

# ENVIRONMENTAL RESOURCE INVENTORY

# ERI

AUGUST 2013

For the Township of:

# BORDENTOWN

Burlington County, New Jersey



by:



with:

The Environmental  
Commission of  
Bordentown Township



*The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals, and the public with a common vision of making a great region even greater. Shaping the way we live, work, and play, DVRPC builds consensus on improving transportation,*

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# Acknowledgments

Funding for the *Environmental Resource Inventory for Bordentown Township* was provided by:

The Association of New Jersey Environmental Commissions (ANJEC) Smart Growth Assistance Grant Program, funded by the Geraldine R. Dodge Foundation,

The Delaware Valley Regional Planning Commission

and

Bordentown Township

## Bordentown Township Committee

Mayor Jim Cann, Deputy Mayor Jill Popko, Stephen Benowitz, Karl Feltes, John Moynihan.

The impetus for the creation of this document, and its guidance and review, came from the Bordentown Township Environmental Commission.

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Chair Roger Plew, Vice-Chair Sid Morginstin, Secretary Marilee Ryan, Livia Popko.

Special thanks are due to Mary Alessio Leck, member of Friends of the Marsh and Emeritus Professor of Biology at Rider University.



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# Executive Summary

Bordentown Township is a municipality of 11,367 people and covers over nine square miles (5,957 acres). The area was first settled in the late 1600s.

Bordentown Township lies in the Inner Coastal Plain, an area of fertile agricultural soils.



Seth Hand Memorial Park

Source: DVRPC

There are about 28 miles of streams running through Bordentown Township, about 10 miles of which are headwater streams. There are also 105 acres of lakes and ponds, including the 21-acre Crystal Lake.

There are portions of four watersheds, each containing one subwatershed within Bordentown Township. In 2010, all of these subwatersheds were impaired for one or more designated uses. The most common causes of impairment were excess total phosphorus and total suspended solids.

In terms of acres, slightly less than half of the township is developed land, followed by wetlands, forest, water, agriculture, and barren land.

There are a number of threatened and endangered species that may be found in Bordentown Township, including the bald eagle, grasshopper sparrow, bobolink, and Northern harrier.

Bordentown's public drinking water supply is drawn from the Potomac-Raritan-Magothy aquifer system through wells located just north of the township in Hamilton Township.

There are a number of archaeological sites listed or eligible for listing on the State and National Registers of Historic Places, including the Abbott Farm Historic District.

The Abbott Marshlands, located in the northwest corner of the township, is one of the most significant natural areas in the state and contains many rare plants and animals.



# Introduction

The purpose of an Environmental Resource Inventory is to identify and describe the natural resources of a community. A community's natural resources—its soil, water, air, forests, fields, and waterways—are fundamental to its character. The protection and wise use of those resources is essential to the public health, safety, and welfare of current and future residents.

The Environmental Resource Inventory provides the basis for the development of methods and steps to preserve, conserve, and utilize those resources, although it does not include specific recommendations to those ends. It is, instead, a compendium of all the existing information that can be found about a township's natural resources, presented in a form that is useful to a broad audience. The Inventory reflects a particular moment in time, and should be updated as new data becomes available.

In the past, Bordentown Township's natural resources made the township an agricultural community. In addition, its position along the Delaware River and the growth of the transportation network that crosses Bordentown made the area an important industrial and commercial center in the 19<sup>th</sup> and 20<sup>th</sup> centuries. Today, as residential development in this part of Burlington County increases, the character of Bordentown Township is also undergoing change. Documentation of its resources has become a necessity, especially if it is to support residents of the future. Bordentown's remaining wetlands and tidal marshes, which provide significant habitat for endangered and threatened plants and animals, will be vital to the continued health of the community and the enjoyment of its citizenry.

## Sources

This document is an update of the *Environmental Resource Inventory (ERI) for the Township of Bordentown (2004)* prepared by the Delaware Valley Regional Planning Commission (DVRPC). This version includes new, updated, and expanded data and information on the built and natural environment of the township.

The maps and data relating to natural resources are mainly derived from the New Jersey Department of Environmental Protection's (NJDEP's) Geographic Information System (GIS) mapping, the Landscape Project produced by the Endangered and Nongame Species Program of the NJDEP Division of Fish and Wildlife, reports by the United States Geologic Service (USGS) and New Jersey Geologic Service, and data and maps compiled by the DVRPC. Information from these sources specific to Bordentown Township has been included whenever it was available. Information from other reports

about specific sites has also been incorporated, along with data provided by the township and county. The ERI has been reviewed and revised by members of the Environmental Commission and other municipal officials.

Descriptive introductions to some topics have been included in the ERI to give readers background on various complex topics. The hope is that this information will also assist the Environmental Commission and other township officials in obtaining additional data from state sources and determining the types of investigations that still need to be conducted.



Crosswicks Creek

*Source: DVRPC*

## Brief History

Long before European settlement, various Native American peoples occupied the lands near the Delaware River, including parts of Bordentown Township. By the time of European arrivals, these Native Americans called themselves the Lenni Lenape. Later, they were called the “Delaware” by Europeans. The Lenni Lenape inhabited much of southern New Jersey and their settlements were usually located along stream banks. They fished and hunted, and there is some evidence that certain wild plant communities were managed. The Lenni Lenape valued the area for its abundance of fish and game, and they utilized the regional creeks extensively for transportation. By 1801, well over a century after the arrival of the first settlers, the Lenni Lenape had sold virtually all of their land to the settlers and moved from the area.

The first European settlers in Burlington County were the Dutch, who populated Burlington Island in 1624. A fort and civil center was established on the Island along with a number of dwellings and a tavern. As early as 1638, Swedish settlers also ventured into the Delaware Valley and purchased land from the Indians to build small settlements along the Delaware River. In 1644, King Charles II of England took control of much of America’s eastern seaboard, and he deeded most of present-day New Jersey to his brother, the Duke of York, who split it into East and West. The British quickly sought to occupy the land and secure its control. West Jersey was settled mostly by English Quakers. Throughout the 17<sup>th</sup> century, sections of New Jersey were acquired from the Lenni Lenape tribe.

Burlington County was officially founded on May 17, 1694. By that time, it was a well-established region, with industries in the county that included a tannery, sawmills, pottery-making facilities, and brickyards. Initially, the Bordentown area was called Farnsworth’s Landing, named after Thomas Farnsworth, one of the original settlers of the area. Thomas Farnsworth, an English Quaker, first settled between Crosswicks Creek and Blacks Creek in 1682, where the Delaware River meets Crosswicks Creek. He relocated from the downstream community of Burlington, New Jersey. At the time of Farnsworth’s arrival there were over 20 farms already located along Blacks Creek. Thirty-six years later, in 1717, Joseph Borden arrived in the well-established Farnsworth’s Landing. He very quickly acquired the majority of the land where Bordentown City is located today.

Bordentown Township and the City of Bordentown have a rich cultural history. During the course of the Revolutionary War, English troops often occupied the area. Moreover, the Bordentown region was home to many notable figures. Francis Hopkinson, a signer of the Declaration of Independence; Thomas Paine, a famous American journalist and writer; Clara Barton, founder of the first free public school in Bordentown who later founded the

Red Cross; and Joseph Bonaparte, the eldest brother of Napoleon and the ex-king of Naples and Spain; all resided in the City of Bordentown. According to a bicentennial history of Bordentown, *Bordentown 1682-1976*, "Bordentown, aside from being an active waterfront community, was a fashionable and aristocratic resort town to which many of Philadelphia's finest families traveled."

Throughout Bordentown's history, gristmills and brick making were important to the local economy. One particular mill, Dunns Mill, had a history spanning nearly 200 years, beginning in 1708 when Francis Davenport built the mill on Blacks Creek. Ownership of the mill changed hands numerous times, and both Samuel Farnsworth and Joseph Borden owned the mill at various points before it was purchased by Martin Luther Dunn in 1875. The mill burned down in 1901 and was never rebuilt, but the land the mill occupied remained in the Dunn family until 1982. Today, all that remains is the foundation of the mill on Blacks Creek off of Dunns Mill Road. Several remains of the clay pits used for brick making can also still be seen in the township, most notably along Rising Sun Road and along Dunns Mill Road.



A Pond at the Site of a Former Clay Pit near Dunns Mill Road  
*Source: DVRPC*

Located between Philadelphia and New York, the township was historically a major transportation center. A stagecoach, the Bordentown and New York Stage, carried passengers and the mail from Bordentown to a point just outside of New York between 1740 and the early 1790s. During the 1780s, a riverboat operated between Philadelphia and Bordentown. In 1831, the Camden and Amboy steam-powered railroad made its debut in Bordentown, and the Delaware-Raritan Canal opened in 1834. The Pennsylvania Railroad leased the railroad and the canal in 1871 and immediately began to close the canal, which by 1932 was completely closed. The railroad continued for another thirty

years, ending its passenger service in 1963, although it continued to be used for freight. Forty years later, New Jersey Transit restored passenger service on the line, which is now called the River LINE and links Trenton and Camden. During the late 19<sup>th</sup> century, trolley lines were created between Trenton, Bordentown, and Camden. A trolley strike in 1923 led to the start of bus service, which eventually replaced trolley service completely in 1932.



Camden & Amboy Railroad

Source: Matt Luyber

In 1849, the Borough of Bordentown was established within the Township of Chesterfield. It was formed from areas of Chesterfield and Mansfield townships and took its name from Joseph Borden (1687-1765), one of the original settlers of the Bordentown region. The Township of Bordentown was established in 1852. Its boundaries included the areas of what is known today as Bordentown Township, the City of Bordentown, and Fieldsboro Borough. Bordentown City separated from the township in 1867, and Fieldsboro Borough separated from the township in 1894. In 1931, Bordentown Township expanded north by annexing the piece of land bounded by Crosswicks Creek, Grovesville Road, and Hogback Road.

There were nearly 6,000 residents living in the Bordentown region during the 1870s. This large population was mainly due to the railroad and a Civil War-era boom.

In 1940, Bordentown Township was a rural community with a population of just 1,095, while the City of Bordentown had a population of 4,223. The suburbanization of the 1950s led to population increases in both the township and the city. In 1960, however, the population of Bordentown Township surpassed the population of the City of Bordentown. Since this time, the population of the township has steadily increased while the population of the city has steadily decreased. According to the 2010 census, Bordentown Township had a population of 11,367, significantly greater than its 2000 population of 8,380, while the City of Bordentown had a population of 3,924, less than its 2000 population of 3,969.

In 1962, the township built a sanitary sewage collection and treatment system, now managed by the Bordentown Sewerage Authority. A full-time Bordentown Township police force was established in 1972. In 1953, Bordentown Township, along with the City of Bordentown, built their first joint elementary school. Prior to 1953, Bordentown Township had a sending agreement with the City of Bordentown. Additionally, in 1965, the first regional high school was constructed, and in 1982 a regional school district was formed.

After World War II, highways were built and the trucking industry began to replace railroad transport of both goods and people. Bordentown Township was primarily rural until the early 1950s. However, the construction of the New Jersey Turnpike and Interstate 295, which began in the 1950s and 1960s, brought major changes to Bordentown. Numerous housing developments began to be constructed on land previously used for farming.

Today, Interstate 295 and the New Jersey State Turnpike intersect Bordentown Township. By automobile, it takes approximately 45 minutes to get to Philadelphia and one-and-a-half hours to arrive in New York City. Bordentown Township is home to a wide array of people with a diverse set of occupations reflecting today's 21<sup>st</sup> century service and light manufacturing economies. Bordentown Township has become a community with a substantial mix of industrial, commercial, and residential uses.

Bordentown's landscape continues to be dominated by the water that was so much a part of its early history—its Delaware riverfront, its three major stream corridors, and the acres of wetlands and marshes surrounding them. Recently, Bordentown Township has taken steps to recognize the importance of creating permanent open space and protecting land from development. During the early 1980s, the township invested in two parks, each costing about \$1 million. Additionally, in 1999, there was a referendum asking Bordentown Township residents if they were in favor of preserving open space, including farmland, and preserving natural and scenic resources. The residents voted in favor of preservation, and a \$0.03 tax per \$100 property valuation dedicated to creating and maintaining open space in Bordentown Township was established. It is estimated that this tax brings in \$150,000 annually.

## Location, Size, and Land Use

Bordentown Township is an incorporated township located at the northern tip of Burlington County, New Jersey. Five municipalities border the township within Burlington County: Chesterfield Township to the east/southeast, the Borough of Fieldsboro and the City of Bordentown to the west, Mansfield Township to the south, and Florence Township to the southwest. It is also bounded by Hamilton Township, in Mercer County, to the north. The northern boundary of Bordentown Township is the Crosswicks Creek, which forms the dividing line between Mercer and Burlington counties. See [Map 1: Places in Bordentown Township](#) and [Map 2: Aerial Photo \(2010\)](#).

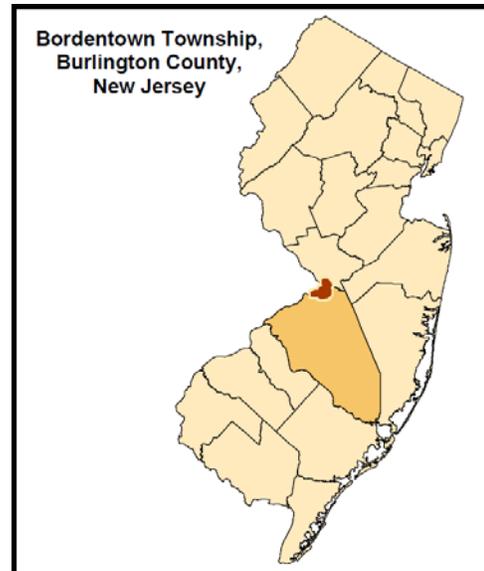


Figure 1: Bordentown Township

Source: DVRPC

Bordentown Township occupies a total area of 9.31 square miles, or 5,957 acres. The U.S. Census Bureau estimates that Bordentown Township had a population of 11,367 in 2010, which was a 36 percent increase from its 2000 population of 8,380 people.

Bordentown Township also includes Newbold Island, a 400-acre island in the Delaware River. Newbold Island has riparian habitat, and a pair of mating bald eagles has been sighted there. Newbold Island is privately owned and is not protected open space. However, people may boat on the Delaware around the island. Public Service Electric and Gas Company (PSE&G) owns the southern half of the island and has proposed several projects for that land, including a controversial nuclear power plant in the 1970s. After an Environmental Impact Statement and several public hearings revealed increasing population density near the site, concern about health effects, and widespread opposition by residents, the proposal was withdrawn by PSE&G. Conectiv proposed building a 550-megawatt power station on the same site, but it was never built. The northern half of the island is privately owned and contains a privately owned and operated heliport.

Bordentown Township is connected by highways and local roads, which the majority of residents use to commute. The township is also served by the River LINE light rail

connecting Camden and Trenton, which provides public transportation access to Philadelphia and the river communities of New Jersey. See the **Transportation** section for more detailed information.

**Table 1: Bordentown General Land Cover (2007)**

shows Bordentown Township's land cover grouped into general categories. The categories are based on data from the New Jersey Department of Environmental Protection's (NJDEP's) 2007 color infrared digital imagery. NJDEP's categorization separates wooded wetlands from upland forest areas and includes the former in the wetlands category. These land uses are shown on **Map 3: NJDEP Land Cover (2007)**.



Woodland near Georgetown Road

Source: Olivia Whelan

According to the NJDEP 2007 data, almost half of Bordentown Township is considered “urban” or developed land (43 percent). This is followed by wetlands, at about 22 percent. Forested land covers over 16 percent of the township, water covers nearly eight percent, agriculture covers about seven percent, and barren land covers almost four percent. Barren land is land where vegetation covers less than 15 percent of the area or areas covered by bare rock, sand or clay, quarries, strip mines, gravel pits, and transitional areas, such as construction sites. For more detailed NJDEP vegetative cover, see **Map 15: Natural Vegetation (2007)** and **Table 21: Bordentown Natural Vegetation (2007)**.

Table 1: Bordentown General Land Cover (2007)

General Land Classes	Area (Acres)	Percent
Agriculture	436.02	7.32%
Barren Land	220.53	3.70%
Forest	962.09	16.15%
Urban	2,536.50	42.58%
Water	463.16	7.78%
Wetlands	1,338.36	22.47%
<b>Total</b>	<b>5,956.67</b>	<b>100.00%</b>

Source: NJDEP, 2007

**Table 2: Bordentown Land Use (2010)** is from DVRPC and is based on analysis of 2010 aerial photography. One difference from the NDJEP data set is that wetlands are not

delineated but are instead included in the forested or vacant land category. See [Map 4: DVRPC Land Use \(2010\)](#).

As seen in [Table 2](#), the largest single type of land use in Bordentown is wooded habitat, which covers 30 percent, or about 1,808 acres of the township. This includes wooded wetlands, which are not specifically identified by DVRPC. Nearly 18 percent of the township's area is single-family detached homes. Vacant land covers nearly 13 percent of the township, which includes non-wooded wetlands areas.

