ENVIRONMENTAL RESOURCE INVENTORY

ERI

MARCH 2011

For the Borough of:

PAULSBORO

Gloucester County, New Jersey

by:

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

with:

Environmental Commission of the Borough of Paulsboro

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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, promoting smart growth, protecting the environment, and enhancing the economy. We serve a diverse region of nine counties: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey. DVRPC is the federally designated Metropolitan Planning Organization for the Greater Philadelphia Region — leading the way to a better future.

The symbol in our logo is adapted from the official DVRPC seal and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

DVRPC is funded by a variety of funding sources including federal grants from the U.S. Department of Transportation's Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), the Pennsylvania and New Jersey departments of transportation, as well as by DVRPC's state and local member governments. The authors, however, are solely responsible for the findings and conclusions herein, which may not represent the official views or policies of the funding agencies.

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

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All photos by DVRPC.

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CHAPTER 1

Executive Summary

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. They are the foundation for its economic success and its quality of life. The protection and wise use of those natural resources are 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 or borough'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.

Paulsboro's natural resources have long shaped the lives of its inhabitants. Its location at the confluence of the Delaware River and Mantua Creek gave rise to the settlement and early development of Paulsboro. Because of this strategic location, Paulsboro played a major role during the Revolutionary War when Fort Billingsport, now adjacent to a public park, defended Philadelphia from the British forces. River-based transportation and later railroads enabled industrial development within Paulsboro. The oil industry has been present in and surrounding Paulsboro since at least 1916. Although still a significant presence, this industry declined in Paulsboro during the 1970s and 1980s, leading to population losses as well. A new $250 million port facility located on a former industrial site, which broke ground in 2009, is expected to spur a new era of growth and development in Paulsboro.

Covering just two square miles of mostly built-out land, it is important for Paulsboro to preserve and protect its existing natural resources. Much of Paulsboro's natural vegetation and potential wildlife habitat is located along and within the Mantua Creek, with additional natural areas and open space located within the borough. Although small in size, these areas are not insignificant in environmental importance. In addition, Paulsboro has many tree-lined streets, providing neighborhoods in the borough with shade, natural beauty, and habitat for birds, squirrels, and other animals.

Documentation of existing environmental resources is necessary if Paulsboro wishes to support a sustainable combination of commercial, industrial, and residential uses in the future. Knowledge of these resources may empower the citizens of Paulsboro to make informed decisions as they decide the future path and identity of the borough.

Sources

Several documents and reports were utilized in preparing the *Environmental Resource Inventory (ERI) for the Borough of Paulsboro*. These reports and references are listed at the end of this document.

The maps and data relating to natural resources are mainly derived from the New Jersey Department of Environmental Protection (NJDEP), the United States Geologic Service (USGS), and the Delaware Valley Regional Planning Commission (DVRPC). Information from these sources specific to Paulsboro has been included whenever it was available. Information from other reports about specific sites has also been incorporated, along with data provided by the Borough 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 Borough officials in obtaining additional data from state sources in the future and in determining the types of investigations that still need to be conducted.

CHAPTER 2

Brief History

Early History

Long before European settlement, various peoples occupied the lands near the Delaware River. By the time of European arrivals, these Native Americans called themselves the Lenni Lenape. Later, they were called the Delaware Indians by Europeans. The subtribe in the Mantua Creek area called themselves the Manteses. The Lenni Lenape inhabited much of southern New Jersey and their settlements were usually located along stream banks. They farmed, maintained orchards, fished, and hunted. The Lenni Lenape valued the area for its abundance of fish and game, and utilized the regional creeks extensively for transportation. Deposits of unique blue clay found along the Delaware River also provided painting and pottery materials for the Lenni Lenape. When the Vacuum Oil Company (later renamed Mobil) began construction of their facility in Paulsboro in 1916, grading of the land uncovered chips of flint and other artifacts that indicated the site of an arrow maker. Fire pits uncovered three feet below the surface of the land and other archeological discoveries including stone knives, numerous arrowheads, gorgets (leather collars), and broken pieces of pottery suggested the location of an American Indian village near the confluence of the Mantua Creek and Delaware River in present-day Paulsboro.

Although these original peoples lived in southern New Jersey for thousands of years while leaving a minimal mark on the land, they succumbed to the diseases and encroachment of the newly arrived European settlers. By 1758, all remaining Native Americans south of the Raritan River were encouraged to live in the 3,258-acre reservation called Brotherton in the present Shamong Township, New Jersey. This has been recognized as the first Indian Reservation in the country, although it did not survive beyond 1802. As with other Eastern tribes, those remaining were ultimately forced westward. Tribes from Brotherton moved to join the Mahicans (or Mohicans) in New York State, and later moved on to Ohio and then Wisconsin.

The first European settlers in the Delaware Valley were the Dutch, who in 1623 established Fort Nassau near what is today Gloucester City, Camden County. The site of this fort has long been unknown but is believed to have been on the Delaware River near the Big Timber Creek. As early as 1638, Swedish settlers also ventured into the Delaware Valley and built small settlements along the banks of tidewater creeks near the Delaware River. In 1644, King Charles II of England took control of much of America's eastern seaboard, and deeded most of present-day New Jersey to his brother the Duke of York,

who conveyed the land to Lord John Berkeley and Sir George Carteret. New Jersey was divided into East Jersey and West Jersey, divided by a line running from present-day Long Beach Island to the northwest corner of the state.

In 1674, Lord Berkeley sold his land in West Jersey for 1,000 pounds to John Fenwick, who bought it in trust for Edward Byllynge (also spelled Byllings), who was bankrupt and unable to be named on a deed. West Jersey was mostly settled by English Quakers seeking refuge from religious persecution in England. Byllynge, also a Quaker, divided his province into 100 shares, or “proprieties,” that were sold to Quaker colonists. In subsequent years, these shares were divided into fractions and the number of proprietors increased greatly.

In 1686, Gloucester County was formed, and at the time included the present-day Atlantic and Camden Counties. During the colonial era, Gloucester County's main economic activity was agriculture, but eventually expanded to include industrial and residential functions.

The first area of Paulsboro to be settled by Europeans was an area along the Delaware River named Byllings Port after Edward Byllynge. Later renamed Billingsport, this area was also called Manta’s Hook by the Swedes and was an early shad fishing center of the region. The shad fishing industry at Billingsport remained active until overfishing caused a collapse of the industry in the early 20th century.

According to local tradition, Paulsboro was founded by 250 colonists in 1685. The Borough of Paulsboro is named after Philip Paul, originally from Edinburgh, Scotland, who settled near Mantua Creek and purchased a 100-acre tract of land in the late 1680s. This tract, stretching from Mantua Creek to the Delaware River, comprises much of present-day Paulsboro. The southern portion of Paulsboro was originally called Crown Point, and was known by that name until at least 1835.

The Paul family sold 96 acres of land at Billingsport to the Continental Congress on July 5, 1776, the first land purchase made by the colonial government, for the development of Fort Billings. Margaret Paul and her son Benjamin Weatherby sold this parcel for 600 pounds to “The Thirteen United Colonies” just one day after the Declaration of Independence was signed. Fort Billings was built at this site at the request of George Washington. The site was chosen because it was located on high ground at the narrowest part of the Delaware River, a strategic defensive location. In 1777, a redoubt and the fort were erected by troops from Virginia, Pennsylvania, South Carolina and New Jersey in accordance with plans prepared by the Polish patriot Tadeusz Kościuszko. Part of a defense system established for the lower river, the primary purpose of this fort was to build and maintain the chevaux-de-frise on the Delaware to prevent the entrance of the British into Philadelphia. The chevaux-de-frise made up an underwater defense system

consisting of poles from 30 to 40 feet in length with a sharp piece of iron on each tip to pierce the bottoms of passing ships.

The entire defense system surrounding the fort consisted of the fortification of strategic points on both sides of the river (Fort Mifflin being on the Pennsylvania side), a chain of alarm guns from the Capes to Philadelphia, the chevaux-de-frise, and a navy of vessels from armed row-galleys to seagoing ships. Fort Billings was the tenth alarm post in the chain of posts running along the Delaware River and was equipped with a small cannon which warned other posts of the arrival of enemy ships. The next most northerly post was Fort Mercer at Red Bank.

During the Revolutionary War, the chevaux-de-frise and the fort delayed the arrival of British ships in Philadelphia by only a few weeks. They did not prevent occupation of the city by the British general Lord Cornwallis who arrived by land on September 26, 1777. The American General Newcomb met with Colonel Bradford at Fort Billings, took his modest force of militia from the fort, and marched south along Kings Highway to meet the British near Mantua Creek. However, the Americans were overwhelmed by the British, who had 1,500 men. Colonel Bradford ordered Fort Billings evacuated, spiked the canons, and set fire to the barracks. For the next two weeks, the British tried to clear the chavaux-de-frise, and by October 13, 1777, they had moved enough poles to allow their ships to pass. The British held the fort until 1778.

After the Revolutionary War, Fort Billings/Billingsport was rented to a farmer. Fort Billings was again used by American troops during the War of 1812 to guard the Delaware River and train soldiers. After an Act of Congress in 1819, the Secretary of War sold any military site that could not be used for fighting. In 1834, Fort Billings was sold to John Ford and Joseph Gill. Currently the site of the historic fort is adjacent to and partly in Fort Billings Park on the western side of Paulsboro.

Rail and air transportation over the Mantua Creek

Early Development and Growth of Industry

The early economy of Paulsboro was based on agriculture, fishing, and transportation. Many crops grown in New Jersey were brought to Philadelphia for sale via the Mantua Creek and the Delaware River. As the town continued to be settled, development was mainly concentrated along Delaware Street and then Broad Street, which was built as a toll road in 1809. In 1812, a small bridge was built across the creek at the current Route 44 crossing. This transportation accessibility led to further development.

By the 1850s, there were about 450 residents in Paulsboro, most of who were farmers and fishermen. At the time, the area was well known in the Delaware Valley for its shad fishing. In 1858, additional streets were built including Washington, Adams, Jefferson, Madison and Monroe. In 1876, the Delaware Shore Railroad Company extended their railroad through Paulsboro, greatly increasing the pace of development. The company would later be taken over by the DuPont Company and renamed the Delaware River Railroad, which later became part of the Pennsylvania Railroad. The rail line through Paulsboro remains in existence and is currently operated by CSX.

The coming of the railroad brought industry to Paulsboro as inputs and goods could be imported and shipped efficiently. In 1880, Coe and Richman bought a farm of 120 acres from Samuel Davis and built one of the largest phosphate works in the United States at that time. Later I.P. Thomas and Sons purchased the facility, which they used for the manufacture of fertilizers and insecticides for farm and home use.

Also in 1880, the Lighthouse Board set out to build four sets of range lights along the Delaware River, one of which – the Tinicum Island Range Lighthouse – was located in Paulsboro. The Lighthouse Board determined that the lights were necessary to guide ships through the channel between the Ship John Shoal Lighthouse off the coast of Cumberland County and League Island, later the site of the Philadelphia Naval Yard. The rear light still stands in Paulsboro at the intersection of Second Street and Mantua Avenue and is listed on the New Jersey and National Registries of Historic Places. See the **Historic Resources** section on page 67 for additional information.

Tinicum Island Range Rear Light

Lincoln Park, an amusement park developed on a 28-acre plot along the Delaware River, was built by Robert Patterson and formally opened on June 14, 1890. It was one of the few recreational destinations made easily accessible to the greater Philadelphia region through the existing transportation network of boats and railroads. Visitors came from the region to swim, picnic, and enjoy the attractions, which included a waterslide, a stone observation tower, daily fireworks, and a music shell that held a 60-piece orchestra. The park was famous for its merry-go-round with brass ring. At the park's peak of popularity, 16 trains, 2 ferries, and 5 steamboats brought people daily to the park. By the early 1900s Lincoln Park declined in popularity and eventually closed. The decline in the park was attributed to the advent of the automobile, which enabled more flexible travel to other locales.

Other vacation amenities existed in Paulsboro in the early 20th century. The Paulsboro Hotel opened in 1916 with 17 rooms. Summer homes were built along the Delaware River

and were occupied by Philadelphia residents during the summer months. These small beach homes offered summer relaxation, swimming, and boating. A number of these houses remain and have been winterized in the “Seawall” area near Riverview Avenue along the Delaware River. Paulsboro also once had a horse racing track, now the site of the Paulsboro Plaza. The half-mile track was built by members of the South Jersey Driving Club, a horse racing club.

St. Paul Methodist Church

The first schoolhouse in Paulsboro was built in 1820 and the first religious meeting in Paulsboro was held in the schoolhouse in 1825. Paulsboro High School was constructed in 1916 and graduated its first class in 1917. The first large church, St. Paul Methodist Church, was built in 1838, followed by those of several other denominations. The first post office in Paulsboro opened in 1844. The current post office was built in 1939. In 1901, the Paulsboro Public Library was founded at the private residence of Elizabeth Nolan at 26 West Broad Street. The library moved to Borough Hall at 28 East Broad Street in 1932, and to its current home of the Gill Memorial Library in 1954. The Paulsboro Volunteer Fire Association began in 1899, and moved to a new building constructed in 1962, after a fire destroyed their first fire house in 1961. In 1904, the Billingsport Volunteer Fire Association formed following a devastating fire at the Bridgeport Ferry Company.

On March 2, 1904, Paulsboro and Billingsport, previously part of Greenwich Township, were incorporated as the Borough of Paulsboro.

Industrial Transitions

In 1916, Vacuum Oil (later renamed Mobil) purchased land on the border of Paulsboro for the construction of a refinery for its export business. The Paulsboro Plant, which opened in 1917, was designed to manufacture lubricating oil. Gasoline and kerosene were considered byproducts of the lubrication, which was used for steam engines and internal combustion engines. Although located in neighboring Gibbstown, the facility is referred to as the Paulsboro plant. Mobil’s Paulsboro refinery was purchased by Valero Energy

Corporation in 1998, which still operates the facility. Valero's Paulsboro plant is currently its only refinery on the East Coast.

Exxon Mobil also operates a research laboratory in Paulsboro that was home to some of the most important technological advances in petroleum processing, including different fluid catalytic cracking processes. In 1974, Mobil 1, a synthetic automotive engine lubricant, was invented at the research plant. Today, Mobil 1 is the leading synthetic motor oil in the world.

As the oil industry continued to grow in and around Paulsboro during the 1920s, so did the infrastructure of the borough. In 1924, Paulsboro bought and began to operate a water company and the Atlantic City Electric Company began to provide electricity, which had been previously provided by the Borough.

To accommodate the increased traffic in and out of Paulsboro, a new bridge was built across Mantua Creek in 1935. This vertical lift bridge, called the Mantua Creek Bridge, was issued a State Historic Preservation Office (SHPO) Opinion in 2003 making it eligible for the New Jersey and National Registers of Historic Places. This bridge is discussed in more detail in the **Historic Resources** section.

Beginning in the 1970s, the petrochemical and oil refining industry began to decline in Paulsboro and elsewhere, driven by a combination of market forces and environmental regulations. As these facilities reduced employment in Paulsboro, the borough's population declined from over 8,000 in 1970 to under 7,000 in 1980, discussed in the **Population and Housing** section.

One major symbol of the decline in the petroleum industry in Paulsboro is the site of the former BP Paulsboro Terminal. This terminal occupied 130 acres at the confluence of Mantua Creek and the Delaware River and was used for petroleum and chemical storage from 1929 until 1996, when it ceased operations. The site has since undergone environmental remediation and has been leased to Paulsboro for the development of a new port on

Future site of the Paulsboro Port

the Delaware River. This site is also the location of a solar farm which, at the time of its development in 2003, was the largest facility of its kind on the East Coast.

On November 26, 2004, the oil tanker Athos I struck a submerged anchor while preparing to dock in Paulsboro. The anchor pierced the vessel's single hull, spilling over 260,000 gallons of crude oil into the Delaware River and six of its tributaries. The spill damaged more than 280 miles of shoreline, affecting habitats and aquatic organisms, killing thousands of birds and other wildlife, and hindering recreational use of the river.

Although Paulsboro has been negatively affected by the environmental implications of its industrial uses, as well as by the decline in employment and taxes from those industries, the Borough and Gloucester County are currently initiating several comprehensive redevelopment plans aimed at revitalizing formerly industrial areas.

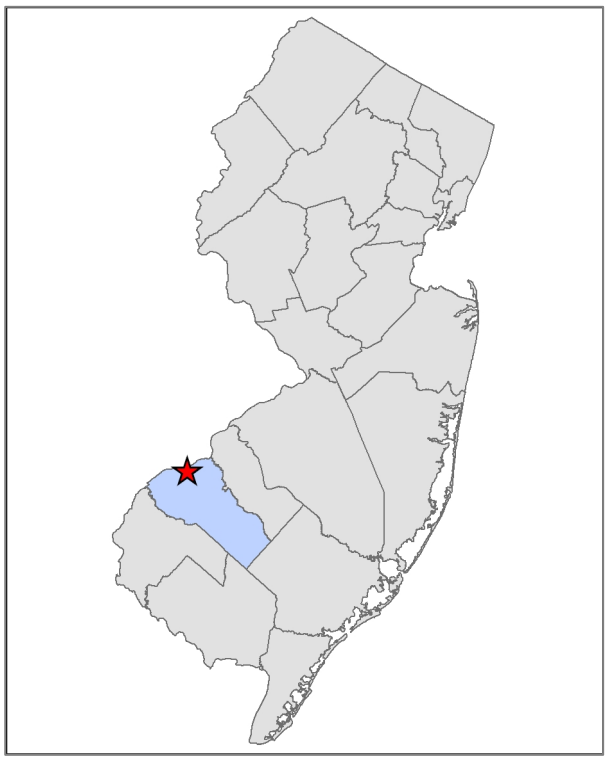
The United States Post Office on Delaware Street

In 1998, Paulsboro adopted a master plan addressing Land Use, Economic Development, and Housing. As part of the plan, several redevelopment zones were created: the Delaware Street Redevelopment Zone, the Paulsboro Plaza Redevelopment Zone, the Exit 18 Redevelopment Zone, the Hotel Area Development Zone, the Marina Redevelopment Zone, and the Port Redevelopment Zone. These zones were designed to address the declining commercial and manufacturing uses in Paulsboro and outline strategies for promoting future growth in the borough. One of the recommendations in the plan was to redevelop the former BP Terminal site into a new port facility on the Delaware River. This project, which broke ground in 2009, is expected to provide jobs, new development, and community revitalization to Paulsboro.

CHAPTER 3

Location, Size, and Land Use

Figure 1: Location of Paulsboro



Source: DVRPC

The Borough of Paulsboro is one of 24 municipalities in Gloucester County, New Jersey. Paulsboro is bordered by West Deptford Township and Mantua Creek to the east, East Greenwich Township to the south, Greenwich Township to the west, and the Delaware River to the north. Paulsboro is located across the Delaware River from Philadelphia, PA and the Philadelphia International Airport. See **Map 1: Borough of Paulsboro** and **Map 2: Aerial Photo (2007)**.

The Borough of Paulsboro has a total area of 1,675 acres (2.6 square miles), of which 1,273 acres (two square miles) is land (76 percent) and 403 acres (0.63 square miles) is water (24 percent).

The borough is accessible by Interstate 295, which has an exit in the southernmost portion of the borough. County Route 653 (Swedesboro Road) crosses through the borough from the south, while State Route 44 (alternately Broad Street and Crown Point Road) runs east-west across the borough.

In 2010, Paulsboro had a total population of 6,097. The borough's population has declined since 1960, unlike the population of Gloucester County as a whole.

The majority of the borough consists of developed land, which covers 58 percent of area in the borough. The next largest type of use is water, which occupies 24 percent of the borough's area, followed by wetlands covering about eight percent. **Table 1: General Land Cover (2007)** shows Paulsboro's land cover grouped into general categories based on the 2007 color infrared digital imagery of the New Jersey Department of Environmental Protection (NJDEP). This is depicted on **Map 3: NJDEP Land Cover (2007).**

Table 1: General Land Cover (2007)

Type	Area (Acres)	Percent
Agriculture	4.03	0.24%
Barren Land	103.93	6.20%
Forest	54.81	3.27%
Urban	970.55	57.93%
Water	402.80	24.04%
Wetlands	139.41	8.32%
Total	**1,675.52**	100.00%

Source: NJDEP, 2007

On a more detailed level, the most common land use in Paulsboro is single unit medium density residential development, which covers 26 percent of the borough's area, followed by tidal rivers, inland bays, and other tidal waters covering 24 percent of the borough. **Table 2: Detailed Land Cover (2007)** breaks down the 2007 general land cover categories into detailed land cover categories.

Table 2: Detailed Land Cover (2007)

Type	Area (Acres)	Percent
Altered Lands	13.83	0.83%
Artificial Lakes	2.38	0.14%
Athletic Fields (Schools)	10.30	0.61%
Beaches	1.99	0.12%
Bridge Over Water	0.40	0.02%
Cemetery	1.02	0.06%
Commercial/Services	94.44	5.64%
Cropland And Pastureland	4.03	0.24%
Deciduous Brush/Shrubland	19.40	1.16%
Deciduous Forest (10-50% Crown Closure)	5.23	0.31%
Deciduous Forest (>50% Crown Closure)	5.35	0.32%
Deciduous Scrub/Shrub Wetlands	16.76	1.00%
Deciduous Wooded Wetlands	16.25	0.97%
Disturbed Wetlands (Modified)	2.45	0.15%
Freshwater Tidal Marshes	12.33	0.74%

Type	Area (Acres)	Percent
Herbaceous Wetlands	5.43	0.32%
Industrial	170.63	10.18%
Major Roadway	23.52	1.40%
Managed Wetland In Maintained Lawn Greenspace	2.58	0.15%
Mixed Deciduous/Coniferous Brush/Shrubland	3.94	0.24%
Mixed Forest (>50% Deciduous With 10-50% Crown Closure)	2.97	0.18%
Mixed Scrub/Shrub Wetlands (Deciduous Dom.)	1.45	0.09%
Mixed Urban Or Built-Up Land	0.85	0.05%
Old Field (< 25% Brush Covered)	14.49	0.86%
Other Urban Or Built-Up Land	129.78	7.75%
Phragmites Dominate Coastal Wetlands	50.34	3.00%
Phragmites Dominate Interior Wetlands	31.83	1.90%
Phragmites Dominate Old Field	3.41	0.20%
Railroads	10.79	0.64%
Recreational Land	19.22	1.15%
Residential, High Density Or Multiple Dwelling	37.60	2.24%
Residential, Rural, Single Unit	6.07	0.36%
Residential, Single Unit, Low Density	21.75	1.30%
Residential, Single Unit, Medium Density	429.72	25.65%
Stormwater Basin	5.30	0.32%
Tidal Rivers, Inland Bays, And Other Tidal Waters	400.02	23.87%
Transitional Areas	88.11	5.26%
Transportation/Communication/Utilities	9.56	0.57%
Total	**1,675.52**	**100.00%**

Source: NJDEP, 2007

Complementing this NJDEP land cover data is land use data provided by DVRPC based on 2005 digital imagery. Unlike the NJDEP data, different types of urban development are identified rather than natural areas. As listed in **Table 3: Land Use (2005)**, single family detached housing is again the most common land use in the borough (30 percent), followed by water (25 percent) and vacant land (21 percent). Heavy industrial manufacturing covers a substantial 11 percent of the borough, which includes facilities related to oil refining. These land uses are depicted on **Map 4: DVRPC Land Use (2005)**.

Table 3: Land Use (2005)

Land Use Description	Area (Acres)	Percent
Commercial	49.80	2.97%
Community Services	15.27	0.91%
Manufacturing: Heavy Industrial	180.38	10.77%
Manufacturing: Light Industrial	38.80	2.32%
Parking: Commercial	12.89	0.77%
Parking: Community Services	4.77	0.28%
Parking: Heavy Manufacturing	2.34	0.14%
Parking: Light Manufacturing	0.77	0.05%
Parking: Multi-Family	1.42	0.08%
Recreation	19.30	1.15%
Residential: Multi-Family	12.97	0.77%
Residential: Single-Family Detached	502.33	29.98%
Transportation	28.49	1.70%
Utility	33.17	1.98%
Vacant	349.16	20.84%
Water	411.09	24.53%
Wooded	12.57	0.75%
Total	**1,675.51**	**100.00%**

Source: DVRPC, 2005

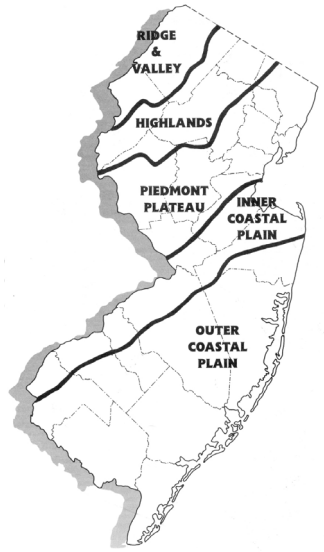
CHAPTER 4

Natural Resources

Physiography

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

Figure 2: The Physiographic Regions of New Jersey



Source: NJDEP

The Borough of Paulsboro is located in the Inner Coastal Plain, the most southerly of the provinces in New Jersey. The Atlantic Coastal Plain landscape extends from Massachusetts to Texas and is divided into Inner and Outer sections. In New Jersey, the Inner Coastal Plain is made up of inter-bedded sand and clay. Deposits originating in the breakdown of Appalachian and Catskill sedimentary, metamorphic, and igneous rocks are inter-bedded with layers formed by oceanic (marine) deposition, which occurred as the ocean shoreline advanced and receded over geologic time. The Inner Plain layers date from the Cretaceous period (Mesozoic era), 135 to 65 million years ago. 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, less fertile, and more porous than those of the Inner Plain.

In the general vicinity of the dividing line between the two segments of the coastal plain is a belt of low hills, which runs northeast and southwest through the southern half of New Jersey. These hills are the youngest of the Cretaceous formations and are largely made up of sand and marl formations. The hills taper to fairly low elevations in Gloucester County but can be identified in the Mullica Hill area. The Inner Coastal Plain lies to the west of this band of hills. Most surface waters in the Inner Coastal Plain begin east of the hills and drain toward the Delaware River.

Topography and Surface Landscapes

Topography relates to the surface terrain and features of an area. Paulsboro's location along the Delaware River and Mantua Creek in the Inner Coastal Plain contributes to its primarily low lying topography. As shown on **Map 5: Elevation**, the highest elevation at 33.61 feet above sea level is located near the intersection of Second Street and Greenwich Avenue.

Because of its low elevation and relatively flat topography, the majority (72 percent) of Paulsboro is located in a floodplain, as shown on **Map 11: Floodplains (2010)**. Generally speaking, most land in the center of the borough and along the Delaware River and Mantua Creek are within a floodplain, while developed areas north of Sixth Street and in the southernmost portion of the borough are outside the floodplain.

The remaining vegetation in the borough is mostly wetlands and tidal marshes, with some areas of grass and shrubs. Within developed areas of the borough, there is significant tree cover of mature, mostly deciduous trees.

Steep slopes along the Delaware River

Steep Slopes

Slope is measured as the percentage of vertical rise to horizontal distance. The majority of Paulsboro has slopes of 10 percent or less, indicating a low-lying and flat landscape. However, there are some areas of Paulsboro with slopes of at least 15 to 20 percent, which are generally considered to be steep slopes. There is a bluff along the Delaware River and additional ridges along the Mantua Creek. In the southwestern part of the borough, there is an area of steep slopes at Berkley Road and Elizabeth Avenue. Other smaller areas of steep slopes are located throughout the borough, such as along the rail tracks parallel to Commerce Street. Paulsboro's steep slopes are depicted on **Map 6: Steep Slopes**.

In general, development is inadvisable in steep slope areas because it can result in soil instability, erosion, sedimentation of streams, increased stormwater runoff, and flooding. This causes habitat destruction, water pollution, and potential damage to property. Erosion on steep slopes is especially prevalent where excessive tree removal has taken place. On steep slopes, structures and septic systems should generally be limited or prohibited.

Soils

Soil is the foundation for all land uses. A region's soil defines what vegetation is possible, influencing agricultural uses. It also determines how land can be developed for other purposes. Soil is also a natural resource that takes millions of years to replenish.

Within Paulsboro, about 47 percent of the borough (including water areas) is composed of soils defined as either urban land or an urban land complex. About 23 percent of the borough is built on dredge materials (Udorthents soils), another 23 percent is occupied by water, and about eight percent is composed of a Mannington-Nanticoke complex. The varying soils series types and variations in Paulsboro, as identified by the Natural Resources Conservation Service (NRCS) of the US Department of Agriculture (USDA), are listed in **Table 4: Soils** and shown on **Map 7: Soils.**

Table 4: Soils

Soil Type	Description	Agricultural Classification	Area (Acres)	Percent
DouB	Downer-Urban land complex, 0-5% slopes	Not prime farmland	101.23	6.04%
EvuB	Evesboro-Urban land complex, 0-5% slopes	Not prime farmland	33.94	2.03%
FauB	Fallsington-Urban land complex, 0-5% slopes	Not prime farmland	7.75	0.46%
MamnAv	Mannington-Nanticoke complex, 0-1% slopes, very frequently flooded	Farmland of unique importance	131.18	7.83%
UddB	Udorthents, dredged materials, 0-8% slopes	Not prime farmland	9.87	0.59%
UddcB	Udorthents, dredged coarse materials, 0-8% slopes	Not prime farmland	277.13	16.54%
UddfB	Udorthents, dredged fine materials, 0-8% slopes	Not prime farmland	0.91	0.05%
UddrB	Udorthents, dredged materials-Urban land complex, 0-8% slopes	Not prime farmland	85.94	5.13%
UR	Urban land	Not prime farmland	90.16	5.38%
USDOWB	Urban land-Downer complex, 0-5% slopes	Not prime farmland	489.49	29.21%
WATER	Water	Not prime farmland	384.99	22.98%
WooB	Woodstown-Urban land complex, 0-5% slopes	Not prime farmland	62.91	3.75%
Total			**1,675.50**	**100.00%**

Source: NRCS, 2004

Soil Series

Several soil series appear more frequently in Paulsboro than in other areas and are briefly described as follows, in order of prevalence.

Urban land

Almost half of all soils (47 percent, 785 acres) in Paulsboro (including water areas) are composed of urban land or urban land soil complexes. Urban land consists of areas where much of the soil surface is covered with asphalt, concrete, buildings, or other impervious cover. The typical sequence, depth, and composition of the soil material vary greatly from place to place. Nearly 600 acres (35 percent) in Paulsboro is composed of urban land in a complex with Downer soil, underlying the majority of residential and commercial development in Paulsboro. Urban land complexes with Evesboro, Fallsington, and Woodstown comprise another 105 acres (seven percent) of Paulsboro. Another five percent of the borough is composed of strictly urban land, located mostly where there are large areas of parking lots and large buildings.

Downer

About 35 percent (590 acres) of Paulsboro is made of Downer soils in a complex with urban land, of which 29 percent is dominated by urban land and six percent is dominated by Downer soils. The Downer series consists of very deep, well-drained soils on upland areas. These soils are loamy or gravelly fluviomarine deposits formed from acidic, sandy, highly quartzose and moderately coarse coastal plain sediments. They have medium natural fertility and require fertilization for maximum crop production.

Udorthents

Over 23 percent (374 acres) of the area underlying Paulsboro is composed of Udorthents soils (of varying materials and slopes), which are made of dredge spoils from the deepening of the Delaware River. Udorthents soils vary from well-drained to somewhat poorly drained soils and are formed in stratified sandy or loamy fill materials. Within Paulsboro, Udorthents soils are mostly located in areas occupied or formerly occupied by the petroleum industry. The properties of these soils vary greatly with depth and location; however, they are generally well suited to use as building sites, in addition to their frequent use for parks, recreation fields, lawns, and landscaping. Restrictive layers and buried objects generally obstruct deep excavations. In urban areas, vegetable gardens generally can be planted if soil tests are made to identify possibly contaminated soil, as with heavy metals. Further discussion of Paulsboro's Udorthents and dredge spoils can be found in **Environmental Issues: Delaware River Dredge Spoils**.

Mannington-Nanticoke complex

About eight percent (131 acres) of Paulsboro contains soils composed of the Mannington-Nanticoke complex. Within the borough, these soils are exclusively located along and within the Mantua Creek. These soils, a combination of Mannington soils and Nanticoke soils, both have silty estuarine deposits as their parent material and contain mucky silt loams and peat. This complex is made of extremely fine soils that are full of organic material. The Mannington-Nanticoke soils erode more easily from wind action because the silty particles of the soil are finer than sandier soil types. Permeability is moderately slow and the seasonal high water table is at the surface, making these soils prone to frequent flooding and ponding. Within Paulsboro, this is the only soil type that is considered farmland of unique significance (discussed below). This is also the only hydric soil in Paulsboro, which is a soil that can support wetlands vegetation.

Agricultural Classification of Soils

Because of its location within the Inner Coastal Plain, Paulsboro once contained significant areas of prime farmland, although these are now covered with development. Different variations of Downer and Woodstown land are classified as prime farmland when not in a complex with urban land. Although 92 percent of Paulsboro is not rated for agricultural use by the NRCS, about eight percent contains soils designated as Soils of Unique Importance. The soils rated for agricultural use are shown on **Map 8: Agricultural Quality of Soils**. These unique soils can support particular food or fiber crops based on criteria including temperature, humidity, air drainage, elevation, aspect, or proximity to market. In order for lands to be classified as Unique Farmland, the land must also be used for a specific high-value food or fiber, and have an adequate moisture supply for that crop. Within Paulsboro, Soils of Unique Importance are located in undeveloped wetlands areas along Mantua Creek. These soils probably supported salt hay production at one time, although many areas are now dominated by the invasive common reed, or *Phragmites*.

Climate

Geographically situated midway between the North Pole and the equator, New Jersey's climate is extremely variable. The state's temperate, continental climate is influenced by hot, cold, dry, and humid airstreams and local weather is highly changeable. From May through September, New Jersey is dominated by moist, tropical air originating in the Gulf of Mexico that is swept in by prevailing winds from the southwest. In winter, winds generally prevail from the northwest, bringing cold, polar air masses from subarctic Canada. The Appalachian Mountains to the west and the Atlantic Ocean to the east have a moderating effect on climate in the area, and temperatures below zero or above 100 degrees are a rarity. Precipitation is fairly evenly distributed throughout the year with maximum amounts during the late summer months. Much of the summer rainfall is from local thunderstorms.

The climate in New Jersey varies within five regions: North, Central, Southwest, Pine Barrens, and Coastal. Paulsboro is located in the Southwest region. The Southwest Zone lies between sea level and approximately 100 feet above sea level. The proximity to Delaware Bay adds a maritime influence to the climate of this region. The Southwest has the highest average daily temperatures in the state and, lacking 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.

In the Southwest Zone, prevailing winds are from the southwest, except in winter when west to northwest winds dominate. High humidity and moderate temperatures prevail when winds flow from the south or east. The moderating effect of the Delaware River also allows for a longer growing season in this region. Autumn frosts usually occur about four weeks later here than in the North, and the last spring frosts are about four weeks earlier, giving this region the longest growing season in New Jersey.

Detailed weather data from nearby Philadelphia International Airport is available from the National Oceanic and Atmospheric Administration, which has operated a station since 1948. As measured by this station, the Paulsboro area experiences a mean high temperature of 87°F and a mean low temperature of 17°F. The region's annual mean temperature is 54.2°F, compared with a statewide mean temperature of 52.3°F. In 2009, the warmest month was August with a mean temperature of 86°F. January, the coldest month, had a mean temperature of 35.5°F. August was also the wettest month with a total rainfall of 10.29 inches, while the driest month was February with 0.84 inches of rain recorded.

Surface Water Resources

All of Paulsboro's surface water drains to the Delaware River, and ultimately to the Atlantic Ocean via the Delaware Bay. Most of the borough's land surface drains to the main channel of Mantua Creek before emptying into the Delaware River. In addition to containing portions of the Delaware River and Mantua Creek, Paulsboro contains a very small portion of a tributary to the Clonmell Stream near the intersection of Billingsport Road (County Route 653) and West Broad Street (State Route 44).

Watersheds

A watershed is all the land that drains to a particular waterway, such as a river, stream, lake, or wetland. The high points in the terrain, such as hills and ridges, define the boundaries of a watershed. Large watersheds are made up of a succession of smaller ones, and smaller ones are made up of the smallest area down to the catchment area of a local site. So, for example, the Delaware River watershed is made up of many smaller watersheds such as the Mantua Creek watershed, which itself consists of smaller subwatersheds. These subwatersheds can be further subdivided into smaller ones, each surrounding smaller tributaries that flow to the larger channel, and so on down to the catchment level. Watersheds are natural ecological units where soil, water, air, plants, and animals interact in a complex relationship.

Each watershed corresponds to a hydrological unit code, or HUC, as delineated by the United States Geological Survey (USGS). A HUC 11 watershed (identified by an 11-digit code) contains a number of HUC 14 subwatersheds (identified by a 14-digit code). The State of New Jersey has 152 HUC 11 watersheds and over 900 HUC 14 subwatersheds. Within Paulsboro, there are portions of three HUC 11 watersheds: Woodbury / Big Timber / Newton Creeks, Mantua Creek and Cedar Swamp / Repaupo Creek / Clonmell Creek. Paulsboro falls within one HUC 14 within each larger HUC 11 watershed, listed in **Table 5: Watersheds** and depicted on **Map 9: Watersheds**.

Lower Delaware Tributaries New Jersey Watershed Management Area 18

The NJ Department of Environmental Protection manages natural resources on a watershed basis. The state has been divided into 20 Watershed Management Areas (WMAs). Paulsboro is located within WMA 18: Lower Delaware Tributaries.

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

Mantua Creek Watershed

The Mantua Creek

Over half of Paulsboro (58 percent, 975 acres) drains to the Mantua Creek. The main branch of Mantua Creek begins in Glassboro and flows 18.6 miles to the Delaware River within Paulsboro. The Mantua Creek is tidal within Paulsboro, and continues to be tidal on its main channel until it reaches Wenonah. Two major tributaries to the Mantua Creek are the Chestnut Branch and Edwards Run. Additional tributaries to the main branch of Mantua Creek include Duffield Run, Porch Branch, Bethel Run, Bees Branch, Monongahela Brook, and Breakneck Run. Near the mouth of Mantua Creek in Paulsboro are wide tidal marshes, many of which were filled many years ago with spoils from dredging of the Delaware River. The border of Paulsboro reflects the original path of the Mantua Creek, although the creek has since been straightened to better accommodate shipping traffic.

Cedar Swamp / Repaupo Creek / Clonmell Creek Watershed

The Cedar Swamp / Repaupo Creek / Clonmell Creek watershed drains about 38 percent (640 acres) of Paulsboro in both the western and northern portions of the borough. Within Paulsboro, land in this watershed drains to the Nehaunsey Brook / Clonmell Creek subwatershed. Both of these streams drain directly to the Delaware River.

Woodbury / Big Timber / Newton Creeks Watershed

A very small portion of Paulsboro (4 percent, 60 acres) in the northeast corner of the borough across the Mantua Creek is located within the Woodbury / Big Timber / Newton Creeks watershed. This section of the watershed drains to the Main Ditch / Little Mantua Creek subwatershed. The Little Mantua Creek drains directly to the Delaware River in West Deptford Township.

Table 5: Watersheds

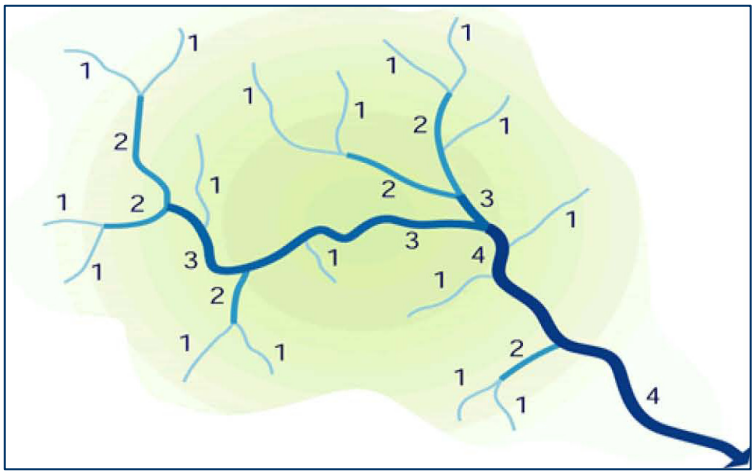
Watershed Name	HUC 11	Subwatershed Name	HUC 14	Area (Acres)	Percent
Cedar Swamp / Repaupo Ck / Clonmell Ck	02040202140	Nehaunsey Bk/Clonmell Ck (Lower Delaware River to Mantua Ck)	02040202140010	640.00	38.20%
Mantua Creek	02040202130	Mantua Creek (below Edwards Run)	02040202130060	975.09	58.20%
Woodbury / Big Timber / Newton Creeks	02040202120	Main Ditch / Little Mantua Creek	02040202120120	60.43	3.61%
Total				**1,675.52**	**100.00%**

Source: NJDEP, 2006

Surface Waters

There are a total of 3.2 stream miles within Paulsboro, as listed in **Table 6**. The borough contains nearly two stream miles of the Mantua Creek, about one stream mile of the Delaware River, and less than one stream mile of Clonmell Creek.

Figure 3: Stream Order



Source: T.A. Endreny, 2003

Waterways are classified by their stream order, which is a hierarchy used to differentiate smaller streams from larger ones. A generalized depiction of stream order hierarchy is shown in **Figure 3: Stream Order**. 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.

Clonmell Creek is a first order stream within Paulsboro, meaning it is the initial section of the stream channel with no contributing tributaries. First order streams are narrow, shallow, and characterized by relatively small base flows. This makes them 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.

Within Paulsboro, the Mantua Creek is a fourth order stream, which indicates that more than one third order stream flows into it. The Delaware River does not have a defined stream order (indicated by the stream order “99”).

Table 6: Streams

Stream Order	Length (Meters)	Length (miles)
1 (Smallest) (Clonmell Creek)	600.25	0.37
4 (Mantua Creek)	2,753.20	1.71
99 (Delaware River)	1,794.75	1.12
Total	**5,148.19**	**3.20**

Source: NJDEP, 2002

The Delaware River and Mantua Creek are both tidal within Paulsboro. Tidal flows both help and hinder maintenance of 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. Silt deposition within a stream tends to increase during flood tides. Deposition is also a natural function of stream shape, although the presence of barriers can problematically increase the amount of silt being carried by the stream.

The Mantua Creek

Paulsboro contains two acres of artificial lakes or ponds, which derive from man-made impoundments formed by damming or an extractive operation. These waterbodies are often used for irrigation and flood control. All artificial lakes in Paulsboro are located within former or current industrial areas.

Although the maps show a lake area in the southern portion of Paulsboro to the east of South Delaware Street, this area is actually a wetlands area and not a permanent pond.

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 US 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 non-tidal (interior). Tidal wetlands can be either saline or freshwater. There are also special wetland categories to denote saturated areas that have been altered by human activities.

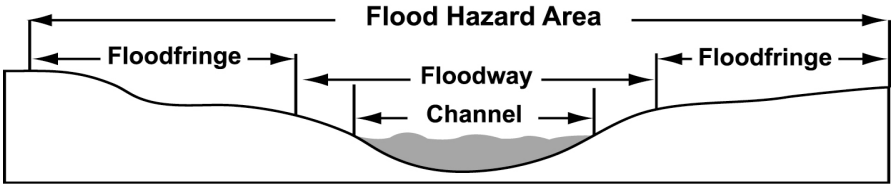
New Jersey protects freshwater wetlands under the New Jersey Freshwater Wetlands Protection Act Rules: N.J.A.C. A 7:7A. The law also protects transition areas, or “buffers,” around freshwater wetlands. The New Jersey freshwater wetlands maps provide guidance on where wetlands are located in New Jersey, but they are not the final word. Only an official determination from DEP, called a “letter of interpretation” (LOI), can legally determine for certain 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 permits are required for most of them.

As shown on **Map 10: Surface Water and Wetlands**, Paulsboro contains both tidal and non-tidal wetlands located along and within the Mantua Creek and Delaware River. There are a total of 139 acres (eight percent of the borough) of wetlands of all types. The most common wetlands types are *Phragmites* dominated coastal wetlands and *Phragmites* dominated interior wetlands, which cover approximately 50 and 32 acres each, respectively. 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 spread aggressively, *Phragmites* often becomes a dominant monoculture and is therefore considered an invasive species.

Floodplains

Areas naturally subject to flooding are called floodplains, or flood hazard areas. See **Figure 4**. 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 4: Parts of a Flood Hazard Area



Source: NJDEP

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

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

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

New Jersey's flood hazard area maps are not available in digital form. Consequently, it is only possible to approximate the spatial extent of the flood hazard area in Paulsboro by using the Federal Emergency Management Agency's (FEMA's) 100- and 500-year floodplain maps. According to FEMA data released in 2010, 1,051 acres (63 percent) of Paulsboro's land is located within a floodplain. Both industrial and vacant lands along the Mantua Creek as well as residential and commercial properties in the center of the borough are within a floodplain. See **Map 11: Floodplains** and **Table 7: Floodplains**.

Table 7: Floodplains

Flood Plain	Area (Acres)	Percent
100 Year Flood Plain	770.52	45.99%
500 Year Flood Plain	281.00	16.77%
Total	**1,051.52**	**62.76%**
Total Paulsboro Area	**1,675.52**	

Source: FEMA, 2010

The fact that over 60 percent of Paulsboro is located in a floodplain presents significant challenges for the borough. Comprehensive stormwater management involving best management practices like tree trenches, rain gardens, rain barrels, and other techniques can help alleviate frequent flooding. Paulsboro Township passed a Stormwater Management Plan in 2006 that addresses strategies to reduce the volume of stormwater runoff and increase infiltration in new developments and redevelopment. Additional efforts to reduce runoff in existing neighborhoods would be beneficial. See section on **Nonpoint Source Pollution** on page 36 for more discussion about stormwater management.

Surface Water Quality

Water quality standards are established by federal and state governments to ensure that water is suitable for its intended use. The federal Clean Water Act (P.L. 95-217) requires that wherever possible, water-quality standards provide water suitable for fish, shellfish, and wildlife to thrive and reproduce and for people to swim and boat.

Waterbodies in New Jersey are classified by NJDEP as 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). Saline estuarine waters are further divided into SE1, SE2, and SE3 depending on their designated uses. 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. In addition, some waterbodies have the antidegradation standard Category 1 (C1). C1 waters are considered exceptional resource waters that have ecological, water supply, or fishery significance, and are protected from measurable changes in water quality due to their unique characteristics.

Within Paulsboro, Mantua Creek is classified by the NJDEP as FW2-NT (SE1), meaning it is a nontrout waterbody with a freshwater/saltwater interface. The portion of Clonmell Creek that reaches into Paulsboro is classified as FW2-NT (C1), which means it is a Category One nontrout freshwater stream. See **Table 8**. The Delaware River main stem, estuary, and bay are not classified according to the NJDEP standards of FW, PL, SE, and SC. These waterways have a unique classification and are under the jurisdiction of the Delaware River Basin Commission.

Table 8: Water Quality Classifications of Streams

Stream Name	Classification
Mantua Creek	FW2-NT(SE1)
Clonmell Creek	FW2-NT(C1)

Source: NJDEP, 2006

According to NJDEP rules, FW2 (both trout maintaining and not) 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 waterbody's designated use(s) is based on whether or not the waterbody is within established limits for certain surface water quality parameters. Some examples of surface water quality parameters include fecal coliform, dissolved oxygen, pH, phosphorous, and toxic substances. NJDEP also evaluates water quality by examining the health of aquatic life in a stream.

New Jersey's Integrated Water Quality Monitoring and Assessment Report

The Federal Clean Water Act mandates that states submit biennial reports to the US 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 waterbodies that

are not attaining water-quality standards. States must also prioritize the impaired waterbodies on the 303(d) List for Total Maximum Daily Load (TMDL) analyses and identify those high-priority waterbodies for which they anticipate establishing TMDLs in the next two years. See **Total Maximum Daily Loads** section on page 38 for additional information.

Beginning in 2002, the NJDEP combined the 305(b) Report and the 303(d) List into a single report, according to the EPA's guidance. The biennial Integrated Water Quality Monitoring and Assessment Report places the state's waters on one of five sublists. Sublists 1 and 2 contain waters that are attaining standards. Sublist 3 contains waters that have insufficient data to determine their status. Sublist 4 contains waters that do not attain water-quality standards, but which meet one of the following three conditions: (1) a TMDL has been completed for the pollutant causing nonattainment; (2) other enforceable pollution control requirements are reasonably expected to result in conformance with the applicable water-quality standards; or (3) nonattainment is caused by something other than a pollutant. Sublist 5, equivalent to the 303(d) List, contains waters that do not attain their designated use and for which a TMDL is required.

In 2006, NJDEP began reporting water quality data on a HUC 14 subwatershed basis, and so the assessments of portions of rivers and streams are reported by the subwatershed they fall within. The Delaware River main stem, estuary, and bay are assessed somewhat differently than HUC 14 subwatersheds. For these waters, the NJDEP uses the Delaware River Zones designated by the Delaware River Basin Commission. Subwatersheds (or 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 Paulsboro support trout or shellfish, these designated uses are not applicable. Also, industrial water supply was not a designated use for any of the subwatersheds in Paulsboro.

The water quality assessment of the three subwatersheds in which Paulsboro is located as well as the portion of the Delaware River bordering Paulsboro is shown in **Table 9: New Jersey Integrated Water Quality Monitoring and Assessment Report (2008)**. Two of the three subwatersheds are impaired for fish consumption and have insufficient data for the other designated uses; the third subwatershed has insufficient data for all designated uses. Paulsboro borders on Zone 4 (subzone 17) of the Delaware River, which was assessed as impaired for two designated uses in 2008. See also **Map 12: Water Quality (2008)**.

Table 9: New Jersey Integrated Water Quality Monitoring and Assessment Report (2008)

Subwatershed ID	Subwatershed Name	Sublist				
		Aquatic Life General	Recreation	Drinking Water Supply	Agricultural. Water Supply	Fish Consumption.
02040202140010	Nehaunsey Bk/Clonmell Ck (Lower Delaware River to Mantua Ck)	3	3	3	3	3
02040202130060	Mantua Creek (below Edwards Run)	3	3	3	3	5
02040202120120	Main Ditch / Little Mantua Creek	3	3	3	3	5
Delaware River 17	Delaware River 4	5	2	N/A	N/A	5

Source: NJDEP, 2008

Subwatersheds that are in nonattainment (Sublist 5) of one or more designated uses are listed on the 303(d) List of Impaired Waters with Priority Ranking, and the pollutant(s) causing the nonattainment status is identified. When the pollutant causing nonattainment is not known, the pollutant is listed as “pollutant unknown” or “toxic unknown.” The ranking (low, medium, high) refers to the priority given a specific assessment unit when determining the schedule for a Total Maximum Daily Load (see next section for further information). The priority ranking is determined by NJDEP and takes into account the severity of the pollution and the uses of the waters, as well as any additional relevant factors. **Table 10: New Jersey’s 303(d) List of Impaired Waters with Priority Ranking (2008),** lists the non-attaining assessment units and their pollutants in Paulsboro. As seen in the table below, all three impaired assessment units are contaminated with Polychlorinated biphenyls (PCBs). In addition, Delaware River Zone 4 is impaired by eight other parameters. However, neither of the two impaired subwatersheds, nor the Delaware River portion, has been ranked as a high priority for remediation.

Table 10: New Jersey's 303(d) List of Impaired Waters with Priority Ranking (2008)

Assessment Unit ID	Assessment Unit Name	Parameter	Ranking
02040202120120	Main Ditch / Little Mantua Creek	PCB	Medium
02040202130060	Mantua Creek (below Edwards Run)	PCB	Low
Delaware River 17	Delaware River 4	Chlordane	Medium
Delaware River 17	Delaware River 4	Copper	Medium
Delaware River 17	Delaware River 4	DDD	Medium
Delaware River 17	Delaware River 4	DDE	Medium
Delaware River 17	Delaware River 4	DDT	Medium
Delaware River 17	Delaware River 4	Dieldrin	Medium
Delaware River 17	Delaware River 4	Mercury	Medium
Delaware River 17	Delaware River 4	PCB	Low
Delaware River 17	Delaware River 4	Temperature	Low

Source: NJDEP, 2008

Polychlorinated Biphenyls (PCBs) were used as coolants and lubricants in electrical equipment from the 1940s until 1977, when their manufacture was stopped due to evidence of their harmful effect on the environment. PCBs do not break down quickly in the environment and accumulate in water, soil, air, and animal life. Exposure to PCBs can cause skin conditions and impair the liver and immune system in humans.

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

Copper and **mercury** are considered heavy, or toxic, metals. Trace amounts of some of these elements are essential to maintain the metabolism of the human body, although consuming them in larger doses can be toxic or poisonous. Heavy metals bioaccumulate, meaning they accumulate in the body and are not easily broken down. 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 enter the water system through industrial processes, such as the manufacture of electronics, paint, batteries, metal, or lamps.

DDT was effective in nearly eliminating typhus during World War II and has successfully combated malaria in many parts of the world, although it has been shown to have harmful

effects on plant and animal life. DDT breaks down in the environment to form its metabolites **DDD** and **DDE**. Exposure to DDT impairs the nervous and immune systems in animals and is highly toxic, particularly for fish. It also causes eggshell thinning in birds, the primary reason why bald eagles and other large raptors became endangered in the United States. **Dieldrin** was an insecticide developed as an alternative to DDT; however, it was later found to be toxic to animals, including humans.

Temperature change can be toxic to aquatic life, in addition to affecting the solubility of other substances. Water quality impairment caused by temperature can be due to industrial processes that use waterbodies for cooling purposes.

Total Maximum Daily Loads

For each impaired waterway (waters on Sublist 5), the state is required by the EPA to establish a Total Maximum Daily Load (TMDL). A TMDL quantifies the amount of a pollutant that a waterbody can assimilate (its loading capacity) without violating water quality standards. A TMDL's purpose is to initiate a management approach or restoration plan based on identifying the sources of a pollutant and determining the percentage reductions of the pollutant that must be achieved by each source. These sources can be point sources, such as sewage treatment plants, or nonpoint sources, such as runoff from various types of residential, commercial, or agricultural lands. A TMDL goes through four stages: it is "proposed" in a report by NJDEP, "established" when NJDEP finalizes its report, "approved" by EPA Region 2 (the EPA region covering New Jersey), and "adopted" when NJDEP adopts it as an amendment to a water quality management plan.

In general, implementation of a TMDL relies on actions mandated by the Municipal Stormwater Management program, including the ordinances that municipalities are required to adopt under that permit.

Since the impaired assessment units in Paulsboro have been ranked as either low or medium priority for remediation, they are not currently included on the TMDL schedule. There is an ongoing effort to establish a TMDL for PCBs in the Delaware River, under supervision by the Delaware River Basin Commission. This is an extremely complicated pollutant to quantify and current and past sources are exceedingly difficult to identify.

Other Monitoring

Certain fish may contain toxic chemicals, such as PCBs, dioxins, or mercury, which accumulate in water and aquatic life. Chemical contaminants, such as dioxin and PCBs, are classified by the USEPA as probable cancer-causing substances in humans. Elevated levels of mercury can pose health risks to the human nervous system. Infants, children, pregnant women, nursing mothers, and women of childbearing age are considered "high-

risk individuals" who may be more vulnerable 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 of PCB, dioxin, and mercury in fish tissue. The NJDEP uses these results to issue advisories to guide residents on safe fish and shellfish consumption practices.

The consumption advisories for fish caught in general freshwater in the state are listed in **Table 11** below. There are additional fish consumption advisories for the lower Delaware River region, which supersede the general advisories. More information on general consumption advisories and details on the safest cooking methods are located at NJDEP's Fish Smart Eat Smart website at http://www.state.nj.us/dep/dsr/njmainfish.htm.

Table 11: Fish Consumption Advisories

Species	General Population	High-Risk Individuals*
	Eat No More Than:	Eat No More Than:
General Freshwater Advisories		
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	
Brown Bullhead		
Sunfish		One Meal Per Week
Lower (Tidal) Delaware River: Trenton, NJ to PA/DE Line, Including all tributaries to the head of tide		
Hybrid Striped Bass	No restrictions	One meal per week
Largemouth Bass		
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	

Source: NJDEP, 2009

Knowing the actual condition of streams and stream banks and planning for their improvement requires fuller surveys and more frequent monitoring than the state can provide. The state primarily monitors main channels in non-tidal areas and only does biological assessments on a five-year cycle. Stream surveys by local organizations are much needed, along with regular monitoring of water quality on all of a community's waterways.

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 waterbodies. The Act classified all water pollution into one of two categories: "point source" pollution coming from a single source, such as an industrial pipe or a large industrial site; and "nonpoint source" pollution, which comes from many diffuse sources. The 1972 act only required states to regulate point sources.

The Mantua Creek

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 conduct water quality, biological, and toxicological analyses, and thermal impact and cooling water assessments periodically.

As September 2010, 20 NJPDES permits were issued to individual facilities within or bordering Paulsboro. These are listed in **Table 12: NJPDES Permits for Point Source Discharges**. Most sites are also shown on **Map 19: Approved Sewer Service Area and NJPDES Permits**.

Table 12: NJPDES Permits for Point Source Discharges

NJPDES Permit Number	PI Number	Facility Name	Discharge Category Code *	Street Address Line1	Municipality
NJ0005584	46142	BP Oil Co	B	303 Mantua Ave	Paulsboro
NJ0005584	46142	BP Oil Co	RF	303 Mantua Ave	Paulsboro
NJG0178748	46142	BP Oil Co	5G3	303 Mantua Ave	Paulsboro
NJ0004278	46026	COIM USA Inc Paulsboro	B	675 Billingsport Rd	Greenwich
NJ0101702	46026	COIM USA Inc Paulsboro	GW	675 Billingsport Rd	Greenwich
NJG0116122	48305	Dana Transport Inc	5G2	4 Crown Point Rd	West Deptford
NJG0162175	280281	Dana Transport Systems Inc	5G2	46 Mantua Grove Rd	West Deptford
NJG0115797	48275	ExxonMobil Oil Corp - Paulsboro Lube Plant	5G2	1001 Billingsport Rd	Paulsboro
NJ0064921	46883	NuStar Asphalt Refining LLC	B	4 Paradise Rd	Paulsboro
NJ0064921	46883	NuStar Asphalt Refining LLC	GW	4 Paradise Rd	Paulsboro
NJ0025861	46959	Paulsboro Marketing Terminal	RF	825 Clonmell Rd	Paulsboro
NJG0180599	530035	Paulsboro Water Treatment Plant	5G3	Summit & Elizabeth Avenues	Paulsboro
NJ0026191	46759	Paulsboro Water Treatment- Plant Well #4	B	Summit & Elizabeth Aves	Paulsboro
NJ0057771	46760	Paulsboro Water Treatment Plant Well #5	B	Broad & Chestnut Sts	Paulsboro
NJG0148504	221690	Paulsboro Yard	5G2	240 W Jefferson St	Greenwich
NJ0004197	46315	Plains Products Terminals LLC	RF	3rd St & Billingsport Rd	Paulsboro
NJ0107778	46315	Plains Products Terminals LLC	GW	3rd St & Billingsport Rd	Paulsboro
NJG0142972	193051	Quality Pallet Inc T/A Royal Pallet	5G2	312 Borrelli Blvd	Paulsboro
NJ0005029	46618	Valero Refining Co NJ	B	800 Billingsport Rd	Greenwich
NJ0085502	46618	Valero Refining Co NJ	GW	800 Billingsport Rd	Greenwich

Source: NJDEP, 2010

*Discharge Category Code	Discharge Category Description
5G2	Basic Industrial Stormwater GP - NJ0088315 (5G2)
5G3	Construction Activity Stormwater (GP)
B	Industrial Wastewater
GW	Discharge to Groundwater
RF	Stormwater

Nonpoint Sources of Pollution

Nonpoint source pollution, or stormwater runoff, has a significant effect on the water quality and channel health of streams in Paulsboro. 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 Gloucester County derives from stormwater runoff from paved surfaces such as streets, commercial and smaller industrial sites, residential areas, and agricultural fields lacking adequate vegetated buffers. The waterways in Paulsboro are affected by stormwater runoff from both within the borough and from other municipalities upstream in the Mantua Creek subwatershed.

Since the adoption of the Federal Clean Water Act and the implementation of NJPDES permitting 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. NJDEP's new Stormwater Management Rules focus on reducing and controlling nonpoint sources of water pollution.

The Municipal Stormwater Regulation Program was developed in response to the EPA's Phase II rules published in December 1999. The NJDEP issued final stormwater rules in 2004 and established four NJPDES general permits for nonpoint source pollution: the Tier A Municipal Stormwater General Permit for urban and suburban communities (Tier A Permit), the Tier B Municipal Stormwater General Permit for rural communities (Tier B Permit), the Public Complex Stormwater General Permit (Public Complex Permit), and the Highway Agency Stormwater General Permit (Highway Permit). Paulsboro is a Tier A municipality and has an approved Tier A Permit. Public complexes include certain large public colleges, prisons, hospital complexes, and military bases, while highway agencies include county, state, interstate, or federal government agencies that operate highways and other thoroughfares. There are no NJPDES permits for either public complexes or highway agencies in Paulsboro. The Tier A Municipal Stormwater General Permit for Paulsboro is detailed in **Table 13** below.

Table 13: NJPDES Permits for Nonpoint Source Pollution

NJPDES Permit Number	Facility Name	Address	Discharge Category Code	Discharge Category Description	Issued	Expires
NJG0148750	Paulsboro Borough	1211 Delaware St	R9	Tier A Municipal Stormwater General Permit	3/1/2009	2/28/2014

Source: NJDEP, 2010

Stormwater Management

Statewide Basic Requirements:

Towns, Highway Agencies, and Institutions

Control post-construction stormwater management in new development and redevelopment through:

Adoption of a stormwater management plan in accordance with N.J.A.C. 7:8-4.

Adoption and implementation of a stormwater control ordinance in accordance with N.J.A.C. 7:8-4. This ordinance requires retention on site of 100 percent 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 (N.J.A.C. 5:21-7). The RSIS was 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.

Conduct local public education:

Distribute NJDEP educational information about stormwater requirements, nonpoint source pollution, and stewardship annually to residents and businesses and conduct a yearly educational "event" (such as a booth with these messages at a community day).

Label all municipal storm drain inlets that are next to sidewalks or within plazas, parking areas, or maintenance yards with a variation of the "don't dump" message.

Distribute information annually regarding fertilizer/pesticide application, storage, disposal, and landscaping alternatives.

Distribute information annually regarding proper identification, handling, and disposal of wastes including pet waste and litter.

Control improper disposal of waste through improved yard waste collection and through adoption and enforcement of ordinances (pet solid waste, litter, improper dumping, and wildlife feeding).

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.

Improve maintenance yard operations, specifically for de-icing material storage, fueling operations, vehicle maintenance, and housekeeping operations.

Increase employee training about all of the above.

The NJPDES Phase II Program lays out guidance and requirements for management of and education about stormwater at the local level. It applies to all towns in New Jersey, all county road departments, and all public institutional facilities on large sites (such as hospitals and colleges). Beginning in 2004, municipalities were required to obtain a New Jersey Pollution Discharge Elimination System (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. See the **text box** on this page for more details.

Under the 2004 NJPDES permit, a town had to meet certain specific requirements in planning, ordinance adoption, education, management of borough facilities, and investigation of parts of the stormwater system. Fulfillment of these Statewide Basic Requirements was scheduled to occur over the course of five years. All of the requirements were intended to reduce the water pollution from stormwater runoff. These permits are currently being renewed for an additional five years.

In Gloucester County, all municipalities were aided in complying with the new rule by a program sponsored by the County Freeholders and managed through the Gloucester County Improvement Authority. This included development of a stormwater management plan and ordinance. The County also sponsored the South Jersey Land & Water Trust, a nonprofit organization, to conduct the annual education event and to assist with labeling storm drain inlets.

Impervious Coverage

The volume of runoff that is carried to a stream impacts stream channel condition. Increased

volume usually results from increased impervious surface within a subwatershed. As an area becomes developed, more stormwater is directed to the streams from neighborhood storm drains, residential and commercial stormwater facilities, and road drainage. An increase in impervious coverage can decrease groundwater recharge, which can lead to a decrease in stream base flow during the dry summer months. In general, scientists have found that levels of impervious cover of ten percent or more within a HUC 14 subwatershed are directly linked to increased stormwater runoff, enlargement of stream channels, increased stream bank erosion, lower dry weather flows, higher stream temperatures, lower water quality, and declines in aquatic wildlife diversity. When impervious cover reaches 25 to 30 percent, streams can become severely degraded.

As shown in **Table 14: Impervious Coverage by HUC 14 Subwatersheds**, the three subwatersheds that Paulsboro lies within have between 11 and 18 percent impervious coverage overall. This is based on 2002 aerial photography analyzed by the NJDEP. Because Paulsboro is a largely built-out municipality, many areas in the borough have a large amount of impervious surfaces that contributes to the subwatershed percentage.

Table 14: Impervious Coverage by HUC 14 Subwatersheds

HUC 14	Subwatershed Name	Acres In Subwatershed	Acres Covered by Impervious Surfaces	Percent of Subwatershed Covered by Impervious Surface
02040202120120	Main Ditch / Little Mantua Creek	3,660.15	585.12	15.99%
02040202130060	Mantua Creek (below Edwards Run)	3,939.33	693.01	17.59%
02040202140010	Nehaunsey Bk/Clonmell Ck(Lower Delaware River to Mantua Ck)	7,666.37	832.03	10.85%

Source: NJDEP, 2002

Stream Buffers

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

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

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

Natural vegetation along the Delaware River

Many of the waterways in Paulsboro lack well-vegetated riparian corridors. There are some areas of the Mantua Creek that do have vegetated buffers made up of tidal marshes and upland forest, shown in **Map 16: Natural Vegetation (2007)**. Parts of the Delaware River waterfront in Paulsboro are vegetated with brushland/shrubland or herbaceous wetlands. Many areas of the Mantua Creek and Delaware River riparian corridors, however, are directly bordered by industrial facilities or residential development in Paulsboro.

Groundwater

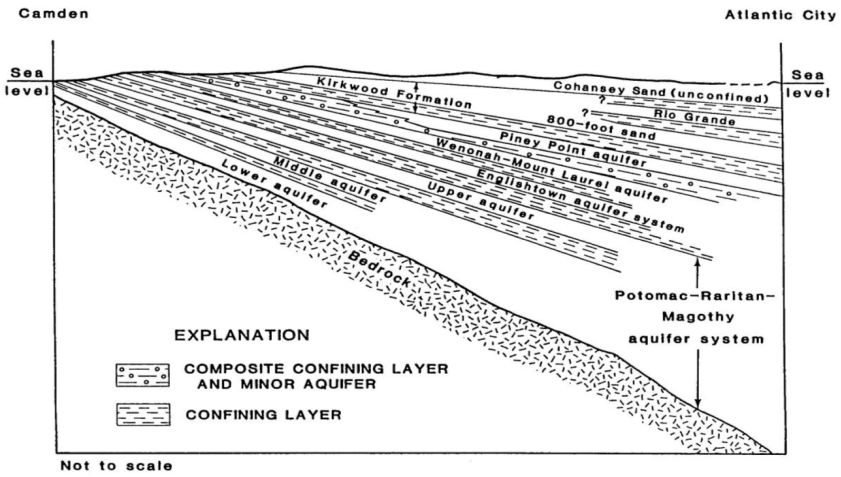
The geology of the New Jersey Coastal Plain can be visualized as a tilted layer cake, with its “layers,” or strata, formed of gravels, sands, silts, and clays. The saturated gravel and sand layers, with their large pore spaces, are the aquifers from which water is drawn. The

silt and clay layers, which impede the movement of water, are called confining units (or confining beds).

A cross section across southern New Jersey from west to east would show that the aquifers are not horizontal but tilt toward the southeast, getting deeper as they cross the state toward the Atlantic Ocean. Because of this tilting, each aquifer emerges on the land surface in a sequential manner. The deepest strata emerge on the surface near the Delaware River. Where a layer emerges and reaches the surface is its “outcrop” area. The Potomac-Raritan-Magothy (PRM) formation, the deepest and most abundant aquifer, is a major water source for Inner Coastal Plain communities like Paulsboro. Lying on top of the PRM is the Merchantville-Woodbury confining unit, the most extensive confining unit in the Inner Coastal Plain.

As shown in **Map 13: Geologic Outcrops**, the PRM aquifer system and the Merchantville-Woodbury confining unit outcrop in Paulsboro.

Figure 5: Aquifers of Southern New Jersey



Source: USGS

Aquifers

Potomac-Raritan-Magothy Aquifers (PRM)

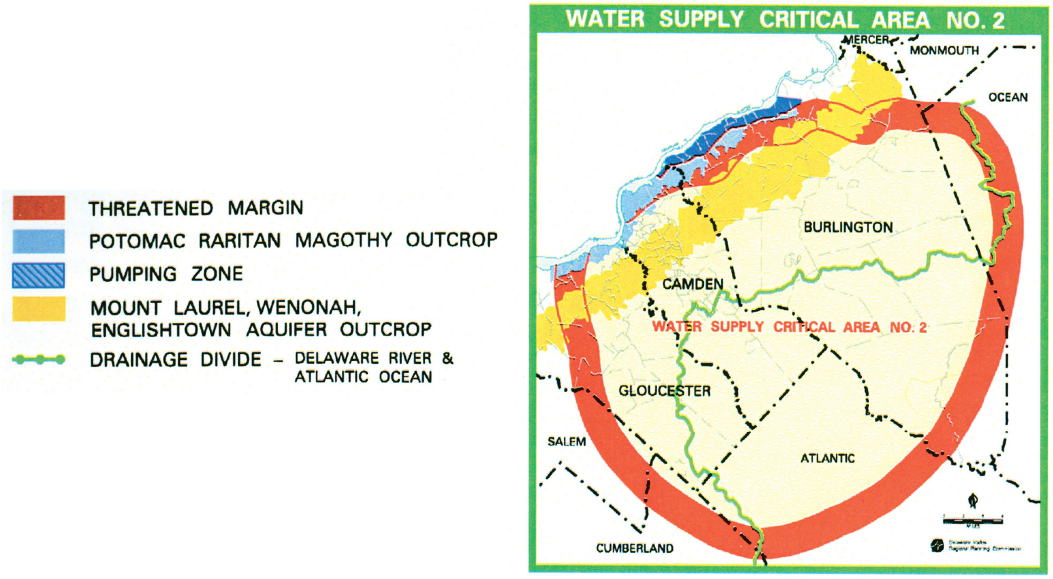
The Potomac-Raritan-Magothy (PRM) is the only aquifer underlying Paulsboro. This multiple aquifer is actually a large series of formations that have been combined and described as a single unit because the individual formations – the Potomac group and the Raritan and Magothy Formations – are lithologically 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 (150 to 60 million years ago).

In the Delaware Valley, three aquifers have been distinguished within the PRM system, designated as lower, middle, and upper, and there are two confining units or layers between the three water-bearing strata. The aquifers themselves are made up largely of sands and gravels, locally interbedded 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 that 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 to New Jersey residents from Burlington to Salem Counties, as well as to communities across the river in Delaware. Because of such large usage, there has been a decline in PRM aquifer water levels. This became so serious that the New Jersey Department of Environmental Protection established Water Supply Critical Area No. 2 in 1986. All water supply companies within Critical Area No. 2 were given annual limits on water withdrawals in the PRM. Usage from the PRM was cut back by over 20 percent and no increases in pumping were allowed. Piping of treated Delaware River water filled the gap in much of the region. As shown in **Figure 6: Water Supply Critical Area No. 2**, Paulsboro falls within Water Supply Critical Area No. 2.

Figure 6: Water Supply Critical Area No. 2



Source: DVRPC

In Gloucester County, use of the lower PRM aquifer for drinking water is limited due to high chloride concentrations (salt water intrusion). This is thought to come from either very

ancient seawater within the lower aquifer, or as the result of movement into it from its eastern side, which is in contact with ocean water. Whatever the cause, the lower aquifer is not usable for drinking supply for much of its extent.

Groundwater Recharge

Recharge of groundwater is an important issue in southern New Jersey because of the dependence on aquifers for drinking supply and for agricultural use. The amount of rainwater that actually enters an aquifer is a function of many factors, including the nature and structure of the aquifer itself. The amount of precipitation that infiltrates the soil and reaches the saturated zone to become groundwater – the recharge of the aquifer – is also dependent on climatic conditions, the nature of the soil, and the vegetation of an area.

The New Jersey Geological Survey (NJGS) has developed a methodology for evaluating land areas for their ability to transmit water to the subsurface, using precipitation records, soil surveys, and land use/land cover data. NJDEP has used this methodology to map and rank land areas throughout the state as to groundwater potential. Recharge, expressed as inches per year, is equivalent to the amount of precipitation that will reach the water table in an area with a particular combination of soils and land use.

In Paulsboro, about 47 percent of the land experiences groundwater recharge of only zero to one inch per year. Large areas with this low recharge rate are located in wetlands areas adjacent to the Delaware River and Mantua Creek. Since these areas are already wet, their low groundwater recharge rate is misleading – the water table is very close to the land surface, which creates the wetland conditions. However, other areas with low recharge rates are located in industrial and developed sections. The areas of Paulsboro with the highest elevations all have groundwater recharge of 11 inches or more per year. These high recharge areas include recreational areas in the borough and alongside the I-295 corridor. See **Table 15: Groundwater Recharge** below and **Map 15: Groundwater Recharge**.

Table 15: Groundwater Recharge

Recharge Rate (inches per year)	Area (Acres)	Percent
0 to 1	648.19	47.3%
2 to 6	88.85	6.5%
7 to 10	560.21	40.9%
11 and above	72.18	5.3%
Total*	**1,369.44**	**100.0%**
**Total area does not include portions of the rivers.*		

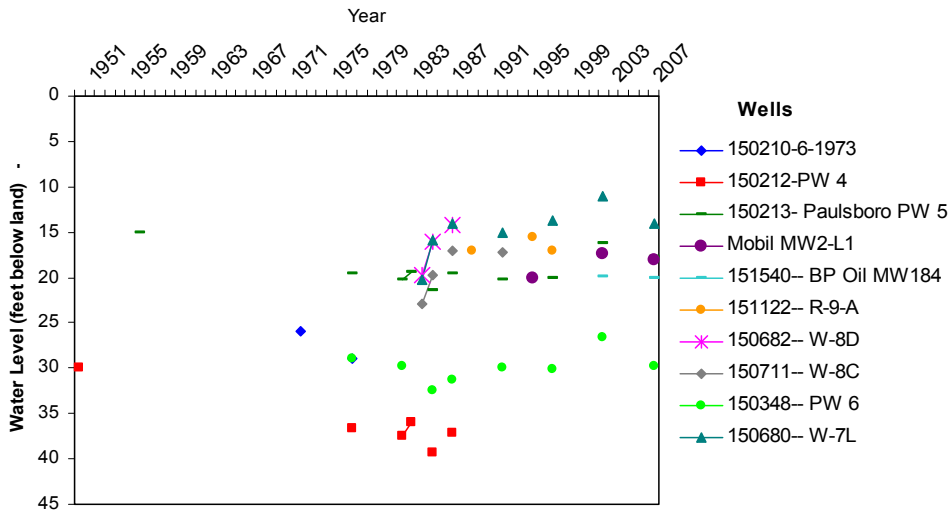
Source: NJDEP, 1997

In general, on high recharge lands, the amount of paving and other impervious cover has the most detrimental impact, although they are also usually the places that are most suitable for building because they are areas of well-drained soils. Conversely, these are also regions where the dilution of substances from septic systems, such as nitrates, may require a larger land area because the soils are usually more porous. For example, minimum average lot sizes of two to four acres are often needed for proper nitrate dilution from septic systems in areas having 10 or more inches per year of groundwater recharge.

While the surest way to protect groundwater recharge is to leave land undeveloped, there are ways in which urbanized areas can adapt to allow precipitation to infiltrate groundwater resources. Best Management Practices (BMPs), such as green streets, tree trenches, bioswales, rain gardens, rain barrels, and porous pavement can be used to capture, treat, and infiltrate precipitation in developed areas from all but the most significant storm events. Also referred to as green infrastructure, these techniques are utilized in more densely developed communities to manage stormwater and protect drinking water supplies, while enhancing quality of life.

Over the last few decades, groundwater levels in Paulsboro's observation wells have remained relatively stable based on field water-level measurements obtained by the USGS. When the water level increases, water is found at a greater depth below the land surface. With increased water level depth, pumps must work harder and wells must be drilled deeper to reach sizable and usable quantities of water. **Figure 7** below lists the recorded groundwater levels for observations wells within and bordering Paulsboro.

Figure 7: USGS Field Groundwater Level Measurements



Source: USGS, 2010

Water Supply Wells

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

There are three active public community water supply wells serving Paulsboro as listed in **Table 16: Public Water Supply Wells** below and shown on **Map 14: Public Water Supply Wells**.

Table 16: Public Water Supply Wells

Well ID	Well Permit ID	Owner	Depth of Bottom of Well (feet below land surface)	Depth to the bottom of well screen (feet below land surface)	Aquifer
WSWL0000066933	3000000069	Paulsboro Water Dept	220.0	220.0	PRM
WSWL0000066945	3000000602	Paulsboro Water Dept	178.0	175.0	PRM
WSWL0000067169	3000011403	Paulsboro Water Dept	-	-	PRM

Source: NJDEP, 2009

As required by federal and state regulations, all public water supply wells in the state are monitored by NJDEP on a regular basis. The monitoring schedules for the public water supply wells in Paulsboro are shown in **Appendix A: Monitoring Schedules for Public Water Supply Wells**.

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

Delineating a Wellhead Protection Area (WHPA)

A WHPA consists of three tiers, each based on time of travel to the well:

- Tier 1 = two years
- Tier 2 = five years
- Tier 3 = twelve years

Calculation of the tier boundaries is based on findings of how long specific contaminants can survive in groundwater, how much time would be required to undertake specific remedies, and the likelihood of natural dilution over distance. The tiers are shown as rings around a well, with the groundwater direction of travel factored in to create plume-like shapes.

Once WHPAs are delineated, potential pollution sources may be managed by landowners or municipalities in relation to the tier locations. Protection of land and restrictions on activities within wellhead zones relating to uses that generate contaminants, and to the storage, disposal, or handling of hazardous materials, are important for maintaining the quality of water within those zones.

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.

As seen in **Map 14: Public Water Supply Wells** the four water supply wells in Paulsboro have very large wellhead protection areas due to the nature of the PRM and the pumping rates of the wells. As seen in **Map 2: Aerial Photo (2007)**, large industrial areas in Greenwich Township are located within the 12-year time of travel portion of the Wellhead Protection Area, meaning that discharges at those facilities entering the groundwater may reach the wells within twelve years. Careful monitoring of these wells by their operator, the Paulsboro Water Department, is necessary to ensure the safety of the borough's drinking water supply.

Air Quality

Air quality is one of the most difficult environmental resources to measure because its sources are diffuse and regional in nature. Sources of air pollution include industry, cars, trucks, and buses, fires, and dust. Air pollutants can travel extremely far from their source. For example, the burning of coal in Ohio, Michigan, and Western Pennsylvania to generate electricity sends pollutants like sulfur, nitrogen, and particulate matter to the East Coast. Locally produced sources of air pollution are caused daily by traffic and industrial complexes in New Jersey and Philadelphia.

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 required transportation projects receiving federal funding to be in conformity with state air quality goals. The 1990 act also revised the way air toxins were regulated, increasing the number of regulated toxic air pollutants from seven to 187.

In 1970, the USEPA was formed to enforce the CAA. In New Jersey, the USEPA allows 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. The EPA sets National Ambient Air Quality Standards (NAAQS) for these pollutants.

Between 1970 and 2007, total emissions of the six criteria air pollutants decreased by more than 50

Air Quality Criteria Pollutants

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

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

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

Nitrogen oxides (NOx) are a group of highly reactive gases which 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.

Air Quality Criteria Pollutants (continued)

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

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

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.

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. As of September 2010, there are 25 facilities with active air quality permits in Paulsboro, listed in **Table 17: Facilities with Active Air Quality Permits**. Some of these facilities have more than one air quality permit, such as BP Oil which has 31 permits related to both activities at its facility and work related to the closure and reuse of the BP Former Terminal Property.

Industrial facilities in the Paulsboro region contribute to air quality pollution

Table 17: Facilities with Active Air Quality Permits

Program Interest (PI) Number	Facility	Address	# of Permits	Municipality
55001	Air Products & Chemicals Inc	675 Billingsport Road		Greenwich
A5613	Bennes Tire and Auto Inc	526 West Broad Street		Paulsboro
55986	Bentley Truck Rental	340 West Buck Street		Paulsboro
55033	BP Oil Inc	303 Mantua Avenue	21	Paulsboro
55939	Buckeye Pipe Line Transportation LLC	600 Billingsport Road		Greenwich
55826	COIM USA Inc	675 Billingsport Road		Greenwich
55940	ExxonMobil Paulsboro Lube Plant	1001 Billingsport Road	3	Paulsboro
55758	ExxonMobil Research & Engineering	600 Billingsport Road	4	Greenwich
55867	Former Peabody Clean Industries	85 Riverview Avenue		Paulsboro
55944	J. Koch Associates Inc	1802 S Delaware Street		Paulsboro
A5630	Lukoil Service Station #57345	642 Broad Street		Paulsboro
55938	NuStar Logistics LP	7 N Delaware Street	2	Paulsboro
A5711	Paulsboro Amoco	I 295 & Berkley Road		Paulsboro
H8864	Paulsboro Boro DPW	300 Baird Ave		Paulsboro
55137	Paulsboro Boro Water & Sewer Dept #7 WTP	Overbrook Ave & Lodge Ave		Paulsboro
55322	Paulsboro Co # 35670	220 Broad Street		Paulsboro
55445	Paulsboro High School	670 N Delaware Street		Paulsboro
55201	Paulsboro Packaging Inc	301 Mantua Ave	31	Paulsboro
55394	Paulsboro Pump Station	Adams Street		Paulsboro
55988	Paulsboro Terminal	825 Clonmell Road		Paulsboro
A5614	Paulsboro Valero Service Station	1803 S Delaware St	2	Paulsboro
55795	Plains Products Terminals	3rd St & Billingsport Rd	2	Paulsboro
A5693	Roadway Motor Plazas-Travelers Plaza	I 295 Exit 18A	2	Paulsboro
55006	Valero Refining Company	800 Billingsport Road	3	Greenwich
55829	Valero Refining Co NJ	800 Billingsport Road	19	Greenwich

Source: NJDEP, 2010

NJDEP enacted the Emission Statement Rule in 1992 requiring certain sites that have an air quality permit to report specific air contaminants, including carbon monoxide (CO), sulfur dioxide (SO_2), ammonia (NH_3), total suspended particulate matter (TSP), respirable

particulate matter (PM10 and PM2.5), lead (Pb), volatile organic compounds (VOC), nitrogen oxides, and 38 other toxic air pollutants.

There are eight facilities within or bordering Paulsboro that are required to submit emission statements, listed in **Table 18: Emission Statement Facilities**. In 2008, all eight facilities released data on their air emissions of the following contaminants: carbon monoxide, carbon dioxide, nitrogen oxides, respirable particulate matter, total suspended particulate matter, and volatile organic compounds. The emissions of the following other contaminants are reported by five or six of these facilities: ammonia, methane, lead, and sulfur dioxide. Some of the other contaminants measured in Paulsboro are: acrolein, benzene, butadiene, cadmium compounds, formaldehyde, mercury, polycyclic organic matter, and trichorethal. The 2008 statements of the seven regulated facilities in Paulsboro are included in **Appendix B: 2008 Air Quality Emissions Statements**.

Table 18: Emission Statement Facilities

PI #	Name	Address	Municipality
55826	COIM USA Inc	Billingsport Rd	Greenwich
55126	ExxonMobil Oil Corp	N Delaware St	Paulsboro
55828	ExxonMobil Oil Corp Paulsboro Fac. Complex	Mobil Oil Corporation	Paulsboro
55127	ExxonMobil Research & Engineering Co	600 Billingsport Rd	Greenwich
55758	ExxonMobil Research & Engineering Co	Paulsboro Technical Ctr	Paulsboro
55831	NuStar Asphalt Refining LLC	4 Paradise Rd	Paulsboro
55795	Plains Products Terminals, LLC	3rd Street & Billingsport Rd	Paulsboro
55829	Valero Refining Co NJ	800 Billingsport Rd	Greenwich

Source: NJDEP, 2010

Air Quality Monitoring in the Region

As of 2009, NJDEP's Bureau of Air Monitoring maintains a network of 42 continuous monitoring stations across the state and is proposing the establishment of two new sites by the end of 2010. 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.

The monitoring station closest to Paulsboro is located in Clarksboro, Gloucester County, approximately 3.2 miles (5.1 kilometers) to the south. The Clarksboro monitoring station tracks ozone and sulfur dioxide concentrations at the "urban" scale representative of ten to 100 kilometers from the station, which would include all of Paulsboro.

Another continuous monitoring station close to Paulsboro is the Ancora State Hospital, located in Winslow Township, Camden County, approximately 25 miles (40 kilometers) to the southeast. This station monitors ozone, carbon monoxide and sulfur dioxide. This station monitors at the "urban" scale, meaning it is representative of ten to 100 kilometers from the station, which would include all of Paulsboro.

Carbon Monoxide

Carbon monoxide (CO) is a byproduct of automobile exhaust, which contributes over 56 percent of all CO emissions in the United States. There are two NAAQS for carbon monoxide: (1) an eight-hour average of 9 ppm, which cannot be exceeded more than once a calendar year, also for primary and secondary effects; and (2) a one-hour average of 35 ppm, which also cannot be exceeded more than once a calendar year for primary and secondary effects. New Jersey's standards are slightly different from EPA's in that the state uses a rolling year unit instead of a calendar year. In 2006, of the 12 stations within the state that monitored carbon monoxide, none exceeded the standards. The Ancora State Hospital station, listed in **Table 19**, had the lowest average concentrations of carbon monoxide of all state-wide stations. (Statewide averages for carbon monoxide are not provided.)

Table 19: Carbon Monoxide Averages, 2006

Monitoring Site	1-hr Max ppm	2nd Highest 1-hr Max ppm	8-hr Max ppm	2nd Highest 8-hr Max ppm
Ancora State Hospital	1.0	1.0	0.6	0.5

Source: NJDEP, 2009

Ground-level Ozone

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_3), 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.

In 2006, the one-hour maximum concentration of ozone was not in excess of the 0.12 ppm standard for Clarksboro, the site closest to Paulsboro. It was in excess once at Ancora State Hospital. Both monitoring stations exceeded the eight-hour standard during 2006. See **Table 20** and **Table 21** below for details.

Table 20: Ozone One-Hour Averages, 2006

Monitoring Site	1-hr Max ppm	2nd Highest 1-hr Max ppm	4th Highest 1-hour Average 2004-2006 ppm	# of days with 1-hour Averages above 0.12ppm
Ancora State Hospital	0.135	0.124	0.114	1
Clarksboro	0.108	0.108	0.117	0
Statewide	*0.135*	*0.131*		*3*

Source: NJDEP, 2009

Table 21: Ozone Data Eight-Hour Averages, 2006

Monitoring Site	1st Highest	2nd Highest	3rd Highest	4th Highest	4th Highest 8-hour Average 2004-2006 ppm	# of days with 8-hour Averages above 0.08ppm
Ancora State Hospital	0.115	0.112	0.093	0.086	0.088	6
Clarksboro	0.091	0.089	0.088	0.083	0.086	3
Statewide	*0.115*	*0.112*	*0.106*	*0.103*	*0.100*	*20*

Source: NJDEP, 2009

Sulfur Dioxide

Emissions of sulfur dioxide are associated with combustion of sulfur-containing fuels such as oil and coal. The most common sources of such emissions are fuel fired power plants and oil refineries. There are three NAAQS for sulfur dioxide: (1) a yearly average of 0.03 ppm for primary effects; (2) a 24-hour average of 0.14 ppm, which cannot be exceeded more than once a calendar year, also for primary effects; and (3) a three-hour average of 0.5 ppm, which also cannot be exceeded more than once a calendar year for secondary effects. New Jersey's standards are slightly different in that they use a rolling year unit instead of a calendar year. In 2006, both the Ancora State Hospital and the Clarksboro stations did not exceed these standards. See **Table 22** and **Table 23** below for details.

Table 22: Sulfur Dioxide 3-Hour and Annual Averages, 2006

Monitoring Site	3-Hour Average Max	3-Hour Average 2nd Highest	12-Month Average Max	Average Calendar Year
Ancora State Hospital	0.032	0.031	0.003	0.002
Clarksboro	0.035	0.033	0.004	0.003

Source: NJDEP, 2009

Table 23: Sulfur Dioxide 24-Hour and Daily Averages, 2006

Monitoring Site	24-Hour Average Max	24-Hour Average 2nd Highest	Daily Average Max	Daily Average 2nd Highest
Ancora State Hospital	0.016	0.011	0.013	0.011
Clarksboro	0.017	0.015	0.015	0.014

Source: NJDEP, 2009

In addition to the continuous monitoring network, the NJDEP Bureau of Air Monitoring operates a manual air quality monitoring network that measures a greater number of parameters. At these stations, samples are taken that are then analyzed in a laboratory for respirable particulate matter, lead, total suspended particulate matter, atmospheric deposition, ozone precursors, and a number of other contaminants. These stations are located across the state, but are generally concentrated in the New York metropolitan area.

The manual air quality monitoring station closest to Paulsboro (and currently in operation) is the Ancora State Hospital station. This station monitors acid deposition at the “urban” scale representative of ten to 100 kilometers from the station, which includes all of Paulsboro. However, this data was unavailable at the time of publication.

Air Quality Index

The Air Quality Index (AQI) is an index for reporting daily air quality. 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)**. 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 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.

Figure 8: Air Quality Index (AQI)

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

Source: NJDEP, 2005

New Jersey is subdivided into nine regions which each report an AQI. Paulsboro is located in Region 8, which includes Camden and Gloucester counties. The monitoring stations for this region are located in Camden, Clarksboro, and Ancora State Hospital. In 2008, the most recent year of annual data, Region 8 reported 208 good (green) and 48 moderate (yellow) days, 15 days which were unhealthy for sensitive groups (orange), and 2 unhealthy (red) days.

Air Quality Monitoring in Paulsboro

In August of 2009, the EPA began implementing an air monitoring program at Paulsboro High School as part of a new federal program aimed at schools at high risk of outdoor air pollution. Paulsboro High School is one of 63 schools in 22 states that were selected to be monitored. The focus was on schools located either near large industries or in urban areas. The program monitors air toxins, or hazardous air pollutants that are known to cause or are suspected of causing cancer and other serious health effects, including respiratory and neurological problems.

At the Paulsboro High School station, the EPA is testing for carbonyls, volatile organic compounds, and toxic metals contained in total suspended particulate (TSP) matter.

These toxics may derive from a variety of sources, including industrial processes and auto-related uses.

A preliminary report on October 29, 2009 by the EPA indicated that there were no short-term health threats from heavy metals pollution. The project is designed to measure possible long-term implications of exposure to air pollution so more conclusive results were not available at the time of publication. Future findings will be available through the Assessing Outdoor Air near Schools initiative of the EPA at: http://www.epa.gov/schoolair/.

In addition, the Paulsboro High School has a monitoring alarm system installed by the neighboring Valero Oil refinery to alert the area of possibly unsafe emissions and leaks. This alarm system was the result of a settlement reached between Valero and NJDEP after a number of violations between 2005 and 2007. These violations included the accidental spraying of oil on hundreds of properties on June 17, 2006, and the release of highly odorous hydrogen sulfide and sulfur oxide gases on February 6, 2007. The alarm system will allow authorities to quickly alert residents about any situations that may require an emergency response such as evacuation or the need to find shelter.

Paulsboro operates a website called “Ready or Not” that serves as a gateway for residents who need help with emergency situations. Besides supplying contact information for local emergency services, hospitals, help lines, and utilities, this website provides education on emergency preparedness. A link for “Ready or Not” is located on both the Paulsboro municipal website and the Paulsboro school system website. Along with Greenwich Township, the borough is in the process of implementing an audible warning / siren system for both natural and man-made emergencies. This system is being funded through a partnership between municipal government and local industry. Although the money is in place, the system has not been installed as of this writing. The warning system is a result of the work of the Gibbstown and Paulsboro Community Alliance Panel (GAPCAP).

CHAPTER 5

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, and 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 hard for an ecosystem to recover or replace species.

The Mantua Creek

Although Paulsboro is a highly developed municipality, it still retains a variety of habitat types. Areas along the Mantua Creek contain different varieties of wetlands ecosystems, and ecosystems within the Mantua Creek and Delaware River contain an abundance of aquatic life. Paulsboro also contains smaller areas of grasslands and upland forest, in addition to an abundance of street trees and residential landscaping that is home to a variety of plant and animal life. The following sections identify and describe in more detail the biological communities within Paulsboro.

Natural Vegetation

A region's vegetation is dependent on many factors, the most important of which are climate and soils. Paulsboro's climate is cool and temperate, with rainfall averaging 54 inches per year in 2008. See the **Climate** section for a detailed description of Paulsboro's

variable climate. Although most soils in Paulsboro are either urban land or dredge spoils, the natural soil types in the borough range from well-drained to poorly-drained, and could support a variety of upland and wetland vegetation. Land in residential areas is mostly built on the well-drained Downer soils, while many areas bordering the Mantua Creek contain poorly-drained hydric soils.

Paulsboro's natural vegetation types, along with human-influenced types of land cover, have been tabulated and mapped by NJDEP's 2007 land cover analysis. This data, based on infrared aerial photography, is the most recent available. The designation of a particular land cover as a vegetation type is based on definitions provided by the Anderson Land Use Classification System, created by the US Geologic Survey. See **Map 16: Natural Vegetation (2007)**. As shown in **Table 24: Natural Vegetation**, almost one-fourth of Paulsboro contains tidal waters containing submerged aquatic vegetation. There are also 139 acres (eight percent) of Paulsboro containing wetlands vegetation of all types, the majority of which are dominated by the invasive species *Phragmites* (the common reed).

Table 24: Natural Vegetation

Vegetation Type	Area (Acres)	% of Borough	% of Natural Vegetation
Beach	1.99	0.12%	0.29%
Brush/Shrubland	23.34	1.39%	3.40%
Brush/Shrubland - Oldfield	17.91	1.07%	2.61%
Tidal Marshes - Freshwater	12.33	0.74%	1.79%
Tidal Waters	400.02	23.87%	58.22%
Upland Forest - Deciduous	10.59	0.63%	1.54%
Upland Forest - Mixed (Deciduous Dominated)	2.97	0.18%	0.43%
Water	2.78	0.17%	0.40%
Wetlands - Coastal (Phragmites Dominated)	50.34	3.00%	7.33%
Wetlands - Herbaceous	5.43	0.32%	0.79%
Wetlands - Modified	5.03	0.30%	0.73%
Wetlands - Phragmites Dominated	31.83	1.90%	4.63%
Wetlands - Scrub/Shrub	18.21	1.09%	2.65%
Wetlands - Wooded - Deciduous	16.25	0.97%	2.37%
Transitional Areas	88.11	5.26%	12.82%
Total Natural Vegetation	**687.12**	**41.01%**	**100%**
Total Area of Paulsboro	**1,675.52**	**100%**	

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 cleaning 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.

Nearly all wetlands in Paulsboro are found in association with Mantua Creek. Wetlands provide high-quality animal and plant habitats, purify the borough's surface and ground waters, and create natural landscapes that add immeasurably to the quality of life for borough residents. 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.

Almost all of Paulsboro's upland forests have been cleared and converted to residential or industrial development. The remaining uplands are relegated to a few remnants along stream corridors, or are patchy woodlands associated with farms and areas with less desirable soils About 13.5 acres (less than one percent) of Paulsboro is composed of upland forests.

There is no comprehensive inventory of tree varieties in Paulsboro. However, the tree composition in the borough is likely one of mixed oaks – white, black, red, chestnut, and scarlet oaks – and may also include beech, pignut and mockernut hickories, black walnut, tulip tree, red maple, and other varieties of trees.

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 three 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.

About 41 acres (two percent) of Paulsboro's land cover consists of brushland, shrubland, or old fields. In Paulsboro, brushland and old fields are generally found adjacent to residential and industrial development, and occurs more often near wetland areas. Trees, such as sassafras, black cherry, red cedar, and white oak are common on old field lands. Meadow onion, broom-sedge, common dogbane, and vines of Japanese honeysuckle (an invasive species) can also be found in grassland habitat.

Grassland near the Mantua Creek

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 categorizes these habitats into one of five groups according to their importance (five being the highest). Categories three through five include habitats throughout the state that possess two exceptional conditions: (1) a documented occurrence of one or more species on either the federal or the state threatened or endangered species lists, and (2) a sufficient amount of habitat type to sustain these species. These habitats are collectively known as "critical habitat." Categories one and two include habitats that either have a documented occurrence of a *species of special concern*[1] in New Jersey, or are deemed suitable for species on the state or federal threatened and endangered species lists, but for which there are no documented occurrences or sightings. These habitats are labeled "suitable habitats." See **Table 25: Landscape Project Habitats**.

Approximately eleven percent (183 acres) of Paulsboro has been identified by the Landscape Project as critical or suitable habitat for threatened or endangered species. It is important to preserve both levels of habitat in order to maintain the diversity of species

[1] A Species of Special Concern is a formal definition; it indicates a species that may be under consideration for listing as threatened due to documented population decline or habitat loss.

that still exists in the borough. The rankings in Paulsboro are primarily the result of habitat being either critical or suitable for rare bird species like the Bald Eagle and Great Blue Heron. See **Map 17: Landscape Project Priority Habitat (2007)**.

Table 25: Landscape Project Habitats

Category	Rank	Area (acres)	% of Total Habitat	% of Borough
Emergent Wetlands	Critical Habitat (4)	34.69	18.95%	2.07%
	Suitable Habitat (2)	52.34	28.60%	3.12%
	Total	**87.03**	**47.55%**	**5.19%**
Forested Wetlands	Critical Habitat (4)	18.93	10.34%	1.13%
	Suitable Habitat (2)	21.92	11.98%	1.31%
	Total	**40.85**	**22.32%**	**2.44%**
Upland Forest	Critical Habitat (4)	33.65	18.39%	2.01%
	Suitable Habitat (2)	19.72	10.77%	1.18%
	Total	**53.37**	**29.16%**	**3.19%**
Beach	Suitable Habitat (1)	1.77	0.97%	0.11%
	Total	**1.77**	**0.97%**	**0.11%**
Total Habitat		**183.02**	**100.00%**	**10.92%**
Total Paulsboro Land		**1,675.52**		**100.00%**

Source: NJDEP, 2007

The Landscape Project divides wetland habitats into two types – forested and emergent wetlands. Emergent wetlands are marshy areas characterized by low-growing shrubs and herbaceous plants in standing water. About 87 acres (five percent) in Paulsboro are identified as critical emergent wetlands habitat, with more than half ranked at the 'suitable' level. Animal species that can be found in these wetland habitats include endangered turtles, salamanders, fish, and insects. Emergent wetlands are also important habitat for migratory waterfowl and passerines (smaller perching birds), such as migrating flycatchers and warblers. Rare and endangered species that utilize emergent wetland habitat found in Paulsboro include the Bald Eagle and the Great Blue Heron.

Forested wetlands cover 41 acres (three percent) in Paulsboro, and much of this is ranked as critical habitat. Forested wetlands are scattered throughout the borough, particularly within the former BP site at the mouth of Mantua Creek, along the Mantua Creek and in the Redevelopment Area near Exit 18 from Rt 295. These areas support species such as migratory and nesting warblers, many of which are species of special concern. They can also be home to various rare amphibians. Paulsboro's wooded wetlands are suitable habitat for the Bald Eagle which is on the New Jersey Threatened and Endangered

Species list, as well as to more common species, such as the Carolina Chickadee and Spotted Turtle.

The Landscape Project ranks 53 acres (23 percent) of Paulsboro's total land cover as suitable or critical upland forest habitat. Over 18 acres (two percent of total land area) are ranked as critical upland habitat. This critical upland forest is found along Mantua Creek and in the former BP site. There are patches of suitable habitat throughout the entire borough.

Additionally, there are about two acres (less than one percent) of Paulsboro that are ranked as suitable beach habitat. Although small in acreage, beach habitat is crucial for many bird species such as plovers, gulls, terns, and sandpipers for feeding and nesting.

Animal Communities

Although no comprehensive inventory of the different animal species within Gloucester County or Paulsboro 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 Paulsboro. These are included in **Appendix C: Vertebrate Animals Known or Probable in Paulsboro**.

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 are smaller than 50 millimeters. 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 long period of time.

There are nine endangered invertebrate species (two beetle species, four butterfly species, and three mussel species) and eight threatened invertebrate species (three

butterfly species and five mussel species) in the State of New Jersey. Of particular interest are freshwater mussels. At one time freshwater mussels were abundant in the streams of the area and were a major food source for native peoples. Unfortunately, due to destruction of suitable aquatic habitats by dams and pollution, the native mussel population has sharply declined. Of those invertebrate species on the New Jersey Endangered and Threatened List, four are federally listed as threatened or endangered: American Burying Beetle, Northeastern Beach Tiger Beetle, Mitchell's Satyr, and the Dwarf Wedgemussel.

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. Birds that nest in the borough have been inventoried by the Audubon Society, but migrants that depend on Paulsboro's wetlands, forests, and coast as stopover sites in which to rest and feed are not as thoroughly inventoried.

Mammals

Mammals appear to be less abundant because they tend to be larger and live in habitats also ideal for human development. There are over 500 mammal species in New Jersey, of which only nine are listed as endangered and none are listed as threatened by the state. Some common mammals found in Gloucester County include the following, most of which have a stable or increasing status in New Jersey according to the New Jersey Department of Environmental Protection: cottontail rabbits, eastern gray squirrels, skunks, brown bats, raccoons, muskrat, opossum, white mice, and white-tailed deer. According to the Natural Heritage Database, there are no rare mammals present in Paulsboro.

Birds

There are between 350 and 500 species of birds in New Jersey, which is an exceptional number given the state's small size. New Jersey is an important location for migratory birds heading south for the winter. Not only is the state an important "rest stop" for birds migrating to warmer climates in Central and South America, but the New Jersey Atlantic Coast and the Delaware Bay are major parts of the Eastern Flyway (established migratory air route) in North America. In addition, many species traveling north in the spring use the Delaware River as a flight path.

There are approximately 64 species of birds likely to be found in the Borough of Paulsboro according to the New Jersey Audubon Society. Common birds in Gloucester County include geese, ducks, vultures, woodpeckers, doves, swallows, crows, grackles, jays, robins, starlings, wrens, cardinals, finches, sparrows, and some hawks. According to the

Landscape Project, Paulsboro contains suitable habitat for two species of rare birds: the Bald Eagle and Great Blue Heron. See **Appendix C: Vertebrate Animals Known or Probable in Paulsboro** for a full list.

A common bird found in Paulsboro is the Canada goose. The State of New Jersey has a "resident" Canada goose population of approximately 100,000 birds that no longer migrate to more southern locales, and that number may double in the next five to 10 years. While geese are an enjoyable component of the urban and suburban environment, providing wildlife opportunities for the public, they can also cause property and environmental damage. Goose droppings that wash into lakes during storm events can elevate coliform bacteria to unhealthy levels, closing lakes to swimming. Goose droppings limit human use of grassy areas in parks, and because geese can be quite aggressive during the nesting season, they can also injure humans.

However, removing geese or preventing them from residing in park areas is a difficult task. Because geese move freely, the most effective management solutions are best conducted at the community level. Canada geese are protected by the Migratory Bird Treaty Act. Therefore, a management program may require the US Department of Agriculture's approval and permits. A new federal rule signed into law in December 2005 eases hunting restrictions and allows county and municipal officials to coordinate with state fish and wildlife departments to destroy birds and/or eggs that pose a threat to public health and safety. Management techniques include planting shrubby vegetation around streams, lakes, and ponds to block waterfowl access, discouraging humans from feeding geese, and removing geese eggs and replacing with decoys.

Reptiles and Amphibians

Reptiles 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. Amphibians in particular 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, although there is no inventory of the herpetological species likely to be found in Paulsboro. Common species include the black racer snake, black rat snake, snapping turtle, box turtle, and painted turtle.

Fish

When European settlers arrived in present-day Gloucester 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 urban development, industrial advancement, overfishing, 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 waterbodies and conducts research and management surveys.

Rudolf G. Arndt, a professor at the Richard Stockton College of New Jersey, created the "Annotated Checklist and Distribution of New Jersey Freshwater Fishes, With Comments and Abundance" (see Sources of Information) by drawing together all the fish inventories for New Jersey, along with his own collection data. According to this study, there are 24 fish species documented in the waterways of Paulsboro, listed in **Appendix C: Vertebrate Animals Known or Probable in Paulsboro**.

The Delaware River and Philadelphia as seen from Paulsboro

CHAPTER 6

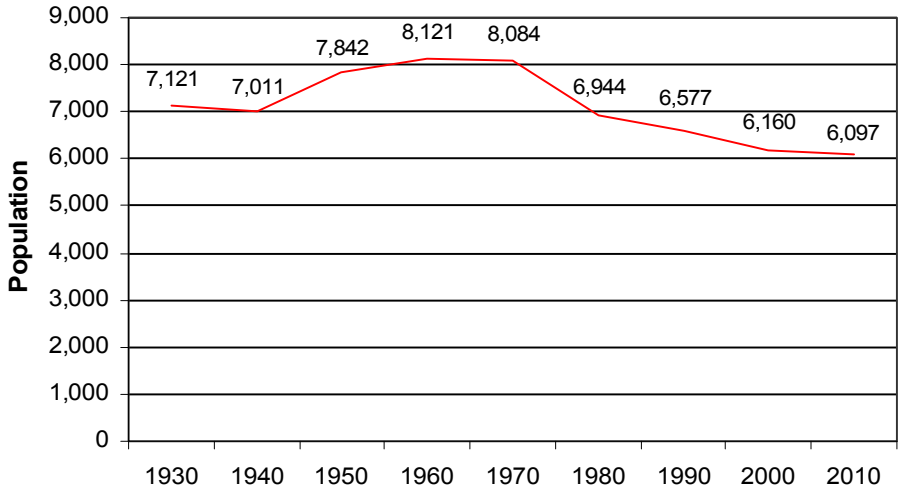
The Built Environment

Population and Housing

The population of Paulsboro has decreased since the 1960s, as illustrated in **Figure 9**. Paulsboro lost the greatest number of people during the 1970s, when the population declined from 8,084 in 1970 to 6,944 in 1980. The population of Paulsboro in 2010 was 6,097. This one percent loss from 2000 was the smallest population decrease in the borough since 1970.

In 2010, about 28 percent of the population was under 18 years, slightly higher than the Gloucester County average of 23 percent and the state and national averages of 24 percent. This indicates a greater demand on Paulsboro's school facilities as well as for public active recreational facilities.

Figure 9: The Population of Paulsboro, 1930 – 2010



Source: US Census Bureau, 1930–2010

Paulsboro's population is ethnically diverse, as shown in **Table 26: Population by Race**. While the population as a whole declined slightly between 2000 and 2010, the Hispanic or Latino population nearly doubled in size in these years.

Table 26: Population by Race

Race	Population	Percent
White	3,098	50.8%
Black or African American	2,125	34.9%
Hispanic or Latino*	542	8.9%
Two or More Races	260	4.3%
Asian	43	0.7%
American Indian and Alaska Native	12	0.2%
Some Other Race	14	0.2%
Native Hawaiian and Other Pacific Islander	3	0.0%
Total	**6,097**	**100.0%**

*Hispanic or Latino population is of any race. All other population numbers refer to those not identifying as Hispanic or Latino.

Source: US Census Bureau, 2010

Transportation

Paulsboro contains an exit for Interstate 295, which connects the borough to the wider metropolitan region. Interstate 295 provides high speed access from Delaware to central New Jersey while bypassing Philadelphia. The highway was designated in 1958, and work was completed on the southern stretch by 1968. Interstate 295 runs roughly parallel to the New Jersey Turnpike for most of its course. Paulsboro is located between Exits 2 and 3 of the New Jersey Turnpike.

Other roads connecting Paulsboro to the larger region include County Routes 667 (Delaware Street), 678 (Berkley Road), and 653 (Billingsport Road) and State Route 44 (Broad Street).

More than five percent of employees in Paulsboro walk to work, much higher than the county average of two percent. About 87 percent of employees drive to work, less than the county average of 92 percent. Many Paulsboro employees work close to home, as the average commuting-to-work time for Paulsboro residents is 19 minutes, compared to 28 minutes in Gloucester County as a whole.

New Jersey Transit operates two bus lines with connections in Paulsboro. The Philadelphia 402 bus provides access between Philadelphia and Pennsville, while the Local 455 bus connects Paulsboro to Cherry Hill. Transportation for senior citizens, people with disabilities, veterans, and low-income residents of Gloucester County is provided by the Division of Transportation Services (DTS) through advance reservations.

The Pureland Shuttle is a reservation-only, free service operated by the South Jersey Transportation Authority and partially funded by the Gloucester County Board of Chosen Freeholders. The free shuttle bus provides service between Camden, Westville, Woodbury, Paulsboro, Gibbstown, Greenwich, and Pureland Industrial Park.

Paulsboro municipality operates a free shuttle to ShopRite in Gibbstown and the town of Woodbury for its residents on Tuesdays. On Wednesdays, the shuttle connects Paulsboro to area malls; Moorestown Mall, Cherry Hill Mall, Voorhees Center, and Deptford Mall on the first, second, third and fourth Wednesday of each month respectively. Since Paulsboro does not have a supermarket or major shopping center, these are valuable transportation options for area residents.

According to the Greater Philadelphia Regional Bicycle Map, generated by the Bicycle Coalition of Greater Philadelphia, Paulsboro has four roads rated for bicycle routes. Three are rated as “Average” – Billingsport Rd, Berkley Rd and Broad Street (State Route 44) – and one is ranked as “Below Average”: Delaware Street (County Route 667).

Historic Resources

Paulsboro has two sites on the New Jersey Register of Historic Places. Fort Billings Park was added to the State Register in 1974. The Tinicum Island Range Rear Light was added to both the State and National Registers in 2005.

There are three additional sites that have been issued State Office of Historic Preservation Opinions, which makes them eligible for inclusion on the State and National Registers. However, one of these – the First National Bank and Trust Company Building – was demolished in February 1996. The other two sites are the former Municipal Building on Broad Street, now used by the Paulsboro Senior Citizens Club, and the State Route 44 Mantua Creek Bridge. **Table 27: Historic Sites** lists these and other historic sites in Paulsboro. See also **Map 18: Historic Resources**.

Fort Billings Park honors the site of an early US fort on the Delaware River, discussed in the **Brief History** section. The land for the fort was purchased by the Continental Congress on July 5, 1776, and was the first land purchase made by the newly-formed United States. The 96-acre site was purchased for 600 £ from the Paul family. Tadeusz Kościuszko designed the fortifications at the request of George Washington, and construction of the fort was completed on August 1, 1777. Billingsport, the tenth alarm

post on the Delaware, was equipped with a small cannon which warned other posts of the arrival of enemy ships. The fort was briefly occupied by the British, but it was evacuated in 1777. The fort was again occupied for more than three months by American troops in the War of 1812. After peace was declared, the fort was deserted and largely forgotten. The site is currently a park, and a marker indicates the significance of the location for the history of the nation.

The **Tinicum Island Range Rear Light** was built in 1880 to guide ships along the Delaware River from the Ship John Shoal Lighthouse off the coast of Cumberland County to League Island in Philadelphia. The Tinicum Rear Range Lighthouse was somewhat unique as its front light was co-located with the front light of the Fort Mifflin Bar Cut Range. These two sets of range lights marked the reach passing Tinicum Island and the channel dredged across Fort Mifflin Bar, but faced in opposite directions with Tinicum Range serving upriver traffic and Fort Mifflin Range serving downriver traffic.

The Tinicum Island Range Rear Light

The steel lighthouse structure stands 85 feet tall and contains a cylindrical tube house with a spiral staircase leading from the neoclassical iron pavilion at the base of the tower to the watch room. The supports for the tower are arranged in a hexagonal pattern surrounding the central column, and the entire structure is supported by stone piers sunk four-and-a-half feet into the ground.

The **First National Bank and Trust Company Building** was founded on May 25, 1901. At the time, capitol stock was fixed at $30,000. Benjamin Paul, of the Paul family for which Paulsboro was named, was the first President of the bank. The bank was later acquired by National Bank and Trust Company of Gloucester County. The building received SHPO designation in 1995, but was demolished in 1996.

The former **Municipal Building** was built around 1910 and was the second home of the First National Bank. It was used as a bank until a new bank building was built in 1929. Sometime after that it became Borough Hall and was used as the municipal building until the present one was constructed in 1976. It is currently used as the home of the Paulsboro Senior Citizens Club.

NJ Route 44 Mantua Creek Bridge

The **NJ Route 44 Mantua Creek Bridge** is a vertical lift bridge built in 1935. When open, it has a vertical clearance of 64 feet above mean high water; its closed position is just five feet above mean high water. From the 1920s to the 1960s, Mantua Creek was a major waterway route for commercial vessel traffic servicing refineries and factories along the waterfront in Paulsboro, NJ. The bridge was staffed by a bridge tender that opened the bridge on demand during daylight hours, and with several hours notice overnight. Currently, the bridge is not staffed, and openings are possible only by advance request.

Buildings of Local Historical Significance

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 the State Historic Preservation Office (SHPO) for such a designation. At the intersection of Broad Street and Commerce Street are two buildings – Gill Memorial Library and the Paul House – with great importance to the history of Paulsboro.

Paulsboro's **Gill Memorial Library** is housed in a building by the architect John Clark dating from 1806 and serves as the borough's free public library. The building also contains historical records documenting Paulsboro's past. Gill Memorial Library started a museum in 1963 with memorabilia of Paulsboro. The museum is a collection of items related to the history and people of Paulsboro, including genealogy, maps, tax records, and memorabilia.

Dating from the 1700s, the **Paul House** is the oldest building in Paulsboro. It is named for the Paul family who settled Paulsboro in 1685. The east gable of the Paul House is from 1810, but the rear section is from a much earlier date. The Borough is in the process of purchasing this building and hopes to turn it into a historical society museum.

New Jersey municipalities are permitted to identify, designate, and regulate their own historic resources through the adoption of historic preservation ordinances (which are recognized as zoning laws under the New Jersey Municipal Land Use Law). In addition, a municipality can obtain technical assistance and federal and state funding for community-based preservation activities if it becomes a Certified Local Government (CLG). This program is jointly administered by the National Park Service and SHPO. To participate, a municipality must maintain a historic preservation commission, survey local historic properties, provide opportunities for public participation in preservation activities, and

develop and enforce local preservation laws. To date, the only CLG municipality in Gloucester County is Harrison Township.

There are also federal incentives for individuals, organizations, or firms who own historic properties and are interested in historic preservation. Interested parties can take advantage of the Rehabilitation Investment Tax Credit, a federal tax incentive to encourage the preservation and reuse of older income-producing properties, including offices, apartment buildings, and retail stores.

Investing in historic preservation efforts can provide a municipality with important and impressive returns. Private and public efforts to preserve and rehabilitate historic districts create attractive places to live, work, and play and stimulate new investment in older residential and commercial centers. An historic district can become a regional draw for tourists. Furthermore, historic preservation maintains a municipality's character, distinctly separating it from other industrial and suburban communities for both new and established residents.

The Paul House

Table 27: Historic Sites

Name	Location	State ID#	Register
Sites Listed on State and National Registers of Historic Places			
Fort Billings (Fort Billings Park)	Fort Billings Park, Clonmell Road	1410	SR: 11/4/1974
Tinicum Island Range Rear Light	2nd Street and Mantua Avenue	I208	SHPO Opinion: 11/16/1999 (Previous SHPO Opinion 7/28/99)
			SR: 7/12/2005
			NR: 9/15/2005
Sites Eligible for State Registers of Historic Places			
First National Bank and Trust Company Building	1 E. Broad Street	2848	SHPO Opinion: 8/11/1995 (Demolished, February 1996)
Municipal Building	24 E. Broad Street	2596	SHPO Opinion: 11/16/1999
NJ Route 44 Mantua Creek Bridge	NJ Route 44 over Mantua Creek	4888	SHPO Opinion: 12/18/2003
Sites of Local Historical Significance			
Gill Memorial House	145 East Broad Street		
Paul House	212 East Broad Street		

Source: NJ State Historic Preservation Office, 2009

Borough Utilities and Services

Drinking Water

Drinking water in Paulsboro is provided by the Paulsboro Water Department (Public Water Supply ID 0814001), which operates three water supply wells in the borough. See **Table 16: Public Water Supply Wells** for a list of the wells, which are shown on **Map 14: Public Water Supply Wells**. All three wells tap the Potomac-Raritan-Magothy (PRM) aquifer, discussed in the **Aquifers** section. The wells vary in depth from 178 to 220 feet below the surface.

According to the EPA, the Paulsboro Water Department serves approximately 6,200 people. Within the past 10 years, there have been no health based violations for the Department as reported to the state. A health based violation is one in which a contaminant exceeded the safety standard, or in which water was not treated properly. In 2007, the Paulsboro Water Department received three violations for failure to regularly monitor three contaminants: monochlorobenzene (chlorobenzene), carbon tetrachloride, and p-dichlorobenzene. In previous years, the Department received other violations for failure to adequately test for a number of other contaminants including benzene, vinyl chloride, xylenes, toluene, styrene, and other chemicals related to industrial processes.

Between 2004 and 2006, testing done by the Paulsboro Water Department system and reported to the NJDEP revealed 16 contaminants in the water system in concentrations that exceeded health guidelines, shown in **Table 28: Contaminants Exceeding Health Guidelines in Paulsboro Water Department System**. These health guidelines are based on the Maximum Contaminant Level Goal (MCLG) for each contaminant. The MCLG is a level established by state and federal agencies that poses no significant health risk. MCLGs allow for a margin of safety and are non-enforceable public health goals. Many of these contaminants are the byproducts of industrial processes, including benzene and disinfection byproducts. The radioactive substances radium and uranium found in the drinking water supply occur naturally in groundwater and geologic formations. Although all these contaminants exceeded health guidelines, none exceeded legal limits. Legal limits are based on the Maximum Contaminant Level (MCL), which is the highest level of a contaminant that is allowed in drinking water. MCLs are enforceable standards and are set as close to MCLGs as feasible. Another nine contaminants were found in the Paulsboro Water Department system, but these did not exceed health guidelines: chloroform, naphthalene, alpha particle activity (including radon & uranium), methyl tert-butyl ether (MTBE), cis-1,2-dichloroethylene, dibromoacetic acid, barium, copper, and selenium.

As discussed in the **Wellhead Protection Areas** section and shown on **Map 14: Public Water Supply Wells**, petroleum industry areas in Paulsboro and Greenwich Township are located within the wellhead protection areas of the three public water supply wells of the Paulsboro Water Department. Therefore, pollutants seeping into the groundwater at these industrial facilities have the potential to reach the Borough's water supply wells within twelve years. Vigilant monitoring and assessment of drinking water resources is essential to protect the public health of Paulsboro.

Table 28: Contaminants Exceeding Health Guidelines in Paulsboro Water Department System

Contaminant	Average Result Obtained	Maximum Result Obtained	Health Guideline (MCLG)*	Legal Limit (MCL)**	Description
Bromodichloromethane	0.72 ppb	2 ppb	0 ppb	80 ppb	Bromodichloromethane is a disinfection byproduct from the trihalomethane (THM) family, and is formed when chlorine, chloramines or other disinfectants react with organic and inorganic matter in water.
Dibromochloromethane	1.69 ppb	7.11 ppb	0.4 ppb	80 ppb	Dibromochloromethane is a disinfection byproduct from the trihalomethane (THM) family, and is formed when chlorine, chloramines or other disinfectants react with organic and inorganic matter in water.
1,2-Dichloroethane	0.27 ppb	0.54 ppb	0 ppb	5 ppb	1,2-Dichloroethane is a chemical used in the production of vinyl chloride; it is released as a pollutant from industrial chemical factories.
Bromoform	3.24 ppb	14.17 ppb	0 ppb	80 ppb	Bromoform is a disinfection byproduct from the trihalomethane (THM) family, and is formed when chlorine, chloramines or other disinfectants react with organic and inorganic matter in water.
1,2-Dichloropropane	0.13 ppb	0.36 ppb	0 ppb	5 ppb	1,2-Dichloropropane is used as a solvent and intermediate in the production of dry cleaning agent perchloroethylene; it is released as a pollutant from chemical factories, landfills, and from agricultural soil due to former use as a fumigant.
Trichloroethylene	0.2 ppb	0.73 ppb	0 ppb	5 ppb	Trichloroethylene is used to remove grease from fabricated metal parts and in the production of some textiles; this pollutant comes from metal degreasing sites, metal finishing and rubber processing industries.
Combined Radium (-226 & -228)	1.83 pCi/L	2.71 pCi/L	0 pCi/L	5 pCi/L	Radium is a radioactive element usually found around uranium deposits.
Combined Uranium (mg/L)	7.82 ppb	11.67 ppb	0 ppb	30 ppb	Uranium is a radioactive element commonly found in most rocks; processed uranium ore is used for power generation and weapons manufacture.
Alpha particle activity (excl radon and uranium)	4.79 pCi/L	7.1 pCi/L	0 pCi/L	15 pCi/L	Alpha particles are a form of radiation associated with radioactive mining waste pollutants and natural sources.

Contaminant	Average Result Obtained	Maximum Result Obtained	Health Guideline (MCLG)*	Legal Limit (MCL)**	Description
Radium-228	0.95 pCi/L	1.57 pCi/L	0 pCi/L	5 pCi/L	Radium-228 is a radioactive element usually found around uranium deposits.
Benzene	0.09 ppb	0.36 ppb	0 ppb	5 ppb	Benzene is a petroleum chemical that contaminates drinking water due to emissions from petroleum and chemical industries, leaching landfills, gas storage tanks (industrial, commercial, or residential), and gas terminals.
Radium-226	0.88 pCi/L	1.52 pCi/L	0 pCi/L	5 pCi/L	Radium-226 is a radioactive element usually found around uranium deposits.
Total trihalomethanes (TTHMs)	5.97 ppb	23.82 ppb	9.8 ppb	80 ppb	Total trihalomethanes constitute the sum of four disinfection byproducts: chloroform, bromodichloromethane, dibromochloromethane, and bromoform.
Total haloacetic acids (HAAs)	1.67 ppb	3.33 ppb	0.7 ppb	60 ppb	Total haloacetic acids refers to the sum of the concentrations of five related disinfection byproducts in a water sample: dichloroacetic acid, trichloroacetic acid, monochloroacetic acid, monobromoacetic acid and dibromoacetic acid.
Lead (total)	2.51 ppb	4.6 ppb	0 ppb	15 ppb	Lead is a metal that enters water by corrosion of household plumbing systems, discharge of industrial pollution and erosion of natural deposits.
Arsenic (total)	0.67 ppb	0.67 ppb	0 ppb	10 ppb	Arsenic contaminates drinking water due to mining runoff, erosion of natural deposits, emissions from glass and electronics processing and the use of arsenical compounds as wood preservatives and pesticides.

**Health Guideline based on the Maximum Contaminant Limit Goal (MCLG), a non-enforceable health goal that is set at a level at which no known or anticipated adverse effect on the health of persons occurs and which allows an adequate margin of safety.*

***Legal Limit based on Maximum Contaminant Level (MCL), an enforceable standard that is set at the highest level of a contaminant that is allowed in drinking water.*

Source: Paulsboro Water Department, NJDEP, 2004-2006

Sewer Service

Sewer service in Paulsboro is facilitated by the Gloucester County Utilities Authority (GCUA), a regional wastewater collection and treatment system located in West Deptford Township. The service area of the GCUA in Paulsboro is shown in **Map 19: Approved Sewer Service Area and NJPDES Permits**. The GCUA treats over 6.3 billion gallons of wastewater annually from residential, commercial, and industrial uses in 16 of the county's 24 municipalities. The local collection piping and machinery is provided by the individual municipalities and connected to the GCUA conveyance system at designated locations throughout the county. The GCUA wastewater treatment facility provides primary and secondary treatment through a biological process which removes more than 95 percent of the pollutants. The treated matter is then discharged through a 72-inch diameter pipeline to the Delaware River. The byproduct of treatment, known as biosolids or sludge, is then incinerated on-site by one of GCUA's two existing incinerators.

Trash and Recycling

The Borough of Paulsboro provides weekly curbside trash and recycling pick up service in the municipality by contracting with a private company for waste. The Public Works Department is responsible for management and pick up of recycling. Trash is collected on Mondays and includes pickup of household waste, furniture, tree trimmings, minor home repair debris, leaves and yard trimmings. "White goods" (household appliances), CFC products, and other metals are picked up the first Friday of each month. Curbside recycling is picked up on Tuesdays and Thursdays and includes paper, cardboard, metal, plastic and glass products. Recycling can be commingled into one container for easier pickup and compliance. Gloucester County coordinates household special waste collection days at the Gloucester County Solid Waste Complex on Swedesboro-Monroeville Road (Rt. 694) in South Harrison Township for the collection of paint (latex and oil-based), motor oil, antifreeze, fluorescent tubes and ballasts, lead acid and Ni-Cad batteries.

Education

The Paulsboro School District educates about 1,400 students from pre-Kindergarten through twelfth grade at its three public schools: Billingsport Elementary School, Loudenslager School, and Paulsboro High School. Students in grades 9–12 from neighboring Greenwich Township attend Paulsboro High School as part of a sending/receiving relationship. Afterschool care is provided by NJ After3 Program for Billingsport Elementary School. Billingsport provides school bus service for pre-school, kindergarten, first and second graders in the morning and afternoon. Loudenslager School has an Active Learning Center providing after school activities and programs, which is

sponsored through a 21st Century Community Learning Grant Program from the federal government.

Additionally, Guardian Angels Regional School, a Catholic school, opened a facility in Paulsboro in September of 2007 for grades four through eight. The school is located at the site of the former St. John Regional School, also a Catholic school. The Guardian Angels Regional School is run by the Franciscan Missionary Sisters of the Infant Jesus, based in Greenwich Township, and follows the curriculum guidelines of the Camden Diocese, based on the New Jersey Curriculum Standards.

Parks and Recreation

Paulsboro has several active and passive recreation locations throughout and adjacent to the borough. Fort Billings Park, located at Delaware Street and Clonmell Road at the site of the original Fort Billings, provides Delaware River access, a playground, picnic area, restroom facilities and parking. Veterans Park is located at the intersection of North Delaware Street and Billings Avenue. Another small park is located at the water tower on Lincoln Avenue near North Delaware Street. There is a playground located at the intersection of Summit Avenue and Elizabeth Avenue, and another on West Buck Street.

Fort Billings Park

Most active recreation facilities in Paulsboro are connected to Paulsboro's school system. Billingsport Elementary School has a playground, blacktop with basketball hoops, and athletic fields. The area surrounding the Tinicum Rear Range Light House on Mantua Avenue and 2nd Street contains a sports complex consisting of a football field and three baseball diamonds, which are home to the Paulsboro Little League. The Baird Avenue Recreation Area is located on leased land adjacent to Loudenslager School and was funded through the Green Acres program of the NJDEP. The Baird Avenue Recreation Area consists of three tennis/basketball courts and a baseball field. In addition, there are six tennis courts, a football field, a track, and four baseball fields next to Paulsboro High School, although physically located in neighboring Greenwich Township. There is a soccer complex at the intersection of Ferry Road,

Riverview Avenue, and Billingsport Road that has four fields, a refreshment stand, and parking. In total, there are nearly 20 acres of recreational land in Paulsboro. See **Map 20: Existing Open Space.**

Recreational organizations in Paulsboro include Paulsboro Little League, Paulsboro Midget Football, Paulsboro Youth Soccer Association, Paulsboro Midget Wrestling Association, Boy Scouts, Cub Scouts, and the Paulsboro Sportsmen's Association. The Borough currently has no comprehensive municipal organization for parks and recreation. The former Recreation Commission, later the Recreation Committee, was dissolved.

New Jersey State Plan

The New Jersey State Development and Redevelopment Plan (the State Plan) is a policy guide to be used by state, regional, and local agencies to increase the consistency of planning efforts. The State Plan provides a vision for the comprehensive development of the state. Municipal, county, and regional plans will be reviewed by the State Planning Commission to evaluate consistency with the State Plan.

The SDRP delineates a number of Planning Areas, each with its own goals, objectives, policies, and strategies. The Planning Area descriptions reflect varying levels of development, infrastructure capacity, and presence of natural resources. The entirety of Paulsboro has been designated as a Metropolitan Planning Area PA-1, a growth area which includes large urban centers and postwar suburbs that are fully or almost fully developed. Further development in PA-1 is expected to be dominated by an intensification of land uses through redevelopment and reuse.

In addition to planning areas, the State Plan designates five levels of Centers where growth should be concentrated, in order of descending size and intensity of use: Urban Centers, Regional Centers, Towns, Villages, and Hamlets. Paulsboro is not currently a State-designated or proposed Center. However, the plan includes guidelines and objectives which have been incorporated into the Paulsboro Master Plan Re-Examination in 2006.

These policy objectives are: (1) using land use controls focusing on development and redevelopment where efficient use of public facilities and services can be achieved; (2) preserving housing stock and providing a range of housing choices, (3) encouraging infill developments, assembly of parcels into efficiently developed sites, and the creation of public/private partnerships, (4) capitalizing on high-density settlement patterns to encourage the use of public and non-auto transportation, (5) reclaiming environmentally damaged sites (brownfields) and preventing future damage, with particular emphasis on retaining wildlife habitat, air quality, open space, and recreational opportunities, (6) maximizing recreational opportunities by enhancing existing parks and facilities and creating new sites; (7) integrating historic preservation into redevelopment efforts; (8)

eliminating deficiencies in public facilities and expanding them where necessary to accommodate future growth and redevelopment; and (9) regionalizing and coordinating as many public services as feasible and economical, encouraging private-sector investment, and public/private partnerships.

See **Map 21: State Planning Areas** for a depiction of the State Plan planning areas and centers in Paulsboro.

CHAPTER 7

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 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 as Superfund sites, which make them 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. A responsible party may be the owner of the property or a group of companies that used the site. This party is responsible for carrying out the cleanup under NJDEP Supervision, and for paying for the cleanup.

There are 21 active Known Contaminated Sites within or bordering Paulsboro as of June 2010. These are listed in **Table 29: Active Known Contaminated Sites**. Additionally, there are two Pending Sites and 22 Closed Sites in the borough. 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. See **Table 29: Pending Known Contaminated Sites** and **Appendix D: Closed Known Contaminated Sites in Paulsboro**. Some sites in this table have more than one remedial level due to multiple cases. Non-residential sites, as of 2009, are shown on **Map 22: Known Contaminated Sites (2009)**. Exact addresses of private homes have been removed to protect resident privacy.

Of the eight hazardous waste sites in Gloucester County currently on the National Priority List (NPL), none are located in Paulsboro. Commonly referred to as Superfund sites, such sites pose a major human health hazard and are in need of federal funds for cleanup. Although not listed on the NPL, there are five sites in Paulsboro that have a D level of remediation and two sites with a C3 level, both levels which constitute highly complex and threatening sites. D level sites are usually designated as Superfund sites.

Table 29: Active Known Contaminated Sites

Site ID	PI Number	Name	Address	Home Owner	Bureau	Remedial Level	Status Date
14378	30057	Air Products & Chemicals, Inc	675 Billingsport Rd	No	BOMM	C2	9/19/1999
14378	7138	Air Products & Chemicals, Inc	675 Billingsport Rd	No	BOMM	C1	3/17/1999
7854	26227	Bennes Tire & Auto Inc