned due to concern over its damage to the environment and human health. Like PCBs, chlordane does not break down easily and builds up in animal life and the environment. In humans, exposure to chlordane can affect the nervous system, digestive system, and liver. Small amounts can cause pain, sickness, and vision problems; large amounts can cause convulsions and death.

DDE is the ethylene metabolite equivalent of DDT, the pesticide used extensively in the 1940s and 1950s. DDD is similar to DDT, but it has only two chloroethylene molecules, compared to the three found in DDT. DDD has some medical use. DDT was effective in nearly eliminating typhus during World War II and has successfully combated malaria in many parts of the world, although it has been shown to have harmful effects on plant and animal life. Exposure to DDT impairs the nervous and immune systems in animals and is highly toxic, particularly for fish. It also causes eggshell thinning in birds, the primary reason why bald eagles and other large raptors became endangered in the United States. The prohibition of DDT enabled the eagle population to become reestablished.

Table 9: Integrated Water Quality Monitoring and Assessment Report, 2010

Subwatershed Name	Subwatershed ID	Water Type	Agricultural Water Supply	Aquatic Life (General)	Fish Consumption	Industrial Water Supply	Primary Contact Rec.	Public Water Supply	Sources of Contamination
Parkers Creek (above Marne Highway)	02040202080010	RIVER	Fully Supporting	Not Supporting: Phosphorus (Total)	Insufficient Information	Fully Supporting	Insufficient Information	Fully Supporting	• Transfer of Water from an Outside Watershed • Agriculture • Urban Runoff/Storm Sewers
Rancocas Creek (Martins Beach to NB/SB)	02040202080020	RIVER	Fully Supporting	Not Supporting: Phosphorus (Total)	Not Supporting: Phosphorus (Total)	Fully Supporting	Insufficient Information	Fully Supporting	• Municipal Point Source Discharges • Agriculture • Urban Runoff/Storm Sewers • Atmospheric Deposition - Toxics
Rancocas Creek (Rt 130 to Martins Beach)	02040202080040	FRESHWATER LAKE & RIVER	Insufficient Information	Insufficient Information	Not Supporting: Polychlorinated biphenyls	Insufficient Information	Insufficient Information	Insufficient Information	• Municipal Point Source Discharges • Agriculture • Urban Runoff/Storm Sewers • Atmospheric Deposition - Toxics
Swede Run	02040202090010	FRESHWATER LAKE & RIVER	Fully Supporting	Not Supporting: Oxygen, Dissolved	Not Supporting: Polychlorinated biphenyls	Fully Supporting	Insufficient Information	Not Supporting: Arsenic	• Agriculture • Urban Runoff/Storm Sewers • Atmospheric Deposition - Toxics

Subwatershed Name	Subwatershed ID	Water Type	Agricultural Water Supply	Aquatic Life (General)	Fish Consumption	Industrial Water Supply	Primary Contact Rec.	Public Water Supply	Sources of Contamination
Pompeston Creek (above Rt 130)	02040202090020	FRESHWATER LAKE & RIVER	Insufficient Information	Not Supporting: pH, Oxygen, Dissolved & Phosphorus (Total)	Insufficient Information	Insufficient Information	Not Supporting: Escherichia coli	Fully Supporting	• Agriculture • Urban Runoff/Storm Sewers
Pennsauken Ck NB (above NJTPK)	02040202100010	RIVER	Insufficient Information	Fully Supporting	Insufficient Information	Insufficient Information	Not Supporting: Fecal coliform	Insufficient Information	• Agriculture • Urban Runoff/Storm Sewers
Pennsauken Ck NB (incl StrwbrdgLk-NJTPK)	02040202100020	FRESHWATER LAKE & RIVER	Fully Supporting	Not Supporting: Phosphorus (Total)	Not Supporting: Chlordane, DDD, DDE, DDT, Mercury, PCB in fish tissue	Fully Supporting	Not Supporting: Fecal coliform	Not Supporting: Arsenic	• Industrial Point Source Discharge • Agriculture • Urban Runoff/Storm Sewers • Source Unknown • Atmospheric Deposition - Toxics
Pennsauken Ck NB (below Strawbridge Lk)	02040202100030	RIVER	Fully Supporting	Not Supporting: Cause Unknown	Insufficient Information	Fully Supporting	Not Supporting: Fecal coliform	Not Supporting: Arsenic	• Urban Runoff/Storm Sewers • Industrial Point Source Discharge •Municipal Point Source Discharges •Agriculture

Source: NJDEP, 2010

Total Maximum Daily Loads (TMDLs)

Pompeston Creek
Source: DVRPC

For impaired waterways with a high-priority ranking for remediation, the state is required by the EPA to establish a Total Maximum Daily Load (TMDL). A TMDL quantifies the amount of a pollutant that a waterbody can assimilate (its loading capacity) without violating water quality standards. The purpose of a TMDL is to initiate a management approach or restoration plan based on identifying the sources of a pollutant and determining the percentage reductions of the pollutant that must be achieved by each source. These sources can be point sources, such as sewage treatment plants, or nonpoint sources, such as stormwater runoff. A TMDL goes through four stages. First, it is proposed in a report by NJDEP, then it is established when NJDEP finalizes its report, next it is approved by EPA, and finally it is adopted when NJDEP adopts it as an amendment to a water quality management plan.

In general, implementation of a TMDL relies on actions mandated by the Municipal Stormwater Management program, which includes the ordinances that municipalities are required to adopt under that program. It also depends on voluntary improvements in stormwater management in agricultural and other areas.

A TMDL determines the percentage reduction needed in order for a stream segment to meet the water quality standard. Nonpoint stormwater sources are the largest contributors, as runoff from various land uses transports pollutants into waterbodies during rain events. Nonpoint sources also include inputs from sources, such as failing sewage conveyance systems, sanitary sewer overflows, and failing or inappropriately located septic systems.

None of the subwatersheds that Moorestown falls within are located on the state's TMDL schedule with a high priority for remediation.

There are eight subwatersheds with a medium priority for remediation. As seen in the table below, four of these TMDLs are for the reduction of pathogens, three are for phosphorus, and one is for both pathogens and phosphorus. There are four subwatersheds where polychlorinated biphenyls (PCBS) are present in the water or in fish tissue. Fecal coliform was present in two subwatersheds, and pH TMDLs were present in one subwatershed. The North Branch of Pennsauken Creek (including Strawbridge Lake) had elevated levels of DDD, DDE, DDT, mercury, PCBs, and arsenic.

Table 10: TMDLs for Impaired Waters in Moorestown, 2010

HUC 14 ID	HUC 14 Subwatershed Name	Priority Rank	Use	Cause	Cycle First Listed
02040202080010	Parkers Creek (above Marne Highway)	Medium	Aquatic Life	Phosphorus (Total)	2006
2040202080020	Rancocas Creek (Martins Beach to NB/SB)	Medium	Aquatic Life	Phosphorus (Total)	2006
			Fish Consumption	Polychlorinated biphenyls	2006
2040202080040	Rancocas Creek (Rt 130 to Martins Beach)	Medium	Fish Consumption	Polychlorinated biphenyls	2010
2040202090010	Swede Run	Medium	Aquatic Life	Oxygen, Dissolved	2008
			Fish Consumption	Polychlorinated biphenyls	2006
			Public Water Supply	Arsenic	2008
2040202090020	Pompeston Creek (above Rt 130)	Medium	Aquatic Life	Oxygen, Dissolved	2010
				pH	2010
				Phosphorus (Total)	2008
			Primary Contact Recreation	Escherichia coli	2008
2040202100010	Pennsauken Ck NB (above NJTPK)	Medium	Primary Contact Recreation	Escherichia coli	2008
02040202100020	Pennsauken Ck NB (incl StrwbrdgLk-NJTPK)	Medium	Fish Consumption	Chlordane	2008
				DDD, DDE, DDT	2008
				Mercury	2008
		Medium	Aquatic Life	Polychlorinated biphenyls	2008
		Medium	Primary Contact Recreation	Fecal coliform	2006
		Medium	Public Water Supply	Arsenic	2006

HUC 14 ID	HUC 14 Subwatershed Name	Priority Rank	Use	Cause	Cycle First Listed
2040202100030	Pennsauken Ck NB (below Strawbridge Lk)	Medium	Aquatic Life	Cause Unknown	2008
		Medium	Primary Contact Recreation	Fecal coliform	2006
		Medium	Public Water Supply	Arsenic	2006

Source: NJDEP, 2010

Water Quality Monitoring Networks

New Jersey's *Integrated Report* is based on the water quality assessments of a number of different monitoring networks. The Ambient Stream Monitoring Network (ASMN) and the Ambient Biological Monitoring Network (AMNET) are the two primary sources of surface water monitoring data. Beyond the information included in the *Integrated Report*, additional water quality data gathered from these monitoring stations is available through the USGS and the NJDEP.

Bridge over Swede Run
Source: DVRPC

The ASMN is a cooperative network between USGS and NJDEP that samples surface water quality at 112 stations in the state. ASMN stations monitor stream flow, as well as temperature, dissolved oxygen (DO), pH, carbon dioxide, nitrogen, ammonia, phosphorus, arsenic, and many other parameters. AMNET is another water quality monitoring system that the Integrated Report is based upon. AMNET, administered solely by NJDEP, consists of over 800 stream sites in the state and provides long-term biological data. The program routinely samples and evaluates the benthic macroinvertebrate population at each site as a biological indicator of water quality. Benthic macroinvertebrates are bottom-dwelling aquatic insects, worms, mollusks, and crustaceans that are large enough to be seen by the naked eye.

There are nine stations that monitor the water quality of the watersheds of Moorestown, listed in the table below. Three of these stations are shared by both the ASMN and AMNET networks. There are another three that are in either the ASMN or AMNET networks. Beyond the information included in the Integrated Report, additional water quality data gathered from these monitoring stations is available through the USGS and the NJDEP.

Table 11: Stream Monitoring Network Stations for Moorestown Watersheds

HUC 14 ID	HUC 14 Name	ASMN ID	AMNET ID	Station Name
02040202080020	Rancocas Creek (Martins Beach to NB/SB)	01467011	AN0174	Parkers Creek at Creek Rd and Centerton Rd
02040202090010	Swede Run	01467027	AN0176	Swede Run Rt 130 Bridge D316-151/3944
02040202100010	Pennsauken Ck NB (above NJTPK)	01467066	-	North Branch Pennsauken Creek at Gaither Drive and Fellowship Rd
		01467063	-	North Branch Pennsauken Creek at Mt Laurel
		-	AN0178	North Branch Pennsauken Creek at Church Rd
		-	AN0179	North Branch Pennsauken Creek at Fellowship Rd
02040202100020	Pennsauken Ck NB (incl StrwbrdgLk-NJTPK)	01467069	-	North Branch Pennsauken Creek near Moorestown
02040202100030	Pennsauken Ck NB (below Strawbridge Lk)	01467072	AN0181	North Branch Pennsauken Creek at Fork Landing Rd
		-	AN0180	North Branch Pennsauken Creek at Rt 537 Bridge B461

Source: NJDEP, 2009

Parkers Creek
Source: DVRPC

Knowing the actual condition of streams and steam banks, and planning for their improvement, requires more frequent surveying and monitoring than the state can provide. The state primarily monitors main channels in non-tidal areas, and only does biological assessments through AMNET on a five-year cycle. A community may benefit from additional stream surveys by local organizations, along with regular monitoring of water quality on all local waterways.

Other Monitoring

Certain fish may contain toxic chemicals, such as PCBs, dioxins, or mercury, which accumulate in bottom sediments and aquatic life, including fish tissue. Chemical contaminants, such as dioxin and PCBs, are classified by the U.S. Environmental Protection Agency as probable cancer-causing substances in humans. Elevated levels of mercury can pose health risks to the human nervous system. Infants, children, pregnant women, nursing mothers, and women of childbearing age are considered to be at higher risk from contaminants in fish than other members of the general public. Since 1982, NJDEP has been catching fish at numerous sampling stations throughout the state and testing for contaminant levels. It then adopts advisories to guide residents on safe consumption practices.

The consumption advisories for fish caught in general freshwater are listed in the table below. Within Moorestown, there are additional fish consumption advisories (which supersede the general advisories) for two species of fish in Rancocas Creek, Pompeston Creek/Swede's Run, Strawbridge Lake and/or Pennsauken Creek. More details on preparation and consumption of fish are found at the advisory website: www.state.nj.us/dep/dsr/njmainfish.htm

Table 12: Fish Consumption Advisories, 2012

<table>
<tr><th rowspan="2">Species</th><th>General Population</th><th>High-Risk Individuals</th></tr>
<tr><th>Eat No More Than:</th><th>Eat No More Than:</th></tr>
<tr><td colspan="3">General Freshwater Advisories</td></tr>
<tr><td>Trout (Brown, Brook, Rainbow)</td><td rowspan="4">One Meal Per Week</td><td>One Meal Per Week</td></tr>
<tr><td>Largemouth Bass</td><td rowspan="5">One Meal Per Month</td></tr>
<tr><td>Smallmouth Bass</td></tr>
<tr><td>Chain Pickerel</td></tr>
<tr><td>Yellow Bullhead</td><td rowspan="3">No Restrictions</td></tr>
<tr><td>Brown Bullhead</td></tr>
<tr><td>Sunfish</td><td>One Meal Per Week</td></tr>
<tr><td colspan="3">Rancocas Creek, Pompeston Creek/Swede's Run, Strawbridge Lake and/or Pennsauken Creek</td></tr>
<tr><td>Common Carp</td><td>Four meals per year</td><td>Do not eat</td></tr>
<tr><td>Bluegill Sunfish</td><td>One meal per month</td><td>One meal per year</td></tr>
</table>

Source: NJDEP, 2012

Causes of Water Quality Impairments

Point Sources of Pollution

Point sources of pollution, which come from a single source, or "point," such as an industrial pipe discharge, are regulated by NJDEP through the New Jersey Pollution Discharge Elimination System (NJPDES). New Jersey created NJPDES in response to the Federal Clean Water Act of 1972, which mandated that each state develop water quality standards and regulate the amount of pollution entering water bodies. The act classified all water pollution into one of two categories: "point source" pollution coming from a single source, such as an industrial pipe; and "nonpoint source" pollution, which comes from many diffuse sources. Although the Federal Clean Water Act only required states to regulate point sources, New Jersey also regulates nonpoint sources through authority of the NJPDES rules. See **Nonpoint Sources of Pollution**.

NJDEP, through the Division of Water Quality and the Bureau of Point Source Permitting, administers the NJPDES program. Under NJPDES, any facility discharging over 2,000 gallons per day (gpd) of wastewater directly into surface water or ground water (generally through a septic system) must apply for and obtain a permit for discharging. Rather than creating individually tailored permits for each and every facility, the Division of Water Quality uses scientific standards to create and issue general permits for different categories of dischargers. NJDEP enforces the terms of the NJPDES permit by visiting discharging facilities and requiring facilities to periodically conduct and submit water quality, biological and toxicological analyses, and thermal impact and cooling water assessments.

As of August 2012, 32 NJPDES permits for point source pollution were issued to individual facilities in Moorestown. These are shown in **Table 13: NJPDES Permits for Point Source Pollution**. Of the 32 permits, one discharges to surface water (codes A, B, ABR), one discharges to groundwater (code T1, GW), 10 discharge to stormwater (code 5G2), and none are a land application of residuals (code D).

Although the NJPDES program has made much progress in regulating point source discharges, a great number of minor discharges have been allowed without regard to their cumulative impact on surface water quality. Environmental commissioners and town clerks receive notice from NJDEP when anyone applies for a permit to discharge to surface water under the New Jersey Pollution Discharge Elimination System (NJPDES). The commissions should examine the application and evaluate the proposal–the need for the permit, the location of the discharge, and the potential negative impacts. They should communicate their findings to NJDEP, the applicant, and the town.

Rancocas Creek

Source: Kerry Miller

Table 13: NJPDES Permits for Point Source Pollution

NJPDES Permit Number	PI Number	Facility Name	Effective Start Date	Expiration Date*	Discharge Category Code	Discharge Category Description
NJG0194361	561067	308 Rt 38 Parking Modification	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)
NJG0172316	479420	Bamberger Beth DMD	10/1/2008	9/30/2012	K2	Dental Facilities Onsite Wastewater Treatment Systems (GP)
NJG0143839	195325	Chemique Inc	6/1/2007	5/31/2012	5G2	Basic Industrial Stormwater GP - NJ0088315 (5G2)
NJ0137812	87757	Coca-Cola Refreshments - Moorestown	12/1/2011	6/30/2012	L	Significant Indirect User
NJG0163317	87757	Coca-Cola Refreshments - Moorestown	6/1/2007	5/31/2012	5G2	Basic Industrial Stormwater GP - NJ0088315 (5G2)
NJ0103535	47500	Combat Systems Engineering Dev Site (CSEDS)	6/1/2009	5/31/2014	GW	Discharge to Groundwater
NJG0161390	47500	Combat Systems Engineering Dev Site (CSEDS)	6/1/2007	5/31/2012	5G2	Basic Industrial Stormwater GP - NJ0088315 (5G2)
NJG0029548	46638	Hartford Road WTP	4/1/2012	3/31/2017	BPW	Potable Water Treatment Plant (GP)
NJG0101320	46638	Hartford Road WTP	12/1/2008	11/30/2013	I2	Potable WTP Basins & Drying Beds (GP)
NJ0079324	47161	IMCO Inc	6/1/2010	5/31/2015	L	Significant Indirect User
NJG0143227	47161	IMCO Inc	6/1/2007	5/31/2012	5G2	Basic Industrial Stormwater GP - NJ0088315 (5G2)
NJG0195880	563353	Lockheed Martin Building 140	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)
NJG0161209	46829	Lockheed Martin MS2	6/1/2007	5/31/2012	5G2	Basic Industrial Stormwater GP - NJ0088315 (5G2)
NJG0199672	568706	Madeira - Residential Subdivision	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)

NJPDES Permit Number	PI Number	Facility Name	Effective Start Date	Expiration Date*	Discharge Category Code	Discharge Category Description
NJG0199605	568632	Madeira - Site Plan	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)
NJG0170895	464794	Masco Bath Corp	5/15/2008	5/31/2012	5G2	Basic Industrial Stormwater GP - NJ0088315 (5G2)
NJG0162248	280413	Mayberry Riggers Inc	6/1/2007	5/31/2012	5G2	Basic Industrial Stormwater GP - NJ0088315 (5G2)
NJG0192457	558722	Moorestown Ambulatory Care Ctr	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)
NJG0206245	581136	Moorestown Library/Town Hall Complex	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)
NJG0176419	207630	Moorestown Twp	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)
NJ0024996	46637	Moorestown Twp WWTP	12/1/2008	11/30/2013	A	Sanitary Wastewater
NJG0157422	46637	Moorestown Twp WWTP	6/1/2007	5/31/2012	5G2	Basic Industrial Stormwater GP - NJ0088315 (5G2)
NJG0196452	564448	Opex Corp Solar Project	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)
NJG0207675	585383	P-237 CSEDS Building Addition	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)
NJG0197025	565129	Preliminary & Final Major Site Plan- Needlema	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)
NJG0202436	573029	Pryor Park	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)
NJG0187089	546686	QTG-CDSD Moorestown	12/14/2010	5/31/2012	5G2	Basic Industrial Stormwater GP - NJ0088315 (5G2)
NJG0181048	531211	Single Family Home	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)
NJG0143171	194735	The Jet Pulverizer Co	6/1/2007	5/31/2012	5G2	Basic Industrial Stormwater GP - NJ0088315 (5G2)

NJPDES Permit Number	PI Number	Facility Name	Effective Start Date	Expiration Date*	Discharge Category Code	Discharge Category Description
NJG0186791	546218	The Preserve At Willowbrook	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)
NJG0203131	574510	Wesley Bishop Park (North & South)	3/1/2012	2/28/2017	5G3	Construction Activity Stormwater (GP)

Source: NJDEP, 2012

Nonpoint Sources of Pollution

Since the adoption of the Federal Clean Water Act and the implementation of the NJPDES program in subsequent years, water pollution from point sources has decreased dramatically. However, as development has continued to spread throughout New Jersey, nonpoint source pollution has increased substantially in recent decades. Nonpoint source pollution, or stormwater runoff, has the largest effect on the water quality and channel health of streams in Moorestown Township. According to US EPA, about half the pollution in New Jersey's surface water comes from nonpoint sources. Development dramatically increases nonpoint source pollution by increasing the volume of water and the level of pollutants in the runoff. Increased runoff causes erosion and sediment buildup in streams, carries nutrients from fertilizers, and washes toxics, bacterial contamination, road salt, motor oils, and litter into the stream.

The sources of polluted stormwater runoff are also the most difficult to identify and remediate because they are diffuse, widespread, and cumulative. Most nonpoint source pollution in Moorestown Township derives from stormwater runoff from paved surfaces, such as streets, commercial and industrial areas, residential sites (with and without detention basins), and agricultural fields lacking adequate vegetative buffers. The waterways in Moorestown are affected by stormwater runoff both from within the township and upstream municipalities, and runoff generated in Moorestown contributes to downstream impacts.

NJDEP's Stormwater Management Rules focus on reducing and controlling nonpoint sources of water pollution. The Municipal Stormwater Regulation Program was developed and established four NJPDES general permits: the Tier A Municipal Stormwater General Permit (Tier A Permit) for more populous municipalities; the Tier B Municipal Stormwater General Permit (Tier B Permit) for rural communities; the Public Complex Stormwater General Permit (Public Complex Permit); and the Highway Agency Stormwater General Permit (Highway Permit). Moorestown Township is a Tier A municipality with a valid Tier A Permit (NJG0150215).

The NJPDES Stormwater program lays out guidance and requirements for management of and education about stormwater at the local level. Municipalities were required to obtain the NJPDES general permit for the stormwater system and its discharges within their borders, which are considered to be owned and "operated" by the municipality. The general permits address stormwater quality issues related to new development, redevelopment, and existing development by requiring regulated entities to implement Statewide Basic Requirements (SBRs).

Stream Buffers

The stream buffer is the region immediately beyond the banks of a stream that serves to limit the entrance of sediment, pollutants, and nutrients into the stream itself. Stream buffers are quite effective at filtering substances washing off the land. The vegetation of the buffer traps sediment and can actually utilize (uptake) a percentage of the nutrients flowing from lawns and farm fields. When forested, a stream buffer promotes bank stability and serves as a major control of water temperature. The buffer region also serves as a green corridor, or greenway, for wildlife to move between larger forested habitat areas. Residents can utilize these greenways for recreation with the addition of trails, bikeways, and access points to water for fishing and launching canoes and kayaks.

The importance of a healthy, intact buffer zone (also referred to as a “riparian corridor”)–especially for headwater streams–has been well documented scientifically over the past 20 years. However, there is less agreement and much continuing research on the appropriate minimum width of a buffer. In the literature on this issue, a recommended minimum buffer width of 100 feet is most common, with differing activities permitted in each of three zones within the buffer. Buffers of up to 300 feet are recommended for wildlife corridors and potential passive recreational use, such as walking trails.

The New Jersey Freshwater Wetlands Protection Act incorporates buffer requirements into its wetland protection regulations. The width of the “transition zone” extending beyond a wetland is determined by the value of the wetland, based on its current use and on the documented presence/absence of threatened or endangered species. Municipalities may not establish buffers on wetlands that exceed those required by the state statute. However, the municipality can make certain that those limits are accurate through its review of the wetlands delineation process, and it can also monitor use of the land within the transition area and take action against encroachments.

As shown in **Map 16: Natural Vegetation (2007)**, most of the streams in Moorestown are bordered by wooded riparian buffers of varying widths.

Protecting riparian areas from development and enhancing or maintaining healthy vegetation in the stream corridor can help improve water quality, reduce flooding, and encourage biodiversity. Environmental commissions can encourage the preservation of existing vegetation and replanting of native vegetation along bare stream banks. Use of native vegetation in landscaping minimizes the need for pesticide and fertilizer use, and requires less frequent watering and mowing.

Groundwater

The geology of the New Jersey Coastal Plain can be visualized as a tilted layer cake, with its “layers,” or strata, formed of gravels, sands, silts, and clays. The saturated gravel and sand layers, with their large pore spaces, are the aquifers from which water is drawn. The silt and clay layers, which impede the movement of water, are called confining beds.

A cross-section across southern New Jersey from west to east (see **Figure 7**) would show that the aquifers are not horizontal, but tilted toward the southeast, getting deeper as they cross the state toward the Atlantic Ocean. Because of this tilting, each aquifer emerges on the land surface in a sequential manner. The deepest strata emerge on the surface near the Delaware River. Where each individual layer emerges is called its “outcrop” area.

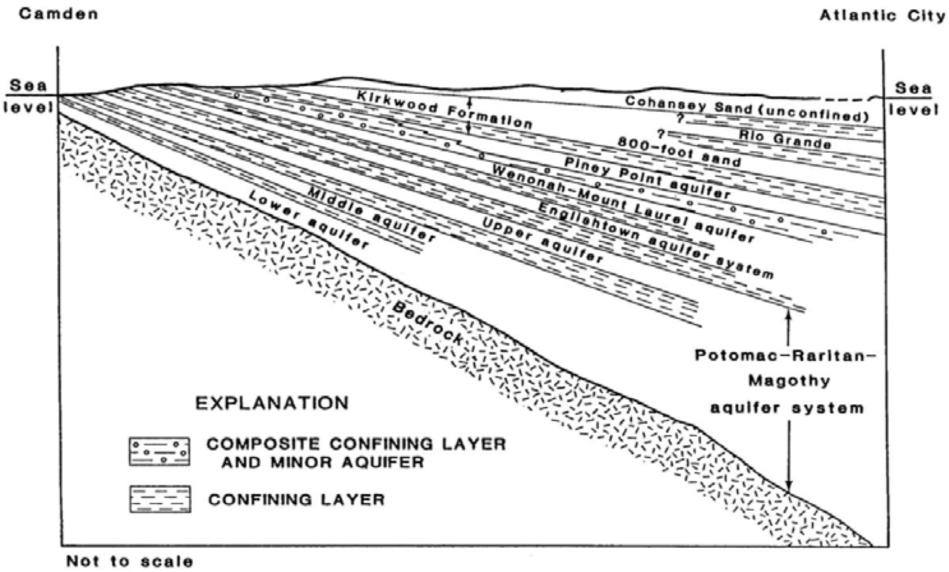


Figure 7: Aquifers of Southern New Jersey along a line from Camden to Atlantic City

Source: United States Geological Survey

The Potomac–Raritan–Magothy (PRM) formation is the deepest and most abundant aquifer. Other smaller aquifers on top of the PRM are the Englishtown and the Wenonah-Mount Laurel. The Kirkwood-Cohansey is a large formation that begins at the divide between the Inner and Outer Coastal Plain.

An outcrop is the area where the aquifer emerges on the land surface. Preventing contamination of the land in outcrop areas is extremely important in order to maintain a safe drinking supply. Confining units may also outcrop. Also known as an aquitard, a confining unit is an impenetrable layer of fine, compact clay that divides one aquifer from another.

As shown in **Map 13: Geologic Outcrops**, the Englishtown aquifer system outcrops in a band along the southern portion of the township, and the Merchantville and Woodbury formations outcrop along the center and northern portions. The Merchantville and Woodbury formations form a confining unit separating the Englishtown aquifer from the PRM aquifer system.

The public water supply wells located in and bordering Moorestown all tap into the PRM aquifer system. Some private wells may draw from the Englishtown aquifer system as well, although public data is not available on private wells. The public wells in Moorestown are shown on **Map 14: Public Water Supply Wells**. In addition to the water drawn from the wells, the Moorestown Water Department also purchases water from the Delaware River through New Jersey American Water.

The Potomac-Raritan-Magothy (PRM) is a deep geological formation underlying Moorestown. This multiple aquifer is actually a large series of formations that have been combined and described as a single unit because the individual formations–the Potomac group and the Raritan and Magothy formations–are lithologically indistinguishable from one another over large areas of the Coastal Plain. That is, they are composed of materials of like kind and size laid down by both an advancing and retreating sea across southern New Jersey, and by deposits of material that came from the breakdown and erosion of the Appalachian and Catskill mountains beginning in the Cretaceous Period.

In the Delaware Valley, three aquifers have been distinguished within the PRM system, designated as lower, middle, and upper, and divided by two confining units or layers between the three water-bearing strata. The aquifers themselves are largely made up of sands and gravels, locally inter bedded with silt and clay. The lower aquifer sits on the bedrock surface. Confining beds between the aquifers are composed primarily of very fine-grained silt and clay sediments, which are less permeable and thus reduce the movement of water between the aquifers. They also help to slow the entry of any contaminants on the surface down into the groundwater.

Water Supply Wells

Wells that provide drinking water may be either private or public water supply wells. Private water supply wells are those that serve less than 25 people and are not regulated by the EPA or DEP. On the other hand, public water supply wells–which may be publically or privately owned–are those that serve at least 25 people or 15 service connections for at least 60 days per year. According to the EPA, public water supply wells serve 90 percent of the people of the United States with drinking water. Public water supply wells are further defined as being either community or non-community. A public community water supply well serves 15 or more service connections used by year-round residents, or at least 25 year-round residents. Public community water supply wells may serve municipalities, subdivisions, nursing homes, or other areas or institutions.

There are seven active public community water supply wells serving Moorestown Township and four wells serving the Maple Shade Water Department, listed in **Table 14: Public Community Water Supply Wells** below. The Moorestown Township wells are shown on **Map 14: Public Water Supply Wells**.

Moorestown Township Water Tower

Source: Joan Ponessa

Table 14: Public Community Water Supply Wells In or Bordering Moorestown

Well ID	Well Permit	Owner	Well Name	Well Address	Date of Well Completion	Finished Depth of Well	Primary Geologic Unit	Hydrologic Unit	Pumping Capacity (gal/min)
WSWL0000067225	3100000060	Maple Shade Water Dept	Well 2	Rte 73 & Rte 537	11/09/1949	121	Magothy Formation	Upper Potomac-Raritan-Magothy Aquifer	140
WSWL0000077232	3100074649	Maple Shade Water Dept	Well 8A	Rte 73 & Rte 537	10/15/2003	289	Raritan Formation - Farrington Sand member	Middle Potomac-Raritan-Magothy Aquifer	1,250
WSWL0000067557	3100012925	Maple Shade Water Dept	Well 11	Rte 73 & Rte 537	02/17/1978	450	Potomac Formation	Lower Potomac-Raritan-Magothy Aquifer	1,250
WSWL0000077233	3100074648	Maple Shade Water Dept	Well 12	Main Street Water Treatment Facility	01/27/2004	458	Potomac Formation	Lower Potomac-Raritan-Magothy Aquifer	1,250
WSWL0000070476	5100000041	Moorestown Township	Well 3	Kings Hwy	04/02/1942	299	Raritan Formation - Farrington Sand member	Middle Potomac-Raritan-Magothy Aquifer	700
WSWL0000067301	3100003806	Moorestown Township	Well 4	510 Hartford Rd	05/07/1959	340	Raritan Formation - Farrington Sand member	Middle Potomac-Raritan-Magothy Aquifer	700
WSWL0000067346	3100004663	Moorestown Township	Well 5	Kings Hwy	11/19/1963	288	Raritan Formation - Farrington Sand member	Middle Potomac-Raritan-Magothy Aquifer	805
WSWL0000067353	3100004727	Moorestown Township	Well 6	Kings Hwy	10/29/1963	288	Raritan Formation - Farrington Sand member	Middle Potomac-Raritan-Magothy Aquifer	700

Well ID	Well Permit	Owner	Well Name	Well Address	Date of Well Completion	Finished Depth of Well	Primary Geologic Unit	Hydrologic Unit	Pumping Capacity (gal/min)
WSWL0000191576	3100050729	Moorestown Township	Well 7	North Church St	05/02/1997	405	Magothy, Raritan, and Potomac Formations	Potomac-Raritan-Magothy Aquifer System	0
WSWL0000067451	3100005387	Moorestown Township	Well 8	Hartford Rd	07/02/1969	332	Raritan Formation - Farrington Sand member	Middle Potomac-Raritan-Magothy Aquifer	700
WSWL965394	E201110960	Moorestown Township	Well 9	North Church St	11/11/2011	405	Magothy, Raritan, and Potomac Formations	Potomac-Raritan-Magothy Aquifer System	2,000

Source: NJDEP, 2009, Moorestown Township, 2013

Public non-community wells are another part of a public water system. There are two types of public non-community water systems: transient and non-transient. The name refers to the type of populations that utilize them and their frequency of use. A transient non-community water system serves at least 25 people each day, but this population changes each day. These systems are at places such as rest stops, gas stations, and restaurants. A non-transient non-community water system serves at least 25 of the same people daily at a minimum of six months per year at places like schools, factories, and office parks.

There are no public non-community wells directly within Moorestown, although there are four located near the municipal border in the townships of Maple Shade and Mount Laurel. They are listed in **Table 15: Public Non-Community Water Supply Wells Serving Moorestown** and shown on **Map 14: Public Water Supply Wells**.

Table 15: Public Non-Community Water Supply Wells Serving Moorestown

Well ID	Well Permit #	System Name	Well Permit	Well Name	Depth of Well
3311	0324314	Laurel Creek Country Club	-	Well	180
3306	0324300	NJ Turnpike / 4N Service Area	31-00212	Well 4N-1	222
3307	0324300	NJ Turnpike / 4N Service Area	31-00213	Well 4N-2	180
3246	0319303	Produce Junction	-	Well	180

Source: NJDEP, 2009

Private Drinking Wells

Private wells supplying potable water are not routinely monitored like public community water systems (public water) and public non-community wells. However, beginning in 2002, the State of New Jersey, under the Private Well Testing Act, required that well water be tested for contaminants when properties are sold or leased. Prior to 2002, each county health department mandated what parameters were to be tested for real estate transactions.

As required by federal and state regulations, public water supply wells (both community and non-community) in the state are monitored by NJDEP on a regular basis. The monitoring schedules for the public water supply wells serving Moorestown are shown in **Appendix D: Moorestown Drinking Water**.

Sampling requirements for a water system may change at any time for several reasons, including analytical results, changes in population, and/or inventory. It is generally the responsibility of the public water system and its licensed operator to make sure that proper monitoring is performed for the entire distribution system and each point of entry for all parameters. Sampling requirements may be confirmed by referring to the Code of Federal Regulations (40 CFR 141) and the New Jersey Safe Drinking Water Act Regulations (N.J.A.C. 7:10).

Air Quality

Air quality is one of the most difficult environmental resources to measure because its sources are diffuse and regional in nature. Common sources of air pollution include industry, cars, trucks, buses, fires, and dust. For example, the burning of coal in Ohio, Michigan, and Western Pennsylvania to generate electricity sends pollutants such as sulfur, nitrogen, and particulate matter all the way to the East Coast. Locally produced sources of air pollution include daily roadway traffic and industrial facilities.

Increasing public awareness regarding air pollution led to the passage of a number of state and federal laws, including the original Clean Air Act of 1963 and a much stronger Clean Air Act of 1970 (CAA). In 1990, the CAA was amended and expanded by Congress to include a market approach to reducing air pollution by allowing certain companies to buy and sell emission "allowances," or "credits." The 1990 CAA also required transportation projects receiving federal funding to be in conformity with state air quality goals. The 1990 CAA also revised the way that air toxins are regulated, increasing the number of regulated toxic air pollutants from seven to 187.

Between 1970 and 2007, total emissions of the six criteria air pollutants decreased by more than 50 percent. The industrial sector reduced its toxic air emissions by 70 percent during this time period. Stricter emissions standards in the auto industry have made cars 90 percent "cleaner" since 1970. Cars also pollute less because refineries are required to produce cleaner fuels; leaded gasoline was completely banned in 1996.

Criteria Pollutants

Ground level ozone (O_3) is formed when volatile organic compounds (VOC) and nitrogen oxides react with sunlight and heat. It is produced more in the summer months and is the primary constituent of smog. Ground level ozone is a pulmonary irritant, which, even in low levels, can be dangerous to sensitive populations, such as people with asthma or emphysema, and the elderly. It can also affect plant growth and is responsible for hundreds of millions of dollars in lost crop production.

Particulate matter (PM), or particle pollution, is made up of dust, ash, smoke, and other small particles formed from the burning or crushing of materials such as wood, rocks, and oil. When ingested, particulate matter can lodge deep in the lungs and can contribute to serious respiratory illnesses, such as asthma or lung disease. Particulate matter also creates haze, reduces visibility, and covers buildings in dirty soot.

Carbon monoxide (CO) is a colorless, odorless gas that is formed when carbon fuel is not burned completely. It is a component of motor vehicle exhaust; therefore, higher levels of CO generally occur in areas with heavy traffic congestion. The highest levels of CO typically occur during the colder months, when air pollution becomes trapped near the ground beneath a layer of rising warm air.

Nitrogen oxides (NOx) are a group of highly reactive gases that contain nitrogen and oxygen in varying amounts. Motor vehicles, electric utilities, and homes and businesses that burn fuels emit nitrogen oxides; they can also be found naturally. Nitrogen oxides are primary components in ground-level ozone (smog), acid precipitation, and other toxic chemicals. Acid precipitation can cause lung ailments in humans, property damage, harm to aquatic life, and other environmental and human health problems.

Sulfur dioxide (SO_2) is released into the atmosphere when fuel containing sulfur, such as coal and oil, is burned, and when gasoline is refined from oil. Sulfur dioxide dissolves in water vapor to form acid precipitation.

Lead (Pb) is a pollutant that was historically released by cars and trucks burning leaded fuel, but metals processing plants and trash incinerators are the major source of emissions today. Lead tends to be a localized air pollutant, found in urban or high traffic areas, and is deposited in soil and water, harming fish and wildlife.

Air Quality Index

The Air Quality Index (AQI) is an index for reporting air quality on a daily basis. The EPA created the AQI to indicate a region's air quality by measuring levels of five of the six criteria pollutants (excluding lead). The AQI is focused on the potential human health hazards experienced by breathing unhealthy air. Scores for the AQI range from 0 to 500 and are divided into six color-coded categories, as shown in **Figure 8: Air Quality Index (AQI)** below. The higher the AQI value, the greater the level of air pollution and associated health concerns.

Figure 8: Air Quality Index (AQI)

Numerical Air Quality Index (AQI) Rating	Descriptive Rating: Levels of Health Concern	AQI Color Code
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

Source: NJDEP

The daily score is based on the highest individual pollutant score reported. For example, if ozone scored 150 and particulate matter scored 100, the daily AQI would be 150, which is considered "Unhealthy for Sensitive Groups." The index is also used to measure overall air quality by counting the number of days per year when the AQI of each metropolitan region exceeds 100. An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level the EPA has set to protect public health.

New Jersey is divided into nine regions, which report their respective AQI. Burlington County is in Region 5: Central Delaware Valley. The monitoring stations for Region 5 are located in Ewing Township and Rider University. In 2011, the most recent year of annual data, Region 5 reported 320 good (green) and 38 moderate (yellow) days, seven days that were unhealthy for sensitive groups (orange), and zero unhealthy, very unhealthy, or hazardous (red, purple, and maroon) days.

Local Point Sources of Air Quality Pollution

Under the CAA, the EPA limits the amount of other air pollutants and toxins that are emitted by point sources, such as chemical plants, industrial factories, power plants, and steel mills. The NJDEP Air Quality Permitting Program issues permits for stationary sources of air pollution, such as power plants, oil refineries, dry cleaners, food processing centers, and manufacturing plants, and regulates and monitors their emissions. There are 49 active air quality permits in Moorestown, listed below in **Table 16: Facilities with Active Air Quality Permits**.

Table 16: Facilities with Active Air Quality Permits

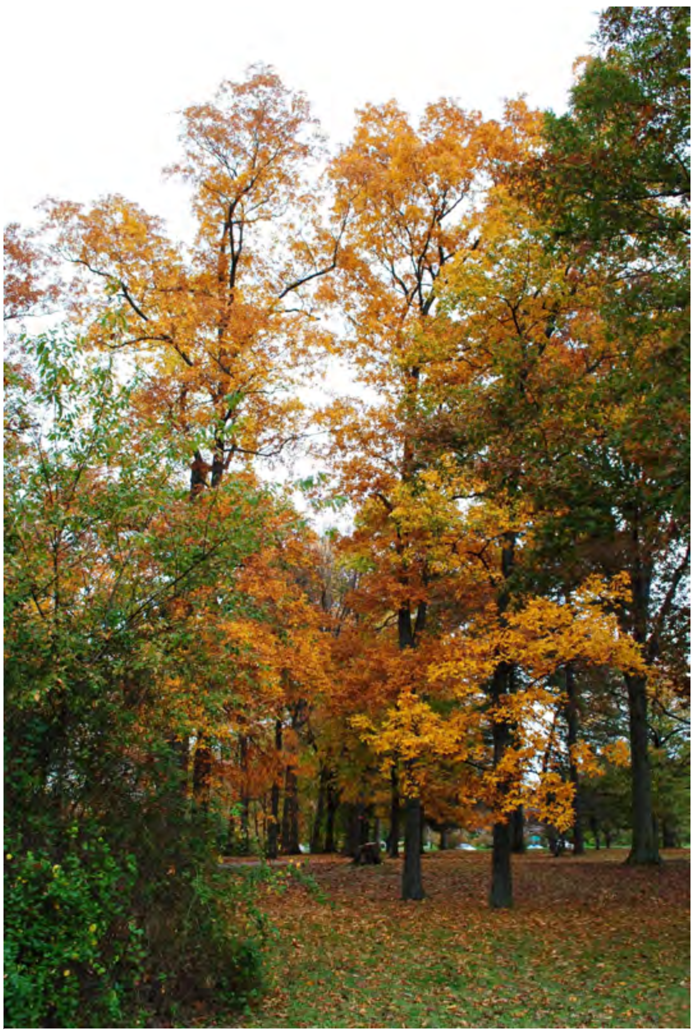
Facility Name	Address	PI Number
308 Harper Drive Office Building	308 Harper Drive	46115
ADT Security Services Inc	50 Twosome Drive	46148
American Biltrite Inc	105 Whittendale Drive	46046
Arfa Enterprises Inc	105 Camden Ave	A9498
Cardinal Press	1253 Glen Ave	45533
CareOne Harmony Village At Moorestown	301 N Stanwick Road	46431
CareOne at Moorestown	895 Westfield Ave	46430
Chapel 2000 and Beyond Inc	1537 Glen Ave	46071
Clondalkin Pharma and Healthcare Inc	1224 Church Road	46143
Comcast Commercial Services Group Holdings	650 Centerton Road	46105
Denglas Technologies LLC	1259 N Church Street	46025
Denton Vacuum LLC	1259 N Church Street	46066
Electro Magnetic Products	355 Crider Ave	45140
Evergreen's Con Care Community	309 Bridgeboro Road	45514
Former Citgo Service Station-Ward's Garage	2 E Main	45327
George C Baker School	139 Maple Ave	45878
Getty Service Station #56111	Camden Ave and Cottage Rd	A4554
IMCO Inc	858 North Lenola Road	45046
J Cleaners and Tailors	121-123 W Main Street	L4536
Laurel Creek Pump Station	Laurel Creek Blvd	45936
Lutheran Home at Moorestown	255 E Main St	46018
Mack Cali Realty Corp	228 Strawbridge Dr	46313
Masco Bath	540 Glen Ave	46482

Facility Name	Address	PI Number
McLean Packaging Corp	1504 Glen Ave	46283
Mill Street Tire	300 N Church Street	46424
Mobil Service Station #15EWD	225 Chester Ave	45503
Moorestown Autobody	26 E Camden Street	G4527
Moorestown Board of Education Maintenance Facility	801 N Stanwick Road	H8716
Moorestown Cleaners	186 W Camden Ave	L4512
Moorestown Gas LLC	201 Rt 38	A45833
Moorestown High School	350 Bridgeboro Road	45885
Moorestown Lukoil	Rt 38 and Mt Laurel	A4527
Moorestown Subheadquarters	300 New Albany Road	45454
Moorestown Twp Library	111 W 2^{nd} Street	46010
Moorestown Twp Water Pollution Control Plant	Cottage St and Pine St	45436
Philadelphia Coca-Cola Bottling Company	1250 Glen Ave	45355
Pleasant Valley Apartments	531 Kings Highway	46004
PNC Bank Eastgate	312 Rt 38	46001
REM-006	1274 N Church Street	45984
Romano's Service Mobile Oil 15EWD	Chester and Plum Street 15-EWD	A4768
Sears Unit #1494	Rt 38 and Lenola Road	46119
Shell Service Station #138332	253 W Main Street	A4509
Shell Service Station #138433	201 Rt 38	A4507
South Valley School	210 Stanwick Road	45887
The Jet Pulverizer Co	1255 N Church Street	45339
Thermacon Industries	345 New Albany Road	45336
Tube Dec LLC	390 New Albany Road	46352
United States Navy-CSEDS-AEGIS Technical REA	300 Centerton Road	45494
Verizon Moorestown Co #55121	105 E Main Street	45338

Source: NJDEP, 2012

NJDEP enacted the Emission Statement Rule in 1992, requiring certain sites that have an air quality permit to report specific air contaminants, including carbon monoxide (CO), sulfur dioxide (SO_2), ammonia (NH_3), respirable particulate matter (PM_{10} and $PM_{2.5}$), lead (Pb), total suspended particulate matter (TSP), volatile organic compounds (VOC), nitrogen oxides (NOx), and 38 other toxic air pollutants. Emission Statement reporting applies if a facility has a potential to emit five tons or greater Pb, ten tons or greater VOC, 25 tons or greater NOx, or 100 tons or greater of CO, SO_2, PM_{10}, $PM_{2.5}$, TSP, or ammonia.

There are seven facilities in Moorestown that are required to submit emission statements: IMCO Inc., Lockheed Martin MS2, Flexprint Inc, Beckett Corporation, Citation Graphics, American Biltrite Inc, and Clondalkin Moorestown. In 2011, three of these facilities released annual emission statements, which are included **in Appendix F: Emission Statements**.



Strawbridge Lake Park
Source: Joan Ponessa