Table 2: Bordentown Land Use (2010)

Type	Area (Acres)	Percentage
Agricultural	475.26	7.98%
Commercial	316.14	5.31%
Community Services	133.72	2.26%
Manufacturing: Heavy Industrial	11.35	0.19%
Manufacturing: Light Industrial	45.33	0.76%
Military	2.56	0.04%
Parking: Commercial	79.66	1.34%
Parking: Community Services	14.33	0.24%
Parking: Heavy Manufacturing	0.23	0.00%
Parking: Light Manufacturing	4.42	0.07%
Parking: Military	1.19	0.02%
Parking: Multi-Family	21.52	0.36%
Parking: Recreation	2.55	0.04%
Recreation	122.02	2.05%
Residential: Mobile Home	3.05	0.05%
Residential: Multi-Family	165.81	2.78%
Residential: Single-Family Detached	1,045.32	17.55%
Transportation	343.23	5.76%
Utility	174.64	2.93%
Vacant	745.56	12.52%
Water	440.82	7.40%
Wooded	1,807.97	30.35%
<b>Total</b>	<b>5,956.70</b>	<b>100.00%</b>

Source: DVRPC, 2010



# Natural Resources

## Physiography

Physiography is the study of a location in relation to its underlying geology. New Jersey is characterized by five main 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.

The Atlantic Coastal Plain landscape extends from Massachusetts to Texas and is divided into Inner and Outer sections. Bordentown Township is located entirely in the Inner Coastal Plain. 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. In New Jersey, the Inner Coastal Plain is made up of alternating layers of sand and clay. Deposits originating in the breakdown of Appalachian and Catskill sedimentary, metamorphic, and igneous rocks lie between or alternate with layers formed by oceanic (marine) deposition, which occurred as the ocean shoreline advanced and receded over geologic time. Geologists use the term “interbedding” to describe beds of rock that lie between or alternate with another type of rock.

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 Plain and do not hold water as well.

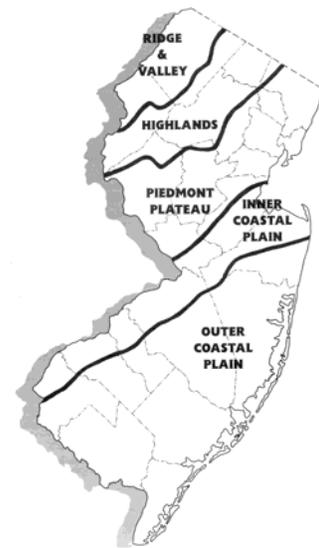


Figure 2: The Physiographic Regions of New Jersey

Source: NJDEP

## Topography and Surface Landscapes

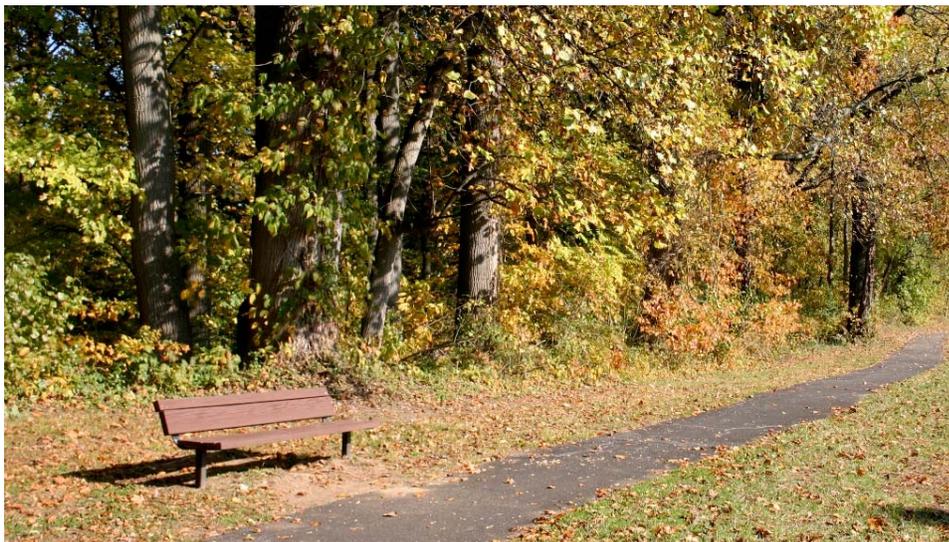
Topography relates to the surface terrain and features of an area. Ridges and high points delineate the boundaries of watersheds, seen in [Map 9: Watersheds](#).

At the confluence of the Delaware River and Crosswicks Creek, the Bordentown landscape is dominated by wetlands bordered on the east by cliffs looking out over the Crosswicks and the Abbott Marshlands. To the south, the Blacks Creek and Crystal Creek stream corridors are heavily wooded, with steep slopes along the banks, giving way to a gently rising landscape. The landscape along the Delaware River southwest of Fieldsboro is mostly inaccessible and largely undeveloped. The landscape on Bordentown's eastern side supports gently rolling farmland, reflective of the agricultural area in Chesterfield Township.

The upland area is characterized by rich soils that once supported extensive beech-oak forests. Along the stream valleys, especially along Crosswicks Creek, are extensive freshwater tidal marshes and wet forests. The streams are relatively flat, as in all of southern New Jersey, with muddy and/or sandy bottoms. Smaller streams flowing to the larger channels form connecting networks of wetland marsh.

The highest elevation in the township is approximately 107 feet above mean sea level, located at a point near the northeast quadrant of the 295 interchange with Route 130 close to Blacks Creek and the border with Bordentown City. The lowest elevations measure about 10 feet above mean sea level and are found where the Crosswicks and Blacks Creeks meet the Delaware River and at Crystal Lake.

Due to its topography and hydrology, about 22 percent of Bordentown Township's land is characterized as being in a floodplain. However, as shown on [Map 11: Floodplains \(1990\)](#), much of the floodplain is limited to the rivers, tributaries, and wetlands where there is significantly less development and agriculture. The entire topography of Bordentown Township is shown in [Map 5: Elevation](#).



Northern Community Park

Source: DVRPC

## Steep Slopes

Slope is measured as the percent of vertical rise to horizontal distance. The majority of Bordentown Township has slopes of less than ten percent, although the township is crossed by upland ridges with slopes of up to 69 percent. Bordentown Township's steep slopes are depicted on [Map 6: Steep Slopes](#). The steepest slopes in the township are located to the south of Blacks Creek between I-295 and the NJ Turnpike. There is another ridge of steep slopes east of the rail bed of the River Line, which continues upland of Crosswicks Creek. Most of the steep slopes in the township are still well-vegetated, as seen on [Map 15: Natural Vegetation](#), but some development has occurred on the edge of some of the very steep slopes.

In general, development of areas with steep slopes is inadvisable because 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.

## 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.

### Soil Series

Most soils in Bordentown Township are of a sandy loam nature, characterized as well-drained and nutrient-rich. The township's soils consist of 21 series types and 58 variations within those series (excluding water), as identified by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

These are listed in [Table 3: Bordentown Township Soils](#) and shown on [Map 7: Soils](#). Several soil series appear more frequently in Bordentown Township than others and are briefly described as follows according to the NRCS soil database.

### Keyport Series

The most dominant soil type in Bordentown Township is the Keyport soil series, which covers 16 percent of the township. These soils tend to be moderately or well drained, consisting of a moderate to fine texture, and formed on clay beds. Often, they gently slope and are found in high positions. However, they can slope as much as 25 percent. Keyport soils have a high available water capacity and drain slowly. Water does not saturate the soil. When dry, the soil cracks widely and crusts, reducing seed germination. It has moderate natural fertility, but it is not ideal for agriculture. This soil will support hardwood

forest and limited types of crops. It is not a good soil for vegetables or fruits; however, it is a suitable soil for small grains, corn, soybeans, hay, and pastures.

### **Freehold Series**

The second most common soil type in Bordentown Township, covering nearly 12 percent of the township, is the Freehold series. These soils, formed from sandy marine deposits, are mostly gently sloping and are well drained. Around stream beds, these soils may be steeply sloping. Freehold soils occur in close association with Collington, Colts Neck, Marlton, Westphalia, Woodstown, and Dragston soils. Freehold soils are easily worked for agricultural production and have low to moderate natural fertility. Different variations of these soils will support upland forests of oak and poplar and provide high quality wildlife habitat. These soils are well suited to many different vegetable crops and can support various seasonal crops because the variations of soils warm at different times of the year

### **Urban Land Series**

Nearly 11 percent of Bordentown Township soils are classified as "Urban Land." The Urban Land series consists of cut and filled land that is mostly developed. The land is used for residential, commercial, industrial, or highway purposes. Typically, 70 percent of the original soil horizon has been destroyed in these areas. There are moderate limitations for woodland or wildlife and severe limitations for crops. Urban land is very impermeable and low in fertility where the original soil is removed. However, where the original soil is moved from one area to another area, the soil has moderate but slow permeability, due to compaction of the soil during construction.

### **Sassafras Series**

Sassafras soils are the fourth most frequently occurring soil in Bordentown, making up about 10 percent of the township. Slopes can range from nearly level to very steep. These soils can support vegetation consisting of mixed oaks and scattered pines. They are considered farmland of statewide importance and have clay in their subsoil. Sassafras soils are easy to work, have a low natural fertility, and respond to fertilization.

### **Woodstown**

Variations of the Woodstown series make up over six percent of all acres in Bordentown Township. Historically, these soils have supported oak, beech, poplar, and pitch pine forests. This series is closely associated with Aura, Downer, Freehold, and other soils, except that Woodstown is not well drained. These soils occur on terraces along large streams and in beds of gravel. Cultivation is hampered by wetness.

### **Udorthents**

Over six percent of Bordentown Township soils are in the Udorthents series. This series consists of somewhat poorly drained to very poorly drained soils that have been altered mainly by filling. This type of soil is located mainly in low areas, such as depressions, drainage ways, and tidal marshes. On-site investigation is needed to determine the

suitability of this unit for any use. The western half of Newbold Island is made up of Udorthents soil, as is the mouth of Crystal Creek and other small areas in the township.

### Adelphia

About five percent of soils in Bordentown Township are in the Adelphia series, which have a fluctuating water table and are moderately well drained. Their natural fertility is moderate, and applied fertilizers do not leach readily. They have very little slope and support native vegetation consisting of hardwood forest species. Various crops are suitable for this type of soil, including small grains, fruits, vegetables, sod, and nursery stock. These high value crops require better drainage, which these soils provide.

### Holmdel

The Holmdel soil series covers less than five percent of Bordentown Township. Soils in the Holmdel series have a moderately high seasonal water table and drain moderately well. Holmdel series soils have moderate to moderately high natural fertility. They respond well to added fertilizers. Most areas with these soil types have been cleared for crops. Small grains, fruits, and vegetables are all capable of growing in these soils. Often, these soils receive both surface runoff and lateral ground water from higher soils.

## Soil Characteristics

### Hydric Soils

Thirty-seven percent of Bordentown Township's soils are hydric soils, as shown in **Table 3: Soils in Bordentown Township**. 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 below their surfaces. 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 and statewide when the limitations are overcome by measures such as drainage or flood control.

Table 3: Bordentown Soils

Soil Type	Description	Area (Acres)	% of Bordentown Twp	Ag. Quality*	Hydric?
AdmA	Adelphia fine sandy loam, 0 to 2 percent slopes	122.92	2.06	P-1	Yes
AdmB	Adelphia fine sandy loam, 2 to 5 percent slopes	24.19	0.41	P-1	No
AdmkA	Adelphia fine sandy loam, clayey substratum, 0 to 2 percent slopes	77.86	1.31	P-1	Yes
AdmkB	Adelphia fine sandy loam, clayey substratum, 2 to 5 percent slopes	31.74	0.53	P-1	No
Admma	Adelphia high glauconite variant fine sandy loam, 0 to 2 percent slopes	33.92	0.57	P-1	Yes
AdmmB	Adelphia high glauconite variant fine sandy loam, 2 to 5 percent slopes	9.51	0.16	P-1	No
CoeAs	Colemantown loam, 0 to 2 percent slopes, occasionally flooded	21.30	0.36	NA	Yes
ComA	Collington fine sandy loam, 0 to 2 percent slopes	43.99	0.74	P-1	No
ComB	Collington fine sandy loam, 2 to 5 percent slopes	114.20	1.92	P-1	No
ComC	Collington fine sandy loam, 5 to 10 percent slopes	37.34	0.63	S-1	No
DoaA	Donlonton fine sandy loam, 0 to 2 percent slopes	57.54	0.97	P-1	Yes
DobA	Donlonton loam, 0 to 2 percent slopes	107.56	1.81	P-1	Yes
FankA	Fallsington fine sandy loam, clayey substratum, 0 to 2 percent slopes	79.34	1.33	S-1	Yes
FmhAt	Fluvaquents, loamy, 0 to 3 percent slopes, frequently flooded	238.19	4.00	NA	Yes
FrfB	Freehold loamy sand, 0 to 5 percent slopes	40.43	0.68	P-1	Yes
FrfC	Freehold loamy sand, 5 to 10 percent slopes	12.40	0.21	S-1	No
FrmA	Freehold fine sandy loam, 0 to 2 percent slopes	12.68	0.21	P-1	No
FrmB	Freehold fine sandy loam, 2 to 5 percent slopes	254.73	4.28	P-1	No
FrmC	Freehold fine sandy loam, 5 to 10 percent slopes	18.33	0.31	S-1	No
FrmD	Freehold fine sandy loam, 10 to 15 percent slopes	31.95	0.54	NA	No
FrmE	Freehold fine sandy loam, 15 to 25 percent slopes	54.89	0.92	NA	No

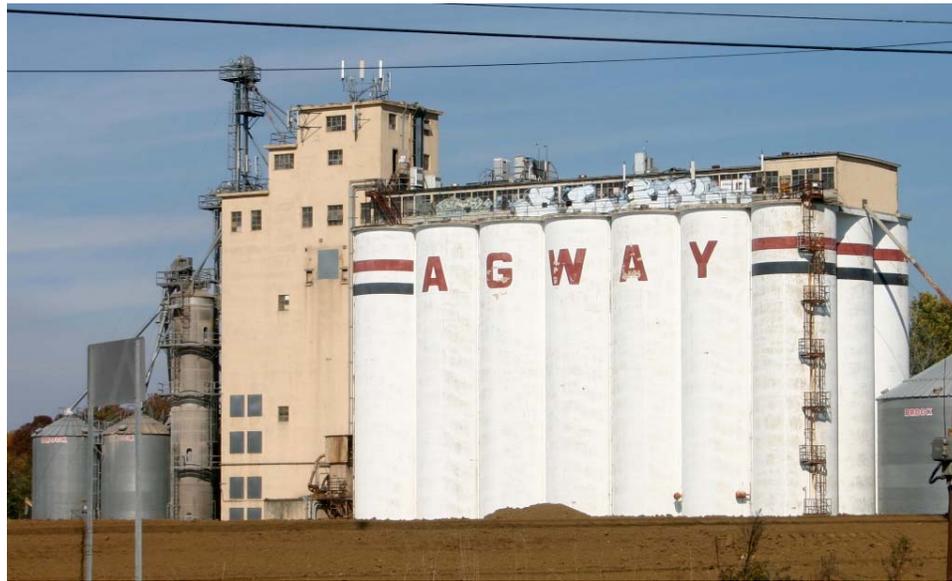
Soil Type	Description	Area (Acres)	% of Bordentown Twp	Ag. Quality*	Hydric?
FrmkB	Freehold fine sandy loam, clayey substratum, 2 to 5 percent slopes	256.69	4.31	P-1	No
GabB	Galestown sand, 0 to 5 percent slopes	6.23	0.10	U-1	No
HodA	Holmdel fine sandy loam, 0 to 2 percent slopes	43.06	0.72	P-1	Yes
HodB	Holmdel fine sandy loam, 2 to 5 percent slopes	10.58	0.18	P-1	No
HodkA	Holmdel fine sandy loam, clayey substratum, 0 to 2 percent slopes	136.29	2.29	P-1	Yes
HodkB	Holmdel fine sandy loam, clayey substratum, 2 to 5 percent slopes	80.68	1.35	P-1	No
KenB	Keyport fine sandy loam, 2 to 5 percent slopes	219.35	3.68	P-1	No
KeoA	Keyport loam, 0 to 2 percent slopes	125.37	2.10	P-1	Yes
KeoB	Keyport loam, 2 to 5 percent slopes	157.68	2.65	P-1	Yes
KeoC	Keyport loam, 5 to 10 percent slopes	185.80	3.12	S-1	No
KeoD	Keyport loam, 10 to 15 percent slopes	158.94	2.67	NA	No
KeoE	Keyport loam, 15 to 25 percent slopes	106.49	1.79	NA	No
KrbA	Kresson loamy sand, 0 to 5 percent slopes	16.95	0.28	S-1	Yes
MamnAv	Mannington-Nanticoke complex, 0 to 1 percent slopes, very frequently flooded	242.56	4.07	U-1	Yes
MbaAt	Marsh, fresh water, 0 to 2 percent slopes, frequently flooded	10.78	0.18	NA	No
PHG	Pits, sand and gravel	21.46	0.36	NA	No
PHM	Pits, clay	103.71	1.74	NA	No
PefB	Pemberton sand, 0 to 5 percent slopes	50.28	0.84	S-1	No
SaeA	Sassafras fine sandy loam, 0 to 2 percent slopes	109.97	1.85	P-1	No
SaeB	Sassafras fine sandy loam, 2 to 5 percent slopes	208.09	3.49	P-1	No
SaeC	Sassafras fine sandy loam, 5 to 10 percent slopes	33.60	0.56	S-1	No
SaekA	Sassafras fine sandy loam, clayey substratum, 0 to 2 percent slopes	43.69	0.73	P-1	No

Soil Type	Description	Area (Acres)	% of Bordentown Twp	Ag. Quality*	Hydric?
SaekB	Sassafras fine sandy loam, clayey substratum, 2 to 5 percent slopes	192.11	3.23	P-1	No
ShsA	Shrewsbury fine sandy loam, 0 to 2 percent slopes	41.73	0.70	S-1	Yes
ShskA	Shrewsbury fine sandy loam, clayey substratum, 0 to 2 percent slopes	36.87	0.62	S-1	Yes
ThfB	Tinton sand, 0 to 5 percent slopes	130.48	2.19	S-1	No
ThfC	Tinton sand, 5 to 10 percent slopes	16.01	0.27	S-1	No
ThftB	Tinton sand, thick surface, 0 to 5 percent slopes	12.28	0.21	S-1	No
URCLAB	Urban land, clayey substratum, 0 to 8 percent slopes	238.29	4.00	NA	No
URSAAB	Urban land, sandy, 0 to 8 percent slopes	378.34	6.35	NA	No
URSACB	Urban land, sandy over clayey, 0 to 8 percent slopes	25.99	0.44	NA	No
UddcB	Udorthents, dredged coarse materials, 0 to 8 percent slopes	52.01	0.87	NA	No
UddfB	Udorthents, dredged fine material, 0 to 8 percent slopes	300.31	5.04	NA	No
UdrB	Udorthents, refuse substratum, 0 to 8 percent slopes	30.93	0.52	NA	No
WATER	Water	367.39	6.17	NA	Yes
WofA	Woodstown fine sandy loam, 0 to 2 percent slopes	88.20	1.48	P-1	Yes
WofB	Woodstown fine sandy loam, 2 to 5 percent slopes	1.78	0.03	P-1	No
WofkA	Woodstown fine sandy loam, clayey substratum, 0 to 2 percent slopes	156.05	2.62	P-1	Yes
WofkB	Woodstown fine sandy loam, clayey substratum, 2 to 5 percent slopes	134.63	2.26	P-1	No
<b>Total</b>		<b>5,956.68</b>	<b>100</b>		<b>36.79%</b>

Source: NRCS, 2008

**\* 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.



AGWAY Site

Source: DVRPC

Certain soil characteristics can severely restrict the use of sites for construction and development. **Table 4: Soil Limitations for Development** records the soils 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 development, although these soils are mostly located in riparian areas and on Newbold Island. 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 a 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 but not limited to the 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 4: Soil Limitations for Development

Soil Series	Soil Types	Acreage	Land Use Implications*		
			Building without Basement	Building with Basement	Septic Systems
Keyport	KenB, KeoA, KeoB, KeoC, KeoD, KeoE	953.63	B	B	C
Freehold	FrFB, FrFC, FrmA, FrmB, FrmC, FrmD, FrmE, FrmKB	682.10	A	A	A
Urban Land	URCLAB, URSAAB, URSACB	642.62	A	A	A
Sassafras	SaeA, SaeB, SaeC, SaekA, SaekB	587.46	A	A	A
Woodstown	WofA, WofB, WofkA, WofkB	380.66	B	A	A
Udorthents	UddcB, UddfB, UdrB	383.25	C	C	C
Water	WATER	367.39	N/A	N/A	N/A
Adelphia	AdmA, AdmB, AdmkA, AdmkB, AdmmA, AdmmBB	300.13	B	A	B
Holmdel	HodA, HodB, HodkA, HodkB	270.62	B	A	B
Mannington-Nanticoke	MamAv	242.56	C	C	C
Fluvaquents	FmhAt	238.19	C	C	C
Collington	ComA, ComB, ComC	195.53	A	A	A
Donlonton	DoaA, DobA	165.10	B	B	C
Tinton	ThfB, ThfC, ThftB	158.77	A	A	A
Pits	PHG, PHM	125.17	A	A	A
Shrewsbury	ShsA, ShskA	78.61	C	C	C
Fallsington	FankA	79.34	C	C	C

Soil Series	Soil Types	Acreage	Land Use Implications*		
			Building without Basement	Building with Basement	Septic Systems
Pemberton	PefB	50.28	B	A	B
Colemantown	CoeAs	21.30	C	B	C
Kresson	KrbA	16.95	C	B	C
Galestown	GabB	6.23	A	A	A

Source: USDA NRCS, 2008

*Key to Land Use Implications	
A = Not Limited	Little or no limitation(s) or easily corrected by use of normal equipment and design techniques.
B = Somewhat Limited	Presence of some limitations which normally can be overcome by careful design and management at somewhat greater cost.
C = Very Limited	Limitations that normally cannot be overcome without exceptional, complex, or costly measures.
NA = Not Rated	Soil series/type not rated for designated use.

## Soil Quality Classification

Bordentown's soils have high agricultural value. Nearly half of the soils in Bordentown Township are considered Prime Farmlands (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. However, many areas that are designated as containing Prime Farmlands have been developed and may no longer be suited for farming.

Farmlands of Statewide Importance (S-1) occupy over 11 percent of the township. These soils are close in quality to Prime Farmland and can sustain high yields of crops when correctly managed with favorable conditions. About four percent of Bordentown contains Farmland of Unique Importance (U-1), located in riparian areas and along Newbold Island. 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. For example, rice, cranberries, citrus, tree nuts, and fruits are often grown on Farmland of Unique Importance. Fiber crops are plants grown for use as paper, rope, and cloth. Rice, cotton, bamboo, and reeds are common fiber crops.

Approximately 35 percent of Bordentown Township's 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, which are not yet rated for agricultural use. Soils not rated by the NRCS are not necessarily limited for agricultural use.

See **Table 5: Agricultural Values for Bordentown Soils** for the acreage of each of these classes of farmland. See also **Map 8: Agricultural Quality of Soils** for a visual depiction.

Table 5: Agricultural Values for Bordentown Soils

Designation	Type/Farm Classification	Area (Acres)	% of municipality
P-1	All areas are prime farmland	2,895.48	48.6%
S-1	Farmland of statewide importance	671.4	11.27%
U-1	Farmland of unique importance	248.8	4.17%
N/A	Not prime farmland	2,117.39	35.45%
	<b>Total</b>	<b>5,956.67</b>	<b>100.00%</b>

Source: USDA NRCS, 2008

## 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.

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.

Bordentown Township is located on the edge of the Central, Southwest, and Pine Barrens climate zones. The following are the descriptions of all three climate zones.

The *Central* climate zone stretches from New York Harbor to the great bend of the Delaware River near Trenton. This region

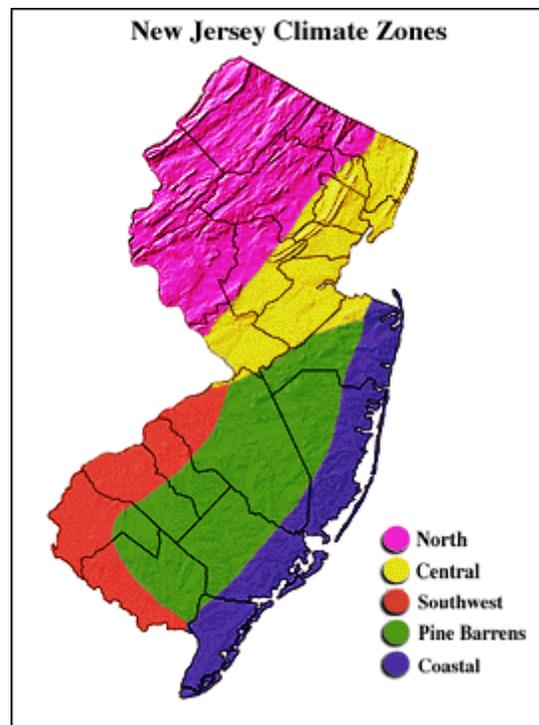


Figure 3: New Jersey Climate Zones

Source: Office of the N.J. State Climatologist

contains many urban areas, such as Trenton, whose paved surfaces and buildings affect local temperatures by retaining more heat. This causes nighttime temperatures to generally be warmer than surrounding rural areas, a phenomenon known as the “heat island effect.”

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.

Unlike the Southwest zone to the west, which is characterized by moist, agriculturally productive soils and the maritime effects of the Delaware Bay, the *Pine Barrens* zone is characterized by sandy soils that retain less moisture. The sandy soils of the Pine Barrens are very porous, allowing precipitation to rapidly infiltrate the ground, leaving the surface dry. The dry, sandy soils release solar radiation absorbed during the day back to space at night at a greater rate, causing a wider range between daily maximum and minimum temperatures than in the Southwest climate zone. These drier conditions also make the Pine Barrens region more prone to forest fires.

The National Climate Data Center (NCDC) operates over 4,000 stations in the United States, none of which are located directly in Bordentown Township. The closest station is in Trenton, N.J., approximately six miles to the northwest of Bordentown Township and within the Central climate zone. Based on NCDC data available through the Office of the NJ State Climatologist at Rutgers University, the mean annual temperature in the Bordentown Township area is 54 degrees Fahrenheit. January is the coldest month with a mean temperature of 32.2 degrees, and July is the hottest month with a mean temperature of 76.3 degrees. The mean annual precipitation is 41.4 inches. August is the rainiest month with a mean precipitation of 4.7 inches, and October and November are the driest months with an average of just 2.9 inches. The average monthly snowfall is greatest in February, which has a historic mean of 7.5 inches.

Severe storm events, including thunderstorms, tropical storms, blizzards, ice storms, hail storms, and tornadoes occur in Burlington County with varying frequency. Tornadoes are infrequent. Only about five generally weak tornadoes occur in New Jersey each year. Most areas in the state experience about 25 to 30 thunderstorms a year.

## Growing Seasons

Bordentown Township 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 indicate which plant species are able to survive the winter in each area. New Jersey has a hardiness zone range from 6A, being the coolest, to 7B being the warmest for average minimum temperatures. In New Jersey, all of Salem County, adjacent portions of

Cumberland County and Gloucester County, and areas along the Atlantic Coast are designated as Zone 7.

Bordentown Township'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 Bordentown Township is about 60 days longer than in northern New Jersey, where frosts generally end in May and begin in October.



Veterans Memorial Park, Joe Lawrence Recreational Facility  
*Source: DVRPC*

## Surface Water Resources

The land in Bordentown Township drains to the Crosswicks Creek, Blacks Creek, Crystal Creek, and several smaller tributaries, and ultimately to the Delaware River.

### Watersheds

A watershed is an ecological unit consisting of 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, 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 Crosswicks Creek watershed, which itself consists of smaller subwatersheds.

Each watershed and subwatershed corresponds to a hydrological unit code, or HUC, as delineated by the United States Geological Survey (USGS). A HUC 11 watershed

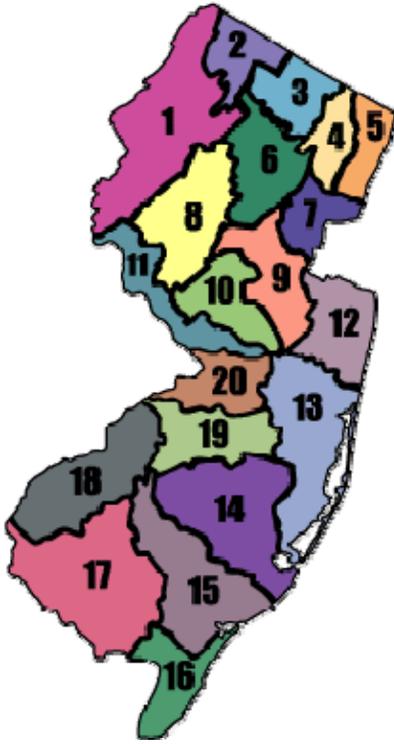


Figure 4: Watershed Management Areas in New Jersey

Source: NJDEP

(identified by an 11-digit code) contains a number of HUC 14 subwatersheds (each identified by a 14-digit code). New Jersey has 152 HUC 11 watersheds and over 900 HUC 14 subwatersheds. Bordentown Township lies entirely within four HUC 11 watershed divisions of the Delaware River watershed: Crosswicks Creek (Below Doctors Creek), Crosswicks Creek (Doctors Creek-Ellisdale tributary), Crafts Creek, and Blacks Creek. These HUC 11 watersheds contain four HUC 14 subwatersheds within Bordentown (one subwatershed per watershed), shown in **Table 6: Watersheds and Subwatersheds in Bordentown**. There are more HUC 14 watersheds that drain to the HUC 11 watersheds, but only the ones within Bordentown Township are listed in the table. See also **Map 9: Watersheds** and **Map 10: Surface Water, Wetlands, and Vernal Pools**.

### Watershed Management Area 20: Assiscunk, Crosswicks, and Doctors Creek

NJDEP manages natural resources on a watershed basis. The state has been divided into 20 Watershed Management Areas (WMAs). Bordentown Township is entirely within WMA 20: Assiscunk, Crosswicks, and Doctors. This includes the Crosswicks Creek, Blacks Creek, Crafts Creek, Doctors Creek, Duck Creek, and the Upper Delaware River to Assiscunk Creek.

Crosswicks Creek is the largest of the creeks in WMA 20. It extends for a total length of 25 miles, and its watershed covers 146 square miles. The Crosswicks Creek drains to the Delaware River at Bordentown, running through the Abbott Marshlands. Its tributaries include Jumble Gut Run, Mile Hollow Run, Thorntown Creek, Doctors Creek, North Run, Jumping Brook, and Lahaway Creek.

Crosswicks Creek is bordered by wetlands for most of its length. Crosswicks Creek forms the northern border of Bordentown Township and runs through the ecologically significant Abbott Marshlands. This freshwater tidal marsh is one of the premier wildlife areas in the state of New Jersey.

Table 6: Watersheds and Subwatersheds in Bordentown Township

Watershed (HUC 11 ID)	Subwatershed (HUC 14 ID)	Total Acres of Subwatershed	Acres within Bordentown Township
Crosswicks Ck (below Doctors Creek) (02040201070)	Crosswicks Ck (below Doctors Creek) (02040201070020)	5,514.44	2,011.77
Crosswicks Ck (Doctors Ck to New Egypt) (02040201050)	Crosswicks Ck (Doctors Ck-Ellisdale trib) (02040201050070)	4,141.95	113.51
Blacks Creek (02040201080)	Blacks Creek (below Bacons Run) (02040201080030)	3,012.38	1,713.79
Crafts Creek (02040201090)	LDRV tribs (Assiscunk Ck to Blacks Ck) (02040201090030)	4,885.91	2,116.80
<b>Total</b>		<b>17,554.68</b>	<b>5,955.86</b>

Source: NJDEP, 2010

## Streams

Waterways are classified by their stream order, which is a hierarchy used to differentiate smaller streams from larger ones. First through third order streams are considered headwater streams and constitute the vast majority of streams worldwide. Fourth through sixth order streams are considered medium streams, while larger order streams are considered rivers.

There are approximately 28 stream miles flowing across Bordentown Township. As shown below in **Table 7: Stream Classification in Bordentown**, most stream miles in Bordentown are first order and fifth order streams. Over 10 miles of these are first order (or headwater) streams, meaning they are the initial sections of stream channels with no contributing tributaries. The headwaters are where a stream is “born” and actually begins to flow.

Headwaters are of particular importance because they tend to contain a diversity of aquatic species and their condition affects downstream water quality. Because of their small size, they are highly susceptible to impairment by human activities on the land. First and second order streams are narrow and often shallow, and they are characterized by relatively small base flows. This makes them

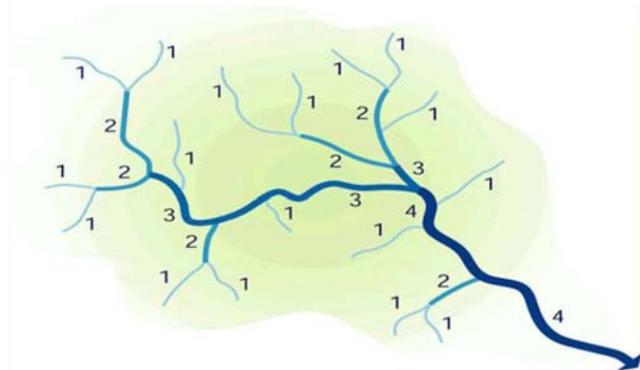


Figure 5: Stream Order Classification

Source: T. A. Endreny, 2003

subject to greater temperature fluctuations, especially when forested buffers on their banks are removed. They are also easily over silted by sediment-laden runoff, and their water quality can be rapidly degraded. In addition, first order streams are greatly affected by changes in the local water table because they are fed by groundwater sources. Headwaters are important sites for the aquatic life that is at the base of the food chain and often serve as spawning or nursery areas for fish.

Higher order streams are influenced progressively less by surrounding land. Higher order streams are broader and usually have larger volumes of water than smaller order streams. These physical changes in the stream are accompanied by shifting biological communities populated by organisms adapted to the unique hydrology and ecology of these streams.

Within Bordentown Township, the lengths of Mile Hollow Run and Jumble Gut Run are first order, as are a number of tributaries to Sucker Run, Blacks Creek, Crosswicks Creek, and Crystal Creek. Thornton Creek, a portion of Sucker Run, and other tributaries are second order streams. Most of Crystal Creek and another portion of Sucker Run are third order streams. Blacks Creek is a fourth order stream, and much of Crosswicks Creek is fifth order. The Delaware River does not have a defined stream order (indicated by the stream order “99”).

Table 7: Stream Classification in Bordentown Township

Stream Order	Length (miles)
1	10.57
2	3.36
3	1.33
4	3.51
5	6.44
6	0.86
99 (Delaware River)	1.80
<b>Total</b>	<b>27.86</b>

Source: NJDEP, 1998

Tidal flows bring Delaware River water into the Crosswicks Creek, Mile Hollow Run, Blacks Creek, and Crystal Creek twice a day. These and other streams are listed below in **Table 8: Named Streams in Bordentown**. Tidal flows both help and hinder maintenance of good water quality in affected streams. The flood (incoming) tide carries leaves and nutrients that are beneficial to aquatic organisms, but it also limits the regular flushing out of silt and pollutant-laden waters coming from upstream. Silt deposition within a stream tends to increase during flood tides, although deposition is also a function of stream shape, the presence of specific flow barriers, and the quantity of silt (the load) being carried by the stream. Disposition of sediment in the Abbott Marshlands compensates for sea level rise and protects inland communities from increased water levels and inundation. See **Map 10: Surface Water, Wetlands, and Vernal Pools**.

Table 8: Named Streams in Bordentown

Blacks Creek
Crosswicks Creek
Crystal Creek
Delaware River
Doctors Creek
Jumble Gut Run
Mile Hollow Run
Sucker Run
Thornton Creek

Source: NJDEP, 2002



Thornton Creek Park

Source: DVRPC

## Lakes and Ponds

There are 105.4 acres of lakes and ponds in Bordentown Township, including one named lake and other small unnamed ponds and water impoundments. Crystal Lake, covering 20.8 acres in size, is located on the border of Bordentown Township and Mansfield Township. Crystal Lake was formed by the damming of Crystal Creek. Crystal Lake Park, located to the south of the lake in Mansfield Township, is a 370-acre Burlington County park that offers hiking, biking, and equestrian trails.

## 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.

Marshes are wetlands that are frequently or continually inundated with water and are characterized by emergent soft-stemmed vegetation adapted to saturated soil conditions. They are invaluable natural resources because they store floodwaters, improve water quality, control erosion, provide wildlife habitat, offer recreational opportunities, and provide other environmental services. Freshwater tidal marshes are marshes influenced by the motion of the tides. Freshwater tidal marshes occur in estuaries where freshwater flows from rivers and streams is influenced by ocean tides, and yet, typically, there is little mixing with salt water. The freshwater tidal marsh complex is considered a rare ecological community in the state.

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.

Wetlands cover 1,338 acres within the township (22 percent of the township), the largest category of which is deciduous wooded wetlands (878 acres). Freshwater tidal marshes cover 209 acres. In addition to natural wetlands, Bordentown Township also includes 144 acres of modified or disturbed wetlands. Modified wetlands are former wetland areas that have been altered by human activities and no longer support typical wetland vegetation, or are not vegetated at all. All categories of wetlands are shown in **Table 21: Bordentown Natural Vegetation**. See also **Map 15: Natural Vegetation**.

In the freshwater tidal marshes, wild rice (*Zizania aquatica*) is perhaps the most distinctive native plant in these regions. This annual grass can grow to be nine feet tall and is an important food source for migratory birds such as red-winged blackbirds and grackles. It is often found near spatterdock and pickerelweed. Other plants found in the tidal marsh include broad-leaved cattail, water hemp, jewelweed, arrow arum, bur marigold, smooth

beggar-ticks, nodding beggar-ticks, and sneezeweed. *Phragmites*, an invasive plant, is found in disturbed areas of the Abbott Marshlands, such as on Duck Island and along pipeline rights-of-way, as well as along the marsh's edges. Also known as the common reed, *Phragmites* colonizes easily and pushes into wetland areas from adjacent dry land areas. It spreads through an underground root system that is difficult to eradicate. In addition to its tendency to aggressively spread, *Phragmites* often becomes a dominant monoculture and is therefore considered an invasive species. Purple loosestrife is another invasive species known to be present in Bordentown Township.

## Agricultural Wetlands

Agricultural wetlands occupy 100 acres of Bordentown Township, shown in [Map 10: Surface Water, Wetlands, and Vernal Pools](#). Agricultural wetlands are modified former wetlands that are under cultivation yet still exhibit evidence of soil saturation in aerial infrared photo surveys.

The Natural Resources Conservation Service sponsors the Wetlands Reserve Program, a voluntary program that offers landowners a chance to receive payments for restoring and protecting wetlands, including agricultural wetlands, on their property. Restoring agricultural wetlands would require removing them from agricultural use and restoring them to their natural state. This program provides technical and financial assistance to eligible landowners who can enroll eligible lands through permanent easements, 30-year easements, or restoration cost-share agreements.

## 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 ponds (obligate breeders), which provide their offspring with a measure of protection because the pond'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 ponds 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 pond is certified, regulations require that a 75-foot buffer be maintained around the pond. NJDEP's division of Land Use Regulation oversees this designation and restricts development around vernal ponds by denying construction permits. Local municipalities can provide additional protection by negotiating conservation easements on the land surrounding the pond 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 on its official map.

The state has identified nine potential vernal pools in Bordentown Township, which are listed below in **Table 9: Vernal Pools in Bordentown** and shown on **Map 10: Surface Water, Wetlands, and Vernal Pools**. These vernal pools are located mostly in the northern part of the township and in the southwestern part of the township near streams and wetlands. Few potential vernal pools have been identified in the central part of the township, where urban development is the primary land use. Surveys of each pond are needed to determine if the pond is still in existence as a natural habitat, and if it is, what species are present. Once surveyed, the New Jersey Division of Fish and Wildlife will review the data and those pools that meet the criteria will be certified.

Table 9: Vernal Pools in Bordentown

Id#	USGS Quad Name	X Coordinate	Y Coordinate	Old Id
10517	Columbus NJ	524144.3	4440984	1761
8479	Trenton East NJ-PA	523022.1	4441823	1273
8484	Trenton East NJ-PA	523139.8	4441977	1274
8488	Trenton East NJ-PA	522961.2	4442027	1275
8469	Trenton East NJ-PA	522640.4	4442211	1272
8492	Trenton East NJ-PA	524334.4	4443181	1276
8496	Trenton East NJ-PA	525674.6	4445331	1277
8515	Trenton East NJ-PA	525887.6	4445830	1281
8500	Trenton East NJ-PA	526337.7	4446019	1278

Source: NJDEP, 2001

## 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).

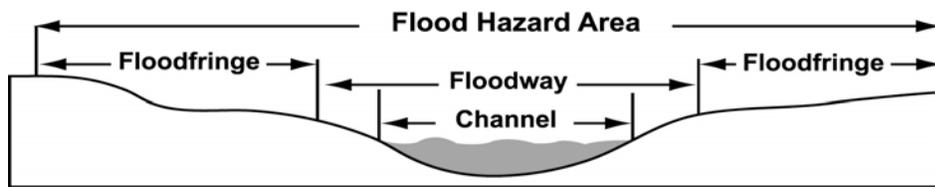


Figure 6: Parts of a Flood Hazard Area

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.

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 plant and invertebrate 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.

New Jersey’s flood hazard area maps are not available in digital form. Consequently, it is possible to approximate the spatial extent of the flood hazard area in Bordentown Township only by using the Federal Emergency Management Agency’s (FEMA’s) floodplain maps. The most recent FEMA floodplain mapping for Bordentown Township is the FEMA Q3 Flood Data, effective 1990. The Q3 Flood Data shows that 1,259 acres, or 21 percent, of Bordentown Township’s land is within the 100-year floodplain area, and an additional 56 acres are within the 500-year floodplain area. Nearly all of Bordentown Township’s floodplain areas are located along the Delaware River, major creeks and streams, and smaller tributaries. See [Map 11: Floodplains \(1990\)](#) and [Table 10: Floodplains in Bordentown](#) below.

Table 10: Floodplains in Bordentown

Floodplain	Area (Acres)	% of Township
100 Year Floodplain	1,258.69	21.13%
500 Year Floodplain	56.01	0.94%
<b>Total Floodplain</b>	<b>1,314.69</b>	<b>22.07%</b>
<b>Total Township Area</b>	<b>5,956.67</b>	<b>100%</b>

Source: FEMA, 1990



A View of Newbold Island

Source: DVRPC

## 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 waterbodies in Bordentown are FW2-NT, meaning they are fresh water streams that neither produce nor maintain trout.

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.



Northern Community Park

*Source: DVRPC*

## **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. So, the assessments of rivers and streams are reported by the subwatersheds 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 Bordentown Township support trout or shellfish, these designated uses are not applicable. As shown in the table below, all four subwatersheds, in which Bordentown Township is partially located, are impaired for at least one designated use. The NJDEP determined that sites located in tidal waters would no longer be assessed and listed due to new water quality testing standards. For aquatic life, the most general and encompassing parameter of water quality, three subwatersheds are impaired and one has insufficient information.

See [Map 12: Water Quality \(2010\)](#) and [Table 11: Integrated Water Quality Monitoring and Assessment Report, 2010](#).

Table 11: Integrated Water Quality Monitoring and Assessment Report, 2010

Subwatershed Name (HUC 14 ID)	Aquatic Life (General)	Primary Contact Rec.	Public Water Supply	Agricultural Water Supply	Industrial Water Supply	Fish Consumption	Sources of Impairment
Crosswicks Creek (Below Doctors Creek) (02040201070020)	<b>Not Supporting:</b> Phosphorus (Total), Total Suspended Solids (TSS), Turbidity	Insufficient Information	<b>Not Supporting:</b> Arsenic	Fully Supporting	Fully Supporting	<b>Not Supporting:</b> Polychlorinated biphenyls	<ul style="list-style-type: none"> <li>•Industrial Point Source Discharge</li> <li>•Municipal Point Source Discharges</li> <li>•Agriculture</li> <li>•Urban Runoff/Storm Sewers</li> <li>•Atmospheric Depositon - Toxics</li> </ul>
Crosswicks Ck (Doctors Ck-Ellisdale trib) (02040201050070)	<b>Not Supporting:</b> Phosphorus (Total), Total Suspended Solids (TSS), Turbidity	<b>Not Supporting:</b> Escherichia coli	<b>Not Supporting:</b> Arsenic, Mercury in Water Column	Fully Supporting	<b>Not Supporting:</b> Total Suspended Solids (TSS)	<b>Not Supporting:</b> Mercury in Fish Tissue, Mercury in Water Column, Polychlorinated biphenyls	<ul style="list-style-type: none"> <li>•Package Plant or Other Permitted Small Flow Discharges</li> <li>•Agriculture</li> <li>•Urban Runoff/Storm Sewers</li> <li>•Atmospheric Depositon -Toxics</li> <li>•Natural Sources</li> </ul>
Lower Delaware River tribs (Assiscunk Ck to Blacks Ck) (02040201090030)	Insufficient Information	Insufficient Information	Insufficient Information	Insufficient Information	Insufficient Information	<b>Not Supporting:</b> Mercury in Fish Tissue, PCB in Fish Tissue	
Blacks Creek (below Bacon's Run) (02040201080030)	<b>Not Supporting:</b> Phosphorus (Total), Total Suspended Solids (TSS)	<b>Not Supporting:</b> Escherichia coli	Fully Supporting	Fully Supporting	Fully Supporting	<b>Not Supporting:</b> Polychlorinated biphenyls	<ul style="list-style-type: none"> <li>•Municipal Point Source Discharges</li> <li>•Transfer of Water from an Outside Watershed</li> <li>•Agriculture</li> <li>•Urban Runoff/Storm Sewers</li> <li>•Atmospheric Depositon -Toxics</li> </ul>

Source: NJDEP, 2012

The four subwatersheds in Bordentown Township 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 11: Integrated Water Quality Monitoring and Assessment Report, 2010**. The causes of impairment include phosphorus (total), total suspended solids, turbidity, mercury, arsenic, polychlorinated biphenyls (PCBs), and E. coli. Brief descriptions of these contaminants follow.

Phosphorus exists naturally at low levels within the environment, although excess phosphorus can lead to harmful algae blooms. As the excess algae dies and its decomposition uses up the oxygen, “dead zones” can develop where no aquatic life can survive. Typical causes of phosphorus pollution include overfertilization of lawns and agricultural areas; runoff from impervious surfaces such as 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.

Total suspended solids (TSS) refer to solid materials, both organic and inorganic, that are suspended in water. High concentrations of TSS make water warmer by absorbing sunlight, while also blocking sunlight from reaching aquatic plants, decreasing photosynthesis, and reducing oxygen in the water, which then kills aquatic animal life. These materials enter waterbodies through stormwater runoff, streambank erosion, industrial wastes, wastewater discharges, improperly managed construction sites, and other sources.

Turbidity relates to how clear water appears. High turbidity makes water appear cloudy or opaque. Materials that cause water to be turbid include clay, silt, finely divided inorganic and organic matter, algae, soluble colored organic compounds, and plankton and other microscopic organisms. Excess turbidity can affect light penetration and productivity, recreational values, and habitat quality, and it can cause lakes to fill in faster.

Mercury and arsenic are considered heavy, or toxic, metals. Heavy metals bioaccumulate, meaning they accumulate in the body because they are not easily broken down. 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, metal, or lamps.

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 move up through 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.

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 from agricultural production into streams. E. coli itself is not necessarily a health hazard but serves as an indicator of the presence of sewage or animal waste, which may contain other more harmful microbes that are not as easily monitored.

## 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.

The ASMN is a cooperative network between USGS and NJDEP that samples surface water quality at 112 stations in the state, four of which are located within Bordentown Township. These stations monitor stream flow as well as temperature, dissolved oxygen (DO), pH, carbon dioxide, nitrogen, ammonia, phosphorus, arsenic, and many other parameters. Monitoring sites are listed below in **Table 12: Ambient Stream Quality Monitoring Sites in Bordentown**.

AMNET is another water quality monitoring system that the *Integrated Report* is based on. 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 three AMNET monitoring sites in Bordentown Township. 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. NJDEP data include reports about what organisms, such as fish, protozoa, and others, are found at the monitoring site. USGS measures water quality and volume during the water year, which runs from October 1 to September 30 of the following year. These monitoring reports include water and air temperatures, nutrient loads, flow volume, and several other parameters.

Table 12: Ambient Stream Quality Monitoring Sites in Bordentown

Station Name	AMNET	ASMN
Blacks Ck Rt 130	AN0134	
Blacks Creek at Fieldsboro NJ		01464532
Crosswicks Ck Main St	AN0126	
Crosswicks Ck Point Breeze NJ	AN0131	
Crosswicks Creek at White Horse NJ		0146452360
Crosswicks at Groveville Rd in Groveville NJ		01464504
Doctors C at Rt 130 at Yardville NJ		01464522

Source: NJDEP, 2008

Knowing the actual condition of streams and stream banks, and planning for their improvement, requires more frequent surveying and monitoring than the state can provide. As described earlier, the state does not monitor all sites continuously or for all parameters. The state primarily monitors main channels in nontidal 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

#### New Jersey Watershed Ambassadors Program

The New Jersey Watershed Ambassadors Program is an AmeriCorps Program hosted by the NJDEP Water Monitoring and Standards Program. The goal of this program is to raise awareness of water quality issues in the state through monitoring and education. This program is organized by Watershed Management Area (WMA), with ambassadors assigned to each WMA. Bordentown Township is located within WMA 20: Assiscunk, Crosswicks, Doctors. The local host agency for WMA 20 is the Mercer County Soil Conservation District. The Watershed Ambassadors Program has conducted biological and visual assessments of streams and lakes in the area, including some recent visual assessments in Bordentown Township and the City of Bordentown along Thornton Creek. The data from these visual assessments are shown in **Table 13: Thornton Creek Visual Assessments**.

Table 13: Thornton Creek Visual Assessments

Side ID	WATHOR 1	WATHOR 2	WATHOR 3
Waterbody	Thornton Creek	Thornton Creek	Thornton Creek
Site Location	Elizabeth Street, City of Bordentown	Joseph Lawrence Park, Bordentown Township	Hogback Road, Bordentown Township
Date of Observation	12/3/12	12/3/12	12/13/12
Average Stream Width (feet)	12.16	2.5	8.16
Habitat Score (Overall)	126	112	137
Epifaunal Substrate/Available Cover	19	15	18
Pool Substrate Characterization	13	10	18
Pool Variability	16	3	17
Sediment Deposition	14	18	15
Channel Flow Status	8	8	10
Channel Alteration	12	6	11
Channel Sinuosity	9	3	10
Bank Stability	3 (left), 3 (right)	9 (left), 9 (right)	6 (left), 2 (right)
Bank Vegetative Protection	9 (left), 7 (right)	7 (left), 7 (right)	7 (left), 6 (right)
Riparian Vegetative Zone Width	8 (left), 5 (right)	8 (left), 9 (right)	8 (left), 9 (right)

Source: AmeriCorps NJ Watershed Ambassador Program, 2013

#### Fish Consumption 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 pose a health risk 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. More details on preparation and consumption of fish are found at the advisory website: [www.state.nj.us/dep/dsr/njmainfish.htm](http://www.state.nj.us/dep/dsr/njmainfish.htm).

The consumption advisories for fish caught in general freshwater are listed in **Table 14: Fish Consumption Advisories, 2012** below. In addition to the statewide general advisories, there are additional fish consumption advisories for the tidal Delaware River and tributaries, Crosswicks Creek, and Crystal Lake.

Table 14: Fish Consumption Advisories, 2012

Species	General Population	High-Risk Individuals
	Eat No More Than:	Eat No More Than:
<b>General Freshwater Advisories</b>		
Trout (Brown, Brook, Rainbow)	One meal per week	One meal per week
Largemouth Bass		One meal per month
Smallmouth Bass		
Chain Pickerel		
Yellow Bullhead	No restrictions	One meal per week
Brown Bullhead		
Sunfish		
<b>Lower Delaware River (Tidal Section)</b>		
Trenton, NJ to Delaware/Pennsylvania border, including all tributaries to head of tide		
Hybrid Striped Bass	No restrictions	One meal per week
Largemouth Bass	One meal per month	Do not eat
American Eel	One meal per year	Do not eat
Channel Catfish		
Striped Bass	Four meals per year	
White Perch		
White Catfish	One meal per month	
<b>Crosswicks Creek at Bordentown (Mercer Co.)</b>		
Largemouth Bass	No restrictions	One meal per week
White Catfish		
<b>Crystal Lake at Fieldsboro (Burlington Co.)</b>		
Largemouth Bass	No restrictions	One meal per month
Black Crappie		One meal per week
Brown Bullhead		No restrictions

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 required states to only 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.

There are nine active NJPDES permits issued to facilities in Bordentown Township. These are shown in [Table 15: NJPDES Permits for Point Source Pollution](#). All nine permits are for stormwater discharges.

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. The mayor and governing body of the municipality where the facility will be located receive notice from NJDEP when anyone applies for a permit to discharge to surface water under the New Jersey Pollution Discharge Elimination System (NJPDES). Copies of the public notice should then be forwarded to the Environmental Commission. The municipality 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.

Table 15: NJPDES Permits for Point Source Pollution

NJPDES Permit Number	PI Number	Facility Name	Street Address	Effective Start Date	Expiration Date	Discharge Category
NJG0176036	513719	Adesta and Transco Staging Area	RT 206	03/01/12	02/28/17	5G3: Construction Activity Stormwater
NJG0204340	577020	Bordentown Waterfront Community	US 130	04/30/12	02/28/17	5G3: Construction Activity Stormwater (GP)
NJG0204455	577289	Bordentown Waterfront Community	US 130	05/03/12	02/28/17	5G3: Construction Activity Stormwater (GP)
NJG0204765	577691	Bordentown Waterfront Community	US 130	05/09/12	02/28/17	5G3: Construction Activity Stormwater (GP)
NJG0129801	49399	Loves Travel Stop 404	2008 State Highway 206 S	06/01/07	05/31/12	5G2: Basic Industrial Stormwater GP - NJ0088315
NJG0178497	521097	New Jersey Turnpike Widening Project	1053 U.S. Route 206	03/01/12	02/28/17	5G3: Construction Activity Stormwater
NJG0193691	560237	NJTTF - Joseph Lawrence Park	Bordentown	03/01/12	02/28/17	5G3: Construction Activity Stormwater
NJG0110639	47864	Parklands Reclamation Landfill	1070 Rt 206	06/01/07	05/31/12	5G2: Basic Industrial Stormwater GP - NJ0088315
NJG0057631	46139	Petro Stopping Center #18	402 Rising Sun Rd	06/01/07	05/31/12	5G2: Basic Industrial Stormwater GP - NJ0088315

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, which is carried by stormwater runoff, has the largest effect on the water quality and channel health of streams in Bordentown 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 and velocity of water and the level of pollutants in the runoff. Increased runoff causes erosion and sediment buildup in streams and washes nutrients, toxins, bacterial contamination, road salt, motor oils and litter into streams.

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 Bordentown 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 Bordentown are affected by stormwater runoff both from within the township and upstream municipalities.

NJDEP's new Stormwater Management Rules focus on reducing and controlling nonpoint sources of water pollution. The NJDEP 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). Bordentown Township is a Tier A municipality.

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).

### **Stormwater Management Statewide Basic Requirements**

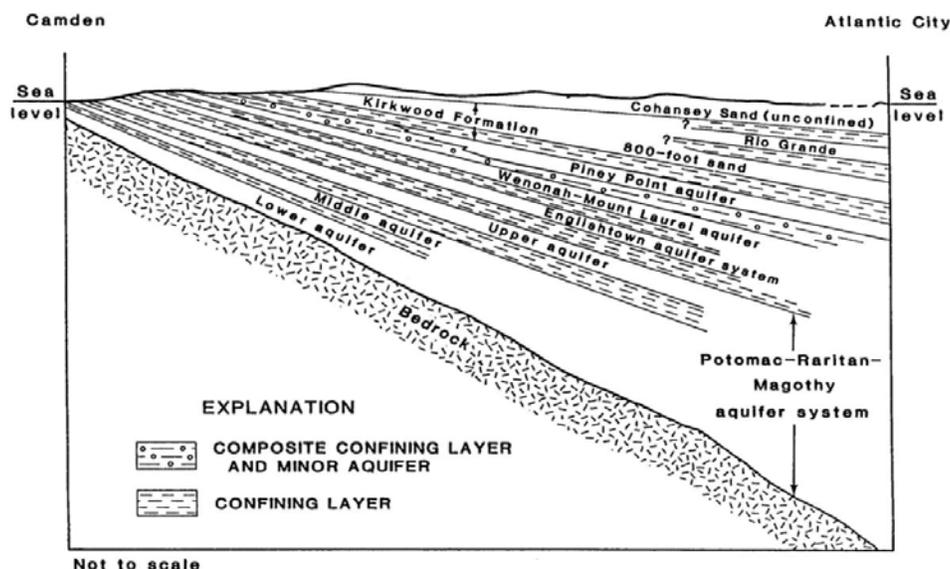
1. Control post-construction stormwater management in new development and redevelopment through:
  - Adoption of a stormwater management plan in accordance with N.J.A.C. 7:8.
  - Adoption and implementation of a stormwater control ordinance in accordance with N.J.A.C. 7:8. This ordinance requires retention on site of 100% of preconstruction recharge and use of low-impact design in stormwater facilities, among other features.
  - Ensuring compliance with Residential Site Improvement Standards for stormwater management. The RSIS has been revised to incorporate the low-impact design and other requirements of the stormwater control ordinance.
  - Ensuring long-term operation and maintenance of Best Management Practices on municipal property.
  - Requiring that new storm drain inlets meet new design standards.
2. Conduct local public education:
  - Distribute educational information (about stormwater requirements, nonpoint source pollution, and stewardship) annually to residents and businesses and conduct a yearly “event” (such as a booth with these messages at a community day).
  - Have all municipal storm drain inlets labeled with some type of “don’t dump” message.
  - Distribute information annually regarding fertilizer/pesticide application, storage, disposal, and landscaping alternatives and regarding proper identification, handling, and disposal of wastes, including pet waste and litter
  - Adopt specific ordinances to control waste disposal and other nonpoint sources.
3. Control improper disposal of waste through improved yard waste collection and through adoption of ordinances (pet waste, litter, improper dumping, and wildlife feeding).
4. Control solids and floatables through increased street sweeping, retrofitting storm drain inlets during road repairs, and instituting programs for stormwater facility management, for roadside erosion control, and for outfall pipe scouring/erosion.
5. Improve maintenance yard operations, specifically for de-icing material storage, fueling operations, vehicle maintenance, and housekeeping operations.
6. Increase employee training about all of the above.

Source: N.J.A.C. 7:8

## 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.

The Potomac–Raritan–Magothy (PRM) formation is the deepest and largest 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. It is composed of two thick layers—the Kirkwood (lower) and the Cohansey (upper)—that overlie the older formations.



A cross section across southern New Jersey from west to east (see [Figure 7](#)) would show that the aquifers are not horizontal, but instead are 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 oldest strata emerge on the surface near the Delaware River.

Figure 7: Aquifers of Southern New Jersey  
Source: USGS

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. [Map 13: Geologic Outcrops](#) shows the outcropping geologic formations in and around Bordentown Township. The Englishtown aquifer outcrops in the southeastern corner of the township. The Merchantville–Woodbury confining unit outcrops in a diagonal band across much of Bordentown Township. The Potomac and Magothy formations outcrop along the western edge as well as the northern section of the township and Newbold Island.

## Aquifers

Bordentown Township's public water supply is drawn from the Potomac-Raritan-Magothy aquifer system (PRM) through wells located just north of the township, in Hamilton Township.

### Potomac-Raritan-Magothy Aquifer System (PRM)

The Potomac-Raritan-Magothy (PRM) is a deep geological formation underlying Bordentown Township. 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.

The PRM is the primary source of drinking water for New Jersey residents from Burlington to Salem counties, as well as communities in Delaware. Because of such high usage, PRM aquifer water levels have declined in recent decades.

### 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 fewer than 25 people; these 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 serve 15 service connections for at least 60 days per year. Public water supply wells are classified 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 serves at least 25 year-round residents. Public community water supply wells may serve municipalities, subdivisions, nursing homes, or other areas or institutions.

The Bordentown Water Department has four active public community water supply wells serving Bordentown Township and City, located just to the north of the township in Hamilton Township. They are listed in **Table 16: Public Community Water Supply Wells**

below and shown on [Map 14: Public Water Supply Wells](#). In addition to serving Bordentown, the Bordentown Water Department sells its water to the Fieldsboro Water Department. Information on the susceptibility ratings, monitoring schedules, and annual drinking water quality report (also known as the Consumer Confidence Report) are found in [Appendix E: Drinking Water](#).

Table 16: Public Community Water Supply Wells

Well Permit	Well ID	System Name	Depth of Bottom of Well (feet)	Primary Aquifer
2805150	WSWL0000065857	Bordentown Water Dept	121	Middle PRM
2805409	WSWL0000065868	Bordentown Water Dept	138	Middle PRM
2808769	WSWL0000065940	Bordentown Water Dept	121	Middle PRM
2834305	WSWL0000066082	Bordentown Water Dept	102	Middle PRM

Source: NJDEP, 2009

Public non-community wells are another part of a public water system. A public non-community water supply well is a public water supply well used by individuals other than year-round residents for at least 60 days of the year. There is one public non-community well in Bordentown Township on Route 206 that serves the Maier's Bakery Thrift Store, listed in [Table 17: Public Non-Community Water Supply Wells](#) below and shown on [Map 14: Public Water Supply Wells](#). Although this business has been closed for some time, the well has an active registration with the NJDEP.

Table 17: Public Non-Community Water Supply Wells

Well ID	System Name	Depth of Bottom of Well
0304305	Maier's Bakery Thrift Store	180

Source: NJDEP, 2012

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.

Sampling requirements for a water system may change at any time for several reasons, including analytical results or changes in population and/or inventory. It is generally the responsibility of the public water system and its licensed operator to make sure 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).

## Wellhead Protection Areas

As part of its 1991 Well Head Protection Program Plan, the New Jersey Department of Environmental Protection has delineated Wellhead Protection Areas (WHPAs) around all community wells. A WHPA is the area from which a well draws its water within a specified time frame (tiers). Pollutants spilled directly on or near the wellhead will enter the water source within that time frame. Once delineated, these areas become a priority for efforts to prevent and clean up groundwater contamination. Other components of the Wellhead Protection Plan include implementing best management practices to protect groundwater, land use planning, and education to promote public awareness of groundwater resources.

The radius of the WHPA depends on a number of factors related to the well and the underlying hydrogeology. The thicker and more porous the aquifer and the slower the pumping rate of the well, the smaller the radius is of the WHPA. The WHPAs for the Bordentown Water Department wells in Hamilton Township, shown on [Map 14: Public Water Supply Wells](#), extend into the northern portion of Bordentown Township onto land that is mostly, but not entirely, protected wetlands.

## 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.



Northern Community Park

Source: Sean Varga

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.

In 1970, the US Environmental Protection Agency (EPA) was formed to enforce the Clean Air Act (CAA). In New Jersey, the EPA allowed NJDEP to enforce the CAA because the state agency developed more stringent air standards and created a State Implementation Plan (see NJAC 7:27). The CAA identified six criteria pollutants—ozone, particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide, and lead—that are destructive to human health and the built and natural environment (see explanation of Criteria Pollutants on right). The EPA sets National Ambient Air Quality Standards (NAAQS) for these pollutants based on human health effects, as well as environmental and property damage.

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.



First ground-mounted solar panels

Source: Bill Ryan

## Criteria Pollutants

Ground-level ozone (O<sub>3</sub>) 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 (NO<sub>x</sub>) 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<sub>2</sub>) 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 Monitoring

NJDEP's Bureau of Air Monitoring maintains a network of over 40 continuous monitoring stations across the state. Most of the monitoring stations are clustered in the New York metropolitan area. Each station monitors at least one of 23 different parameters, including many air pollutants as well as wind speed, wind direction, solar radiation, or other parameters. Several of these parameters—carbon monoxide, nitrogen oxides, ozone, sulfur dioxide, smoke shade, particulate matter, and various meteorological data—are measured continuously and data is available instantaneously. As enabled by the CAA, the EPA has set National Ambient Air Quality Standards (NAAQS) for the six criteria pollutants: particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. There are two kinds of NAAQS: the primary standard is based on human health effects, while the secondary standard is based on environmental and property damage.

There is a continuous monitoring station located approximately 15 miles to the southeast of Bordentown Township in Colliers Mills, NJ, Ocean County. In 2011, the Colliers Mills monitoring station monitored ozone (O<sub>3</sub>) at the "urban" scale, representative of an area including Bordentown Township.

The amount of ozone has decreased greatly in New Jersey since the 1980s, and one-hour concentrations have not exceeded 0.200 parts per million (ppm) since 1988. For ground-level ozone (O<sub>3</sub>), there are two NAAQ standards: (1) a one-hour concentration of 0.12 ppm, and (2) an eight-hour average concentration of 0.08 ppm. For the national standards, these are the same for both primary and secondary effects. New Jersey, however, has tightened

the one-hour concentration standard for secondary effects to 0.08 ppm. Ozone was monitored at 15 stations throughout the state in 2011. The Colliers Mills station did not exceed the one-hour standard, although it did exceed the eight-hour standard on 11 days in 2011, as shown in **Table 18: Ozone One-Hour Data** and **Table 19: Ozone Eight-Hour Data** below.

Table 18: Ozone One-Hour Data, 2011

Monitoring Site	1-hr Max ppm	2nd Highest 1-hr Max ppm	4th Highest 1-hour Average 2007-2009	# of days with 1-hour Averages above 0.12 ppm
Colliers Mills	0.114	0.107	0.109	0

Source: NJDEP, 2011

Table 19: Ozone Eight-Hour Data, 2011

Monitoring Site	1st Highest	2nd Highest	3rd Highest	4th Highest	Avg. of 4th Highest 8-hour Averages 2008-2010	# of days with 8-hour above 0.08 ppm
Colliers Mills	0.101	0.094	0.089	0.085	0.081	11

Source: NJDEP, 2011

## 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) for Region 5, 2011** below. The higher the AQI value, the greater the level of air pollution and associated health concerns.

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 and Rider University. In 2011, the most recent year of annual data, Region 5 reported 320 good (green) and 38 moderate (yellow) days, 7 days that were unhealthy for sensitive groups (orange), and 0 unhealthy, very unhealthy, or hazardous

(red, purple, maroon) days.

Numerical Air Quality Index (AQI) Rating	Descriptive Rating: Levels of Health Concern	AQI Color Code	Region 5 Days, 2011
0 to 50	Good	Green	320
51 to 100	Moderate	Yellow	38
101 to 150	Unhealthy for Sensitive Groups	Orange	7
151 to 200	Unhealthy	Red	0
201 to 300	Very Unhealthy	Purple	0
301 to 500	Hazardous	Maroon	0

Figure 8: Air Quality Index (AQI) for Region 5, 2011

Source: DVRPC, 2012

### 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 27 active air quality permits in Bordentown Township, listed below in **Table 20: Facilities with Active Air Quality Permits.**

Table 20: Facilities with Active Air Quality Permits

Facility Name	Address	PI Number
APCO Petroleum Corp-APCO Bordentown	2000 Rt 206	A467
Badshah Oil Corp	1077 Rt 206	A9756
Bob Maguire Chevrolet (closed)	237 Rt 130	46308
Bordentown Armory	1048 US HWY 206	45611
Bordentown Gas Inc Service Station	231 Rt 206	A4780
Bordentown Fuel Service Area	Chesterfield Rd	H4502
Bordentown Twp DPW	262 Crosswicks Rd	A3765
Bordentown Twp Middle School	50 Dunns Mill Rd	46172
Bordentown Twp Regional High School	318 Ward Ave	46151
Delta Gas	676 Rt 206	A4821
Hertz Corp	1037 Rt 206	H8761
Juvenile Medium Security Facility	W Burlington St	45197
Laurel Run Corp-Laurel Run Apts.	Rt 206	45173
Laurel Run STP	Georgetown Rd	46267
Mershon Concrete LLC	5251 Rt 130	45417
Mile Hollow Pump Station	Stanton Ave	46331
NJDOT Bordentown Maintenance Facility	Dunns Mill Rd & Rt 130	H4531
Nu Wave Cleaners	310 Ward Ave	L8586
NWL Transformers Inc	312 Rising Sun Rd	45070
Parklands Recycling & Disposal Facility	1070 Rt 206	46099
P&C Cleaner	626 Rt 206	L4560
Shahi Valero Service Station	51 Rt 130 N	A4503
Tri State Petro-Tri State Yardville	42 Rt 130S	A4607
Turnpike Amoco Service Station	1080 Rt 206	A4665
Verizon NJ Bordentown Co#53414	195 Crosswicks Rd	45548
WM of Central Jersey Inc	1070 Rt 206	45231

Source: NJDEP, 2012

## Biological Resources

When a community protects wildlife and habitat, it is also protecting biodiversity, which is important for the health and productivity of the ecosystem and its inhabitants, including humans. Biodiversity refers to the variety of genetic material within a species population, the variety of species (plants, animals, microorganisms) within a community, and the variety of natural communities within a given region. Biodiversity facilitates adaptation and evolution, improving a species' chance of survival as the environment changes. A diversity of plant and animal species is also necessary to maintain healthy human environments, working landscapes, and productive ecosystems. Lower organisms, many not well known, contribute to nutrient cycling, decomposition of organic matter, soil rehabilitation, pest and disease regulation, pollination, and water filtering. Once biodiversity declines, it is extremely difficult for an ecosystem to recover or replace species.

Bordentown contains various ecosystems, from the Abbott Marshlands to Newbold Island to the many riparian corridors along its streams. Wooded wetlands are the most abundant type of ecosystem in Bordentown, followed by deciduous upland forests and tidal marshes. Areas of upland forest are located adjacent to wooded wetlands and on much of Newbold Island.

### Natural Vegetation

A region's vegetation is dependent upon many factors, the most important of which are climate and soils. Bordentown's climate is temperate, and it is characterized by moderate temperatures, precipitation, and wind, with an average annual temperature of 54 degrees Fahrenheit. The average annual precipitation is 41.4 inches and is fairly well distributed throughout the year. The majority of Bordentown Township's soils are poorly drained soils that exhibit ponding and sustain wetland plants. However, Bordentown also has a large amount of moderately well-drained soils that support a diversity of trees and crops. See the [Soils](#) section for a detailed description of Bordentown Township's soils.

Bordentown Township's natural vegetation types, along with human-influenced types of land cover, have been tabulated and mapped by NJDEP's 2007 land cover analysis and are shown below in [Table 21: Bordentown Natural Vegetation](#). See [Map 15: Natural Vegetation \(2007\)](#).

Table 21: Bordentown Natural Vegetation

Vegetation Type	Area (Acres)	Percentage of Township
Brush/Shrubland-Oldfield	109.18	1.8%
Brush/Shrubland	180.11	3.0%
Tidal Marshes-Freshwater	208.57	3.5%
Tidal Waters	392.00	6.6%
Upland Forest-Coniferous	2.83	<1.0%
Upland Forest-Deciduous	642.86	10.8%
Upland Forest-Mixed (Coniferous Dominated)	6.59	<1.0%
Upland Forest-Mixed (Deciduous Dominated)	20.51	<1.0%
Water	71.20	1.2%
Wetlands-Coastal (Phragmites Dominated)	11.86	<1.0%
Wetlands-Herbaceous	19.75	<1.0%
Wetlands-Modified	144.10	2.4%
Wetlands-Phragmites Dominated	5.04	<1.0%
Wetlands-Scrub/Shrub	71.30	1.2%
Wetlands-Wooded-Deciduous	877.74	14.7%
<b>Total Natural Vegetation Cover</b>	<b>2,763.61</b>	<b>46.4%</b>
<b>Total Bordentown Land</b>	<b>5,956.67</b>	<b>100.0%</b>

Source: NJDEP, 2007

## Wetlands

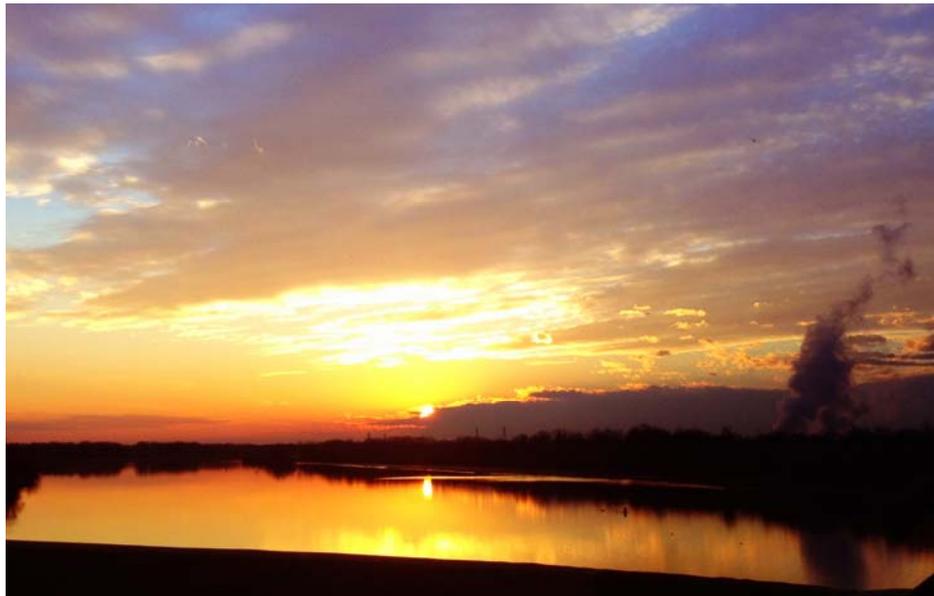
Wetlands are a critical ecological resource, supporting both terrestrial and aquatic animals and boasting biological productivity far greater than that found on dry land. Wetlands play a vital role in maintaining water quality by naturally filtering surface and ground waters. The ecological importance of wetlands, however, has not always been appreciated. For over three centuries, people drained, dredged, filled, and leveled wetlands to make room for development and agriculture. Although the pace of wetland destruction has slowed markedly in the past three decades, human activities have destroyed approximately 115 million of the original 221 million acres of wetlands in the United States since the beginning of European settlement.

Scattered throughout Bordentown Township are deciduous wooded wetlands (sometimes referred to as wetland forests or, more typically, hardwood swamps). Virtually all of the wetlands in the township are found in association with streams and their tributaries. Deciduous wooded wetlands occupy nearly 900 acres (nearly 15 percent) of Bordentown Township and support mixed hardwoods that flourish in lowlands. The trees in Bordentown's deciduous wooded wetlands may include American sycamore, river birch,

white ash, swamp white oak, green ash, and sweetgum. Deciduous wooded wetlands provide important habitat for a wide variety of mammals, birds, reptiles, and amphibians.

Closely associated with deciduous wooded wetlands are scrub/shrub wetlands, occupying over 70 acres of Bordentown Township. These wetlands are generally composed of young, medium-height, primarily deciduous woody plants. Scrub/shrub wetlands are usually in early successional stages and will later become shrub-dominated wetlands or those dominated by canopy species. The trees in Bordentown Township's scrub/shrub wetlands may include red maple, ash, and sweetgum, and they are dominated by shrub species such as silky dogwood, buttonbush, winterberry, swamp rose, elderberry, Southern arrowhead, and hazel alder.

Other types of wetlands found in Bordentown Township include herbaceous wetlands, also known as emergent wetlands. These herbaceous wetlands generally occur as freshwater tidal marshes along the main channel of Crosswicks Creek, the largest and most significant of which is the Abbott Marshlands. Nontidal emergent wetlands are also found in Bordentown along Jumble Gut Run, Mile Hollow Run, Thornton Creek, the upper portion of Blacks Creek, Laurel Run, and Spring Hill Brook. Herbaceous wetland plants in Bordentown may include rice cutgrass, reed canary grass, pond lily, tearthumb, arrow-leafed tearthumb, broadleaf cattail, and the common reed (*Phragmites*). Herbaceous wetlands may be dominated by *Phragmites*, a reed that colonizes easily and pushes into wetland areas from adjacent dry land areas, spreading through an underground root system that is difficult to eradicate. In addition to its tendency to aggressively spread, *Phragmites* often becomes a dominant monoculture and is therefore considered an invasive species.



Sunset over the Delaware River

Source: M. Gonzalez

Modified wetlands are areas that have been altered by human activities and do not support natural wetland vegetation, but show signs of soil saturation on aerial infrared

surveys. Modified wetlands encompass agricultural wetlands, former agricultural wetlands, disturbed wetlands, and wetlands that occur in maintained green spaces, such as open lawns, golf courses, and stormwater swales. Bordentown Township has several large tracts of modified wetlands covering over 140 acres of the township.

Wetlands are protected through enforcement of the buffer requirements of the New Jersey Freshwater Wetlands Protection Act.

## Upland Forests

Upland areas are those locations without water at or near the soil surface. Upland forests are located on drainage divides, terraces, and slopes where water is not the controlling factor and where drainage is sufficient so that soils do not become saturated for extended periods of time. Nearly all old growth forests in New Jersey were harvested for lumber during colonial times.

Over 11 percent of Bordentown Township consists of upland forests. Most of Bordentown's original upland forests were cleared and converted to farms during the 18<sup>th</sup> and early 19<sup>th</sup> centuries. While some second-growth forests have returned, other areas have been converted to residential or commercial development. The remaining upland forests tend to be located near stream corridors or are patchy woodlands on less desirable soils associated with large farms.

The composition of upland forests in the township is largely one of mixed oaks (white, black, red, chestnut, and scarlet oak) joined by beech, pignut, and mockernut hickories, black walnut, tulip tree, and red maple. Beech/oak forest is found predominantly around the lower third of Blacks Creek, beginning at the Delaware River and heading east until Route 206. Past this point, the forest becomes a mixed oak forest. Additionally, hickories are found in abundance at the northeastern corner of the township, on Crosswicks Creek.

Dogtoothed violets and skunk cabbage are common along Blacks Creek and parts of Crosswicks Creek. The understory is dominated by flowering dogwood, black cherry, ironwood, and sassafras. Vines are common, including Virginia creeper, wild grapes, Japanese honeysuckle, and poison ivy. Spicebush, arrowwood, and black haw are common shrubs in moister locations.

Rhododendrons form a unique part of the Bordentown landscape. They are in abundance in parts of Bordentown because of the very specific conditions they require. When located in the New Jersey Inner Coastal Plain, rhododendrons must be situated on north-facing slopes with Keyport soils. Bordentown Township has these conditions primarily along Blacks Creek, between Route 130 and Burlington Street, and also near Route 206. Rhododendrons, reaching 20 feet in height, have been spotted in these areas.

## Grasslands and Agricultural Lands

NJDEP defines grassland habitat as brushland, shrubland, or old fields that were cleared or disturbed at one time and then abandoned. Following abandonment, old fields are overgrown by perennial herbs and grasses. These pioneer plants remain the dominant species for 3 to 20 years. Later, woody plants take over. This habitat is visible, especially along wood edges, roadsides, and in landscapes where mowing is infrequent and where woody plants are not yet the dominant vegetation.

In Bordentown, 180 acres or approximately 3 percent of the township is brush or shrubland. An additional 109 acres or 1.8 percent of the township is classed as old fields. The majority of old fields and brushland/shrubland within the township is located on the western half of Newbold Island.

## Landscape Project Priority Habitats

The Landscape Project, developed by the Endangered and Nongame Species Program of the NJDEP Division of Fish and Wildlife, documents the value of various types of habitats within New Jersey. It ranks these habitats out of five classifications based on their importance (five being the highest). The NJDEP divides New Jersey into six habitat regions based on ecological similarities. Bordentown Township is located completely within the Piedmont Plains habitat region.



Blacks Creek

Source: M. Gonzalez

Nearly half of the area of Bordentown Township is ranked as priority habitat by the Landscape Project. This includes waterways within the township boundaries. Newbold Island and the riparian areas of the Delaware River, Crosswicks Creek, Crystal Creek, and Blacks Creek are all ranked as high priority habitat. These areas are listed below in **Table 22: Landscape Project Priority Habitat**. It is important to preserve all levels of habitat in order to maintain the diversity of species that still exists in the township. Many areas along the Delaware River and Crosswicks Creek provide habitat for the bald eagle, a state endangered species. There is also habitat in the Delaware River and Crosswicks Creek for the shortnose sturgeon, a state and federal endangered species, as well as the great blue heron, a species of special concern. Newbold Island also provides habitat for the state threatened wood turtle and the state endangered Northern harrier. Non-riparian areas of Bordentown also provide habitat for the state threatened wood turtle, bobolink, grasshopper sparrow, and three species of special concern: Eastern meadowlark, Cooper's hawk, and great blue heron. See **Map 16: Landscape Project Priority Habitat (2012)**.

Table 22: Landscape Project Priority Habitat

Rank	Area (Acres)	% of Township Land
1	776.60	13.04%
2	378.84	6.36%
3	243.69	4.09%
4	1,076.22	18.07%
5	370.35	6.22%
<b>Total Landscape Project Habitat</b>	<b>2,845.71</b>	<b>47.77%</b>
<b>Total Bordentown Township Land</b>	<b>5,956.67</b>	<b>100.00%</b>

Source: NJDEP, 2012

## Animal Communities

Although no comprehensive inventory of the different animal species within Bordentown Township exists, there are records of sightings, biological studies of range, and assessments of endangered and threatened species status. Using federal, state, and other scientific sources, it is possible to identify and describe known and possible animal communities of Bordentown Township. These are included in **Appendix B: Animals in Bordentown Township**.

### Invertebrates

Invertebrates are the basis of a healthy environment and are part of every food chain—either as food for amphibians and fish, or as a part of nutrient cycling systems that create and maintain fertile soils. Invertebrates consist of insects (beetles, butterflies, moths, dragonflies, ants, termites, bees, wasps, flies, and others), arachnids (spiders, ticks, and mites), crustaceans (crayfish and microscopic copepods), mollusks (mussels, clams, snails, and slugs), and worms.

Macroinvertebrates are invertebrates that are visible to the naked eye but smaller than two inches. Benthic (bottom-dwelling) macroinvertebrate communities provide a basis for ecological monitoring and are relatively simple to collect from shallow stream bottoms. These communities consist largely of the juvenile stages of many insects, such as dragonflies and mayflies, as well as mollusks, crustaceans, and worms. Monitoring for diverse assemblages of macroinvertebrates reveals the effect of pollutants over a longer period of time, as compared to chemical monitoring, which measures water quality at one moment in time. The Ambient Biomonitoring Network (AMNET) surveys streams for macroinvertebrate communities, which indicate certain levels of water quality, discussed in the section on **Surface Water Quality**.

The Eastern pondmussel and the tidewater mucket, both threatened species in the state, are both found in the waters of Bordentown Township.

A list of butterflies found in the Abbott Marshlands is found in **Appendix C: Abbott Marshlands**.



Praying Mantis

Source: *Olivia Whelan*

## **Vertebrates**

Vertebrates are less numerous than invertebrates, but their larger size makes them much more visible, and thus better studied and recorded. Fish species are fairly well documented, as are mammals. Lists of animals that may be found in Bordentown are found in **Appendix B: Animals in Bordentown Township** and **Appendix C: Abbott Marshlands**.

## Mammals

Mammals appear to be abundant because they tend to be larger and live in habitats also ideal for human development. There are 90 mammal species in New Jersey, of which nine are listed as endangered and none are listed as threatened by the state. Some common mammals found in Bordentown include the opossum, Eastern mole, little brown bat, Eastern cottontail, Eastern chipmunk, gray squirrel, white-footed mouse, meadow vole, muskrat, red fox, raccoon, long-tailed weasel, mink, striped skunk, beaver, river otter, and white-tailed deer. There are no rare mammals located in Bordentown Township.

## Birds

New Jersey has about 400 species of birds, which is an exceptional number given the state's small size. New Jersey is an important "rest stop" for birds migrating to and from climates in Central and South America. The New Jersey Atlantic Coast and the Delaware Bay are crucial elements of the Eastern Flyway (established migratory air route) in North America.

Bordentown Township is home to a variety of birds. Some birds that are very numerous or are common and frequently seen include the great blue heron, mallard, turkey vulture, American robin, gray catbird, Canada goose, and house sparrow. The rare bobolink, grasshopper sparrow, Eastern meadowlark, Cooper's hawk, Northern harrier, and bald eagle are also all found in Bordentown. A complete list of birds found in Bordentown Township is found in [Appendix B: Animals in Bordentown Township](#).

### Important Bird and Birding Areas

The Important Bird Area (IBA) is a global effort by the Audubon Society to identify and conserve areas that are vital to birds and other species. The New Jersey Audubon Society has an expanded initiative called the Important Bird and Birding Area (IBBA) Program, which identifies areas that provide essential habitat for sustaining bird populations (Bird Areas), as well as areas that provide exceptional opportunities for bird watching (Birding Areas). The New Jersey IBBA Program has identified 122 sites within the state.

Two sites, Crystal Lake and the Abbott Marshlands, are located partially within Bordentown Township.

**Crystal Lake** is a large freshwater lake buffered from dense urban areas by cultivated fields, deciduous forest, scrub-shrubland, and nontidal wetlands. The Crystal Lake IBA stretches northward between Newbold Island and Dunns Mill Road and eastward between Route 130 and Route 206. The surrounding residential, agricultural, and industrial development impair water quality, stream flow, and groundwater supplies that feed the lake. There are several large development projects proposed for nearby agricultural parcels. New Jersey state-endangered bald eagles breed at Crystal Lake and occasionally winter in the area. Other breeding birds observed at Crystal Lake include great blue herons, red-bellied woodpeckers, downy woodpeckers, hairy woodpeckers, northern bobwhites, Baltimore orioles, and Northern flickers. One of the few forested areas in the region, this site provides spring and fall migrants with resting and roosting habitat before

they continue their migration. Several areas around Crystal Lake have been developed into suburban neighborhoods, reducing the amount and quality of habitat.

The **Abbott Marshlands** (identified by the Audubon Society as the Hamilton-Trenton Marsh IBA) is the only IBA in Mercer County. Covering about 2,800 acres, the site supports state-endangered pied-billed grebes and bald eagles. Cliff swallows, listed as a state species of special concern, occur here in impressive numbers. Breeding forested wetland species include the wood duck, mallard, prothonotary warblers, and fish crows. Hundreds of gadwalls, American wigeons, Northern shovelers, Northern pintails, green-winged teals, and ring-necked ducks winter at the marsh and often move through the area during spring migration. Migratory songbirds also depend on the resources of this urban oasis during spring and fall migration. Nearly half of the bird species sighted at the marsh—100 of 230 species—nest in the marsh.

## Reptiles and Amphibians

Reptiles and amphibians can be quite elusive when surveys attempt to document them. Some reptiles and amphibians, called herpetological species, are rare because they depend on vernal ponds, as discussed in the **Surface Waters Resources** section. Amphibians tend to be very sensitive to environmental changes, offering a visible warning to humans that significant changes are occurring.

New Jersey is home to approximately 80 reptile and amphibian species. Some common herpetological species that have been documented in Bordentown Township include the red-backed salamander, bullfrog, green frog, spring peeper, Southern leopard frog, Eastern painted turtle, snapping turtle, stinkpot turtle, Northern fence lizard, garter snake, Northern water snake, rough green snake, Southern ringneck snake, and Eastern ribbon snake. See **Appendix B: Animals in Bordentown Township** for a complete list of reptiles and amphibians that may be found in the township.

## Fish

When European settlers arrived in present-day Burlington County, they encountered Lenape Indians, who regularly fished along the inland streams and gathered shellfish in the Delaware River. Shad fishing was an important industry along the Delaware River until the early twentieth century. Due to the unintended consequences of overfishing, urban development, industrial advancement, and mechanized agriculture, the amount and diversity of aquatic life has decreased dramatically throughout most of New Jersey.

The New Jersey Division of Fish and Wildlife, under the Bureau of Freshwater Fisheries, monitors and actively aids the propagation, protection, and management of the state's freshwater fisheries. The bureau raises several million fish for stocking in suitable water bodies and conducts research and management surveys.

There are over 50 species of fish that are likely to be found in Bordentown Township's many streams and lakes, including the shortnose sturgeon, which is an endangered

species both in the state and the nation. See [Appendix B: Animals in Bordentown Township](#).

## Rare Wildlife

The Natural Heritage Database of the NJDEP lists nine species of rare wildlife found in Bordentown Township. Of these nine species, seven are birds, one is a reptile, one is an invertebrate, and none are mammals or amphibians. These wildlife species are listed as either endangered, threatened, or a species of special concern in New Jersey. One species, the shortnose sturgeon, is also listed as federally endangered. The rare animals are listed in [Appendix B: Animals in Bordentown Township](#). Additionally, there may be other rare species sighted by township residents but not yet verified by the Endangered and Nongame Species Program. They are, therefore, not included in this list.

## Natural Heritage Database and Natural Heritage Priority Sites

The New Jersey Natural Heritage Program identifies the state's most significant natural areas through a comprehensive and continuously updated inventory of rare plant and animal species and representative ecological communities. The Natural Heritage Database compiles information on the distribution, biology, status, and preservation needs of these species and communities. The Natural Heritage Database provides the foundation for the designation of Natural Heritage Priority (NHP) sites. NHP sites are exemplary natural communities within the state that provide critically important habitat for rare plant and animal species. Preserving these areas should be a top priority in efforts to conserve biological diversity in New Jersey. Biodiversity rankings of NHP sites range from B1 (outstanding significance for biodiversity) to B5 (general biodiversity interest). In Bordentown Township, the [Abbott Marshlands](#) (referred to as the Trenton Marsh) is an NHP site.

Designation as an NHP site does not carry any specific requirements or restrictions on the land. Rather, the designation is made because of a site's high biological diversity value. Owners of NHP sites are encouraged to become informed stewards of the property and to consider working with the local community, nonprofit groups, or the state to preserve the land permanently.

Information on particular sites may also be provided by the Nature Conservancy or by the NJDEP Endangered and Nongame Species Program, and especially through the latter agency's Landscape Project.

## Abbott Marshlands

The Abbott Marshlands (also known as Hamilton-Trenton-Bordentown Marsh) is one of New Jersey's most significant natural areas. This is despite being intersected by two major interstates and a railroad line, and containing uses like a former landfill, sewage

treatment plant, and a power generating plant. A popular destination for bird watching, hiking, fishing, canoeing, and photography, the Abbott Marshlands is the northernmost tidal freshwater wetland on the Delaware River. The Abbott Marshlands, located on the eastern side of the Delaware River, is situated among the urbanized areas of Trenton, Hamilton Township, and Bordentown Township. The marsh is bordered by a dense infrastructure network that includes the River LINE, Interstates 295 and 195, and other roadways and associated development. The entire marsh is 3,030 acres and contains 1,250 acres of wetlands and adjacent uplands in public ownership. The Abbott Marshlands is identified by the Natural Heritage Database as the Trenton Marsh NHP Site, and by the Audubon Society as the Hamilton-Trenton Marsh IBA.

The **Trenton Marsh NHP Site**, covering 1,250 acres, is a freshwater tidal marsh natural community and is home to several state endangered plant and animal species. Those threatened and endangered plants and animals identified in Bordentown Township by the Natural Heritage Database are listed in **Appendix A: Plant Species in Bordentown Township, Rare Plant Species** and in **Appendix B: Animals in Bordentown Township, Rare Wildlife**. Rare plants found in Bordentown include the pawpaw, pale Indian plantain, occluded bindweed, and many others. Natural Heritage Grid Maps show the general locations of rare plant species and ecological communities, without providing the sensitive detailed information that could place these resources at risk for vandalism or illegal collection. These maps are available to Environmental Commissions and for research projects but are otherwise not public.



Northern Community Park  
Source: DVRPC

The marsh is made up of several habitats, including tidal and nontidal wetlands, shrub forest wetlands, constructed wetlands, deciduous woodland, and upland forests with second-growth oak woods. There are lakes including Spring Lake, Rowan Lake, and Sturgeon Pond in the north. The Delaware & Raritan (D & R) Canal greenway also passes through the marsh.

These diverse habitats support over 1,200 species of plant and animal life. Over 900 plant species have been identified in the marsh, including 30 species considered endangered, threatened, or rare in the state. Over 200 bird species have been recorded, including, the osprey, great blue heron, least bittern, Virginia rail, and cliff swallow.

The wetlands area of the marsh is defined by the tidal waters of the Delaware River and the Crosswicks, Watson, and Duck creeks. Plants found here include New York ironweed, wild rice, arrow arum, bur marigold, yellow pond lily, and water smartweed. Phytoplankton—tiny microscopic photosynthetic cells—inhabits these waters as well. Phytoplankton is the foundation of the food web and supports other fish found in the Hamilton-Trenton Marsh, such as the killifish, Johnny darter, alewife, shad, yellow perch, and the short-nosed sturgeon. These fish

populations, in turn, support fish-eating birds such as mergansers, cormorants, osprey, egrets, and herons. The river otter has recently reestablished the Hamilton-Trenton Marsh as its home.

To the southeast of the marsh, uplands overlook Crosswicks Creek from a bluff. Oaks and red maples are the dominant trees. Dense thickets of mountain laurel and great rhododendron are found here as well. Pitch pines and Eastern hemlocks also occur along the bluffs. A variety of birds, especially migratory species, inhabit the upland forests. Titmice and Carolina chickadees are commonly found in the mountain laurel-rhododendron thickets.

Second-growth forests are found to the northeast of the marsh along the bluffs near Spring Lake, as well as on the islands off of Spring Lake and the Hamilton Water Treatment Plant. These are former agricultural fields or places that have been altered by human activities, where the second growth of oaks, tulip trees, black gums, and other hardwood trees has occurred. Song sparrows and Carolina chickadees reside in the second-growth forests.

Wetlands are fragile ecosystems susceptible to pollution, development, and nonnative species. Although they are regulated under the New Jersey Freshwater Wetlands Protection Act, this law does not guarantee protection. Under current regulations, wetlands can still be disturbed, drained, or filled. Commercial and residential development threatens the Hamilton-Trenton Marsh. Effluent from the Hamilton Township sewage treatment plant and a coal-fired power plant on Duck Island contribute to pollution problems as well. Recreational overuse from activities such as off-road vehicles and unauthorized digging for archaeological artifacts destroy habitats. The marsh is disturbed by construction and maintenance activities along roadways, as well as the railroad and a former landfill. Habitat diversity has been reduced due to nonnative flora, such as the common reed (*Phragmites australis*), Japanese bamboo (*Polygonum cuspidatum*), reed canary grass (*Phalaris arundinacea*), and Japanese stilt grass (*Microstegium vimineum*). Other nonnative flora, such as mile-a-minute weed (*Persicaria perfoliata*), have been identified at the marsh but are not yet widespread. Along the Delaware River and Crosswicks Creek, lesser celandine (*Ranunculus ficaria*) has become an invasive species of concern.

A *Cooperative Stewardship Plan* for the marsh was completed in 2010 by the Friends for the Marsh organization, a project of the D & R Greenway Land Trust. The plan serves as a vision and guide for the marsh, and seeks to balance natural conservation with enhancing educational and recreational opportunities within the marsh. The marsh is a significant environmental resource because it reduces flood damage and provides water filtration, groundwater recharge, and wildlife habitat. There are prehistoric Native American archaeological sites around the marsh that are part of the Abbott Farm National Historic Landmark. Six goals are identified, with strategies and action items identified for each: Protection and Preservation, Stewardship, Education, Recreation, Marsh Identity and Interpretation, and Coordinated Management and Organization. Friends for the Marsh organizes canoe trips, field trips, and a history education weekend for the public. Several community parks are part of Abbott Marshlands, including the Northern Community Park and Bordentown Bluffs. Northern Community Park has some athletic facilities and

recreational trails. Bordentown Bluffs has a large scenic overlook and several hiking and dog-walking trails accessible from the adjacent neighborhood. The Stanton Lane entrance to Bordentown Bluffs was recently re-opened and provides trail access to the D & R Canal State Park. This area provides opportunities to see many birds and native plants. Swimming and wading are prohibited due to dangerous tides.



Northern Community Park

*Source: DVRPC*

The Tidal Delaware Water Trail is another way to explore the Abbott Marshlands. This 56-mile boating trail, planned by the Pennsylvania Environmental Council, identifies recreational boating access points, amenities, and points of interest along the Delaware River. Several historical and environmental points of interest along the trail feature the Abbott Marshlands and Abbott Farm National Historic Landmark.

For a complete list of species found in the marsh, see [Appendix C: Abbott Marshlands](#).



# The Built Environment

## Population and Housing

In 2010, the U.S. Census estimated that Bordentown Township had a population of 11,367 people, up a dramatic 36 percent from its 2000 population of 8,380, due to a number of recent large-scale residential developments in the township. See **Figure 9: The Population of Bordentown Township**, below.

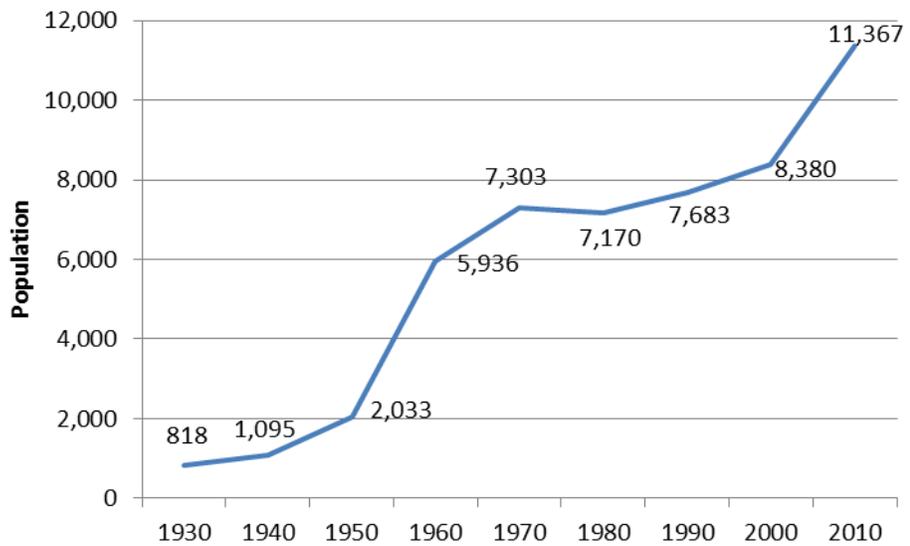


Figure 9: The Population of Bordentown Township, 1930–2010

Source: U.S. Census Bureau, 2010

The township's median age is 38.1, slightly more than the national average of 35. The percentage of residents of Bordentown Township aged 65 and over was 10.6 percent in 2010, slightly less than the national average of 12 percent. Approximately 23.2 percent of Bordentown Township's residents are children between the ages of 5 and 18. This represents the age group that is most likely to generate demand for public schools, community facilities, and recreational opportunities. See **Figure 10** below for a complete breakdown of Bordentown's population by age and gender.

Based on the 2010 U.S. Census, Bordentown Township's population has racial diversity, with 74.4 percent of the population identifying themselves as white, 10.7 percent black or African American, 10.6 percent Asian, two percent as two or more races, and less than one percent each of other races. Hispanics or Latinos (of any race) make up about six percent of the population of Bordentown Township.

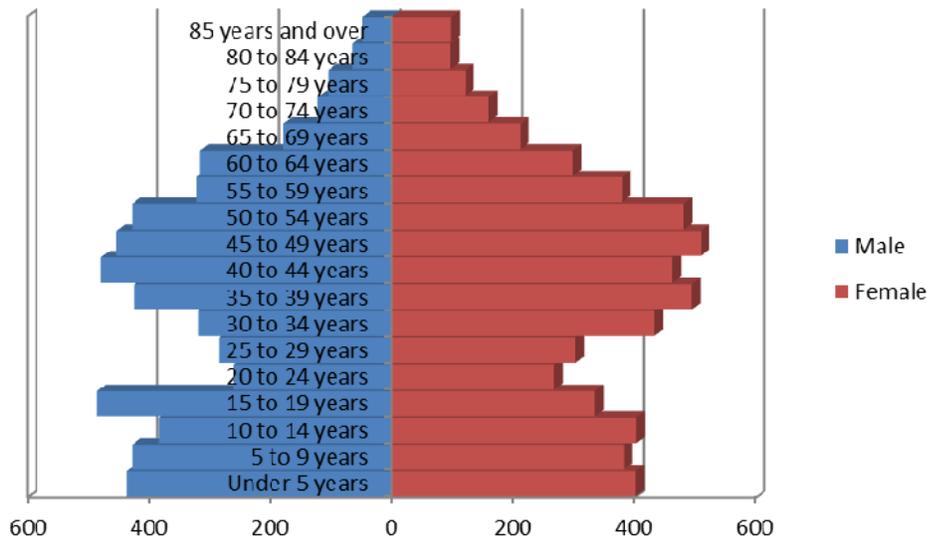


Figure 10: Bordentown Township Population by Age and Gender (2010)

Source: U.S. Census Bureau, 2010

According to U.S. Census data from 2010, Bordentown Township had 4,173 occupied housing units, of which about 78.8 percent (3,289 units) were owner-occupied, higher than the national average of 66 percent.

## Transportation

Bordentown Township is located in a highly accessible part of Burlington County. It is approximately 31 miles from Philadelphia and less than 10 miles from Trenton. The township is crossed by Interstate 295 and the NJ Turnpike (I-95). Interstate 195 is located just to the north of the township in Hamilton Township. U.S. Routes 130 and 206 intersect in the township.

A number of smaller roads in the township connect Fieldsboro and the City of Bordentown to outlying areas. There are a number of newer roads in the township built as part of residential subdivisions.

Accessibility to highways and other major roads is integral to the lives of Bordentown Township residents, as approximately 94.2 percent of the township's employed population

commutes to work by automobile, according to the 2010 US Census. The mean travel time to work for Bordentown Township residents is 26.7 minutes, slightly lower than the New Jersey average of 28 minutes and slightly higher than the national average of 24 minutes. Just 1.8 percent of Bordentown Township residents rely on public transportation for their commute, while 4.0 percent of residents use other means of transportation.

In addition to roadways, Bordentown Township also benefits from the passenger light-rail service, the River LINE. The River LINE was historically known as the Camden and Amboy Railroad and was reopened by New Jersey Transit (NJT) in the winter of 2004 after a 42-year hiatus in passenger service. Freight service operated on the line during the last four decades, and now operates only at night. The new light-rail line connects Trenton and Camden with a total of 20 stops in between. The service provides links to other NJT buses and trains, and to Amtrak and SEPTA in Trenton and to PATCO in Camden. The Bordentown station is located in Bordentown City, at Park Street and Prince Street. A new River LINE station is proposed to be built in Bordentown Township as part of the Bordentown Waterfront Community development currently under construction.

The Delaware River Heritage Trail is a planned 60-mile loop trail from Trenton to Palmyra in New Jersey and Morrisville to Philadelphia's Tacony neighborhood in Pennsylvania. The extent of the trail in and around Bordentown Township is shown on [Map 19: Parks and Open Space \(2011\)](#). The Delaware River Greenway Partnership and a coalition of government and non-profit partners in both New Jersey and Pennsylvania are working to complete this trail.

## Historic Resources

Bordentown Township hosts several properties and districts on the National and State Registers of Historic Places, listed below in [Table 23: Historic Sites of Bordentown Township](#) and shown on [Map 17: Historic Resources](#). The **Abbott Farm Historic District**, on the National and State Registers, is an archaeological site of very early Native American settlements. The **Camden and Amboy Railroad Historic District** is also on the National and State Registers and follows the current right of way of the River LINE. The **Delaware and Raritan Canal Historic District** spans 100 yards to either side of the canal and is also on the National and State Registers. The **New Jersey Manual Training and Industrial School for Colored Youth**, a historic site, is a campus of buildings near the Delaware River between Bordentown City and Fieldsboro. This school, also known as the Bordentown School, was closed in 1955 after *Brown v. Board of Education* prohibited segregated schools. The campus was then used by the E.R. Johnstone Training and Research Center, a home for developmentally disabled people. In 1996, the Johnstone Campus was turned over to the New Jersey Juvenile Justice Commission.

Bordentown also contains several prehistoric sites given opinions of eligibility by the SHPO (State Historic Preservation Officer), which are shown on the archaeological site grid to prevent unauthorized excavations. They are referred to as the **Blacks Creek, Mile Hollow**, and **Thornton Creek** prehistoric sites. The **Hilltop House**, located on the Camden and Amboy Railroad near Newbold Island, was given a SHPO opinion in 1997.

These properties and historic districts all meet the New Jersey and National Register criteria for significance in American history, archaeology, architecture, engineering, or culture and possess integrity of location, design, setting, materials, workmanship, feeling, and association. Other sites may have the potential to be listed as local, state, or national landmarks but have not been nominated by local citizens or identified by SHPO for such a designation.

Table 23: Historic Sites of Bordentown Township

Name	Location	State ID#	Register
<b>State and National Registers of Historic Places</b>			
Abbott Farm Historic District		1654	NR: 12/8/1976 SR: 8/16/1979
Camden and Amboy Railroad Historic District	Camden and Amboy Railroad ROW	2969	SHPO opinion: 6/26/1975
The Delaware and Raritan Canal Historic District	Entire Canal bed and all lands 100 yards to either side	1600	NR: 5/11/1973 SR: 11/30/1972
The New Jersey Manual Training and Industrial School for Colored Youth	Roughly bounded by Burlington Road, the Delaware River, and I-295	2973	NR: 1/5/1998 SR: 10/23/1997
<b>Eligible Sites for State and National Registers of Historic Places</b>			
Blacks Creek Prehistoric Archaeological District		749	DOE: 11/29/1977 SHPO Opinion: 12/19/1975
Thornton Creek Site		3868	SHPO Opinion: 5/2/2001
The Hilltop House	Fourth Street	2971	SHPO Opinion: 2/29/1997
Mile Hollow Prehistoric Site		2972	SHPO Opinion: 5/29/1987
Hogback Road Site		4359	SHPO Opinion: 2/27/2001

Source: NJ State Historic Preservation Office, 2012

Although located primarily in Hamilton Township, the **Abbott Farm Historic District** extends into the northwestern corner of the Township. Named after the famed 19<sup>th</sup> century archaeologist Charles Conrad Abbott, this site is the largest known Middle Woodland village site in the coastal Mid-Atlantic and New England region. The Woodland time period is considered an important cultural development stage for prehistoric Native Americans, when pottery making and the cultivation of crops began. Use of the area began about 13,000 years ago, and this archaeological site has been at the center of a controversy over the antiquity of human presence in the Americas. It is illegal to dig and remove archaeological artifacts from the area. The site's proximity to the Abbott Marshlands, the

northernmost tidal Delaware marsh, and its archaeological and cultural importance make environmental protection and historic preservation important priorities.

In 2008, the Planning Division of Mercer County organized an interpretive planning process for the Abbott Farm Historic District involving the County, an interpretive planning firm, and an archaeological and historical research firm. This interpretive plan aims to create a cohesive interpretive program and to increase public understanding of and participation in this historic and environmental resource.

The **Crossroads of the American Revolution National Heritage Area** is another historic and environmental resource in Bordentown. This National Heritage Area was established in 2006 by the National Parks in order to help communities preserve historic resources and local identity, improve inter-governmental relationships, and preserve historic resources. The Crossroads of the American Revolution National Heritage Area encompasses a 2,155-square mile area in New Jersey.

Another historic site in Bordentown is **Point Breeze**, Joseph Bonaparte's estate. Joseph Bonaparte, the former king of Spain and elder brother of Napoleon, moved to the United States after he and his brother were banished from France in 1816. Joseph Bonaparte built a mansion and landscaped much of his 1,880-acre estate in Bordentown. Although the original house burned down in 1820, another house was rebuilt in its place, and Bonaparte lived there until returning to Europe in the 1840s. The estate was auctioned by Joseph Bonaparte's grandson, and eventually the British consul built an Italianate villa where the houses stood. Although Point Breeze is privately owned and is not protected open space, it has nonetheless enriched the area's cultural history. Bonaparte and subsequent residents exposed New Yorkers and Philadelphians to European tastes, and some furniture and art from Point Breeze now belong to the Philadelphia Museum of Art.

Bordentown has several organizations that educate the public about historic resources and preserve and rehabilitate historic sites. The Bordentown Historical Society, established in 1930, offers online exhibits and special events focused on local history, such as holiday house tours and socials. Other community organizations offer walking tours of downtown Bordentown and other places of interest.

## Cultural Resources and Open Space

### Parks, Recreation, and Preserved Open Space/Farmland

Bordentown Township has four major public parks with over 685 acres of recreational land and facilities, parkland, natural resource protection, and farmland shown on **Map 19: Parks and Open Space**. Bordentown's parks include Northern Community Park, Joseph H. Lawrence Park, Bossert Park, Terry Field, Laurel Park, and Constitution Park. Northern Community Park and Joseph H. Lawrence Park are the largest parks, and both feature athletic fields, picnicking areas, playgrounds, parking, and some natural areas. Northern Community Park has recently undergone a series of improvements, including new trees

and lighting. Public school facilities at Bordentown Regional High School and Peter Muschal School are also used by residents for recreation.

While Bordentown Township provides fields and facilities for recreation, field rentals are overseen by the Public Works Department. Athletic programs for all ages are also run independently of the town by community organizations.



Site of Bordentown Waterfront Community

*Source: DVRPC*

The state owns 238 acres of land, primarily located along the banks of the Crosswicks Creek and Blacks Creek. Bordentown Township has one 78-acre preserved farm located to the east of the NJ Turnpike. Bordentown Township has protected significant amounts of open space along the Crosswicks Creek, although a large area west of Route 206 remains unprotected. Bordentown's other major stream corridor, Blacks Creek, in the southern part of the township, also remains largely unprotected. To remedy this, the Bordentown Township Open Space Advisory Committee submitted "A Proposal for the Blacks Creek Greenway" to the township in December 2003. This plan documents the Blacks Creek corridor's natural resources, including forested ridge and valley formations, unique marshland, many large old beeches, tulip trees and oaks, and native stands of rhododendrons. The plan also emphasizes the area's cultural resources, including historic mills dating from the early 18<sup>th</sup> century and scenic views from the ridgelines.

The Blacks Creek Greenway Plan recommends the creation of additional community parks to (1) improve the quality of the township's park and recreation system, making it attractive for residents, visitors, and potential businesses; (2) provide public recreational space in an area of the township that is without public parks; (3) provide diverse active

and recreational opportunities that are currently not available; (4) create opportunities for environmental and historical interpretation of unique sites; (5) allow safe public access to the greenway and its unique natural areas; and (6) ultimately improve the quality of life for township residents.

Township residents can use neighboring Bordentown City's park on the Delaware River, which has a boat ramp, beach, and fishing pier; but Bordentown Township lacks its own riverfront access, despite its own significant frontage along the Delaware River. The proposed Bordentown Waterfront Community, currently under development on the former North American Marine Salvage Company site, would offer waterfront access to the Delaware River. Located on the site of a remediated brownfield, the proposed transit village will include up to 671 apartments and townhouses, stores, restaurants, a public park, pier, and a new River LINE stop.



Northern Community Park

*Source: Roger Plew*

## Township Utilities and Services

### Drinking Water

The Bordentown City Water Department supplies public drinking water to residences in the more developed sections of Bordentown Township. Drinking water is drawn from four public supply wells that tap the Potomac-Raritan-Magothy aquifer just north of the township in Hamilton Township (see [Aquifers](#)). Additional information on water supply

wells is available in the [Water Supply Wells](#) section. See also [Map 14: Public Water Supply Wells](#).

## Sewer Service

The Bordentown Sewage Authority provides sewer collection service to all developed areas in Bordentown Township and adjacent Bordentown City. The municipal sewer service area is shown in [Map 18: Sewer Service Area \(2012\)](#). Not all areas shown on the map currently have sewer service. The Bordentown Sewer Authority treatment facility on average treats 1.6 million gallons per day (mgd) and has a design capacity of 3 mgd. All sludge is treated on site and the cleaned fluid is discharged.

## Trash and Public Works

In Bordentown Township, household trash is picked up once per week except on major holidays. Bulk waste, including furniture and yard waste, is collected once per week. "White goods," which consist of large household appliances (washer/dryers, refrigerators, hot water heaters, etc.) are collected every Wednesday as long as the municipality is notified by 3:00 PM on Tuesday.

Burlington County collects commingled glass, cans, and plastics (numbers 1 and 2 only) as well as mixed paper and cardboard. Residents leave their recycling on the curb by 6:00 AM every other Monday to be collected.

In addition, Bordentown has a fall leaf pickup. During these times, residents are able to rake and pack leaves into bags not to exceed 30 pounds in weight. The Public Works Department prefers that leaves are raked to the curbside gutter for vacuum collection. NJDEP stormwater regulations forbid the placement of leaves within 10 feet of a storm drain. It is also illegal to put leaves in household trash. At other times of the year, leaves and yard waste will be collected on the normally scheduled bulk waste collection day.

The Bordentown Township Public Works Department offers several other services including recycling drop-off, snow plowing, Christmas tree pick-up, and field and facility rentals. The Public Works Department also oversees road maintenance and construction, as well as the permitting for contractors carrying out construction affecting roadways.

In 2013, the Bordentown Township Committee approved a \$2.3 million expansion plan for the Public Works Department. As part of this plan, the Township Committee has agreed to purchase a property adjacent to the Crosswicks Road Public Works facility. The property will add 3.6 acres to the existing facility and will allow the township to accept additional materials such as recyclable electronics, paint, light bulbs, car batteries, and other items that often are dumped illegally at the facility.

## Education

The Bordentown Regional School District serves the Township of Bordentown, the City of Bordentown, and the Borough of Fieldsboro. New Hanover Township sends students on a tuition basis to grades 9 to 12. There are a total of five schools in the school district.

There are two elementary schools serving grades kindergarten through third grade: Peter Muschal School, located in Bordentown Township, and Clara Barton Elementary School, located in Bordentown City. The MacFarland Intermediate School, located in Bordentown City, serves fourth and fifth grades. The Bordentown Regional Middle School occupies the former Regional High School site in Bordentown Township and serves sixth through eighth grades. The new Bordentown Regional High School, located in the township, was completed in 2005 and serves ninth through twelfth grades.



# Environmental Issues

## Known Contaminated Sites

The New Jersey Known Contaminated Sites List includes former factory sites, landfills, locations of current or former leaking underground storage tanks, sites where chemicals or wastes were once routinely discharged, and places where accidents have resulted in spills and pollution. Contamination may have affected soil, groundwater, surface water, or a combination of site conditions. The most dangerous sites, from a human health standpoint, can be listed on the National Priorities List (NPL), under the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA is commonly referred to as “Superfund” because sites on the NPL are eligible for federal and state cleanup funds. Other sites may be remediated by state cleanup funds (via the New Jersey Spill Compensation and Control Act). The majority of the sites are remediated by the responsible parties as required pursuant to state and federal regulations. Responsible parties may be current or former owners or users of the site.

There are 15 active Known Contaminated Sites within Bordentown Township, listed in **Table 24: Known Contaminated Sites in Bordentown Township**. These are active sites with confirmed contamination of the soil, groundwater, and/or surface water. Additionally, there is one pending site and 37 (non-homeowner) closed sites in the township. An active site has one or more active cases with confirmed contamination, and may have one or more pending or closed cases. A pending site has one or more cases with confirmed contamination, no active cases, and may include closed cases. Closed sites are those with remediated contamination and have no active or pending cases. Sites are identified by a Program Interest (PI) number. See **Table 25: Pending Known Contaminated Sites in Bordentown Township** and **Appendix D: Closed Known Contaminated Sites**. Some sites in this table have more than one remedial level due to multiple cases. Non-residential sites are shown on **Map 20: Known Contaminated Sites (2012)**. Private homes have been removed from the lists to protect resident privacy.

Updates to this list of Known Contaminated Sites and additional information on each site may be found at the NJDEP Data Miner website.

Table 24: Known Contaminated Sites in Bordentown Township

PI Name	Address	PI Number	Site ID	Remedial Level *
Alstarz Sports Pub LLC	144 Rt 130	300073	229264	C1
Badshah Oil Corp	1077 Rt 206	032332	49239	C1
Bordentown City Sanitary Landfill	Rt 206 & Farnsworth Ave	G000005065	63875	C3
Bordentown Maintenance Yard	Rt 130 & Dunns Mill Rd	012366	11020	B
Bordentown Shell	252 Rt 130	007601	11027	C2
Bordentown Twp Public Works	262 Crosswicks Rd	012162	41593	C2
Circuit Foil USA Inc (AKA Square D Company)	88 Rt 130	007412	14684	D
E R Johnstone Training & Research Center	Burlington St	013933	37622	C1
J&S Automotive & Lawnmower	30 Rt 130	012429	33613	C2
Johns Car Care Center	232 Rt 130	019253	15547	C2
Love's Travel Stop #404	2008 Rt 206	001515	16733	C2
Mosca Thomas B & Pauls Service Ctr	686 Rt 206	015211	11013	C2
NJDOT Route 206 Section 39	Rt 206	130531	92501	C3
Sam Enterprises LLC	598 Rt 206	466003	375998	C1
Southgate Apartments	272 Ward Ave	022851	54044	C2

Source: NJDEP, 2012

*Remedial Level
B: Single Phase Remedial Action, Single Contamination Affecting Only Soils.
C1: No Formal Design, Source Known Potential Groundwater Contamination.
C2: Formal Design, Known Source with Groundwater Contamination.
C3: Multi-Phased Remedial Action, Unknown or Uncontrolled Discharge to Soil or Groundwater
D: Multi-Phased Remedial Action, Multiple Source/Release to Multi-media Including Groundwater

Table 25: Pending Known Contaminated Sites in Bordentown Township

PI Name	Address	Site ID	PI Number
Parklands Reclamation	1070 RT 206	15905	848

Source: NJDEP, 2012

Fourteen hazardous waste sites in Burlington County have been listed on the National Priority List (NPL), more commonly referred to as Superfund site. These sites pose a major human health hazard and are in need of federal funds for cleanup.

There is one NPL site located in Bordentown Township: Square D Company, also known as Copper Foil Corporation, Circuit Foil Corporation, and Yates Industries, Inc. Located at 90 US Highway 130 in Bordentown Township, the site was originally used for copper-foil manufacturing. The site was also used for clay mining in the 1930s before becoming a municipal landfill. The site was also used for a wastewater treatment plant that made use of unlined lagoons and disposal areas, including waste piles, landfills, and sludge drying pads. Due to these activities, the groundwater and soils became contaminated, primarily due to inorganic heavy metals, including chromium, copper, arsenic, zinc, and lead. Most of the contaminated soils were excavated from the site, and the area was filled with clean soil. The groundwater is being pumped and treated by an on-site wastewater treatment system, and then discharged to the Bordentown Sewer Authority. This pump-and-treat system and groundwater monitoring will continue indefinitely to ensure that contaminated groundwater does not migrate off-site.

Technical documents about the site are available for public review at the NJDEP Division of Solid & Hazardous Waste Records Center.

## Underground Storage Tanks

There are nine active and compliant sites in Bordentown Township with regulated underground storage tanks that contain hazardous substances, pursuant to N.J.A.C. 7:14B et seq. As of 2012, there are 5,731 underground storage tank facilities and 15,862 underground storage tanks in New Jersey. Tanks and facilities are inspected based on several parameters and according to the NJDEP standard of one inspection every three years. On-site inspections have found a 90 percent compliance rate with release detection and prevention measures, compared to the national compliance rate of 70.9 percent. Information about these facilities and inspections can be found in the EPA Public Record Summary and other reports. The phase-in period of the Site Remediation Reform Act and related amendments to the Brownfield and Contaminated Sites Act ended May 7, 2012. These changes included establishing a professional board for Licensed Site Remediation Professionals (LSRP) and allowing LSRPs to supervise remediation, instead of requiring the New Jersey Department of Environmental Protection to approve all surveys.

Underground storage tanks are listed in **Table 26: Active and Compliant Underground Storage Tanks**. A hazardous material may be motor fuel, petroleum products, toxic pollutants, or other hazardous wastes or substances. Most of Bordentown's active and compliant underground storage tanks are auto body shops, gas stations, and military facilities, located along major township roads. If there is a known release to soil and/or groundwater, a site will also be listed on **Table 24: Known Contaminated Sites in Bordentown Township**. There may also be private residences in Bordentown Township that still have underground storage tanks, used primarily to hold home-heating oil. As these tanks age and rust, they often begin to leak, which becomes a serious threat to the groundwater below them. Those private residences are not publicly listed by NJDEP unless they pose a human health hazard. Underground storage tanks are not required to be removed, although removal may reduce any resulting environmental liabilities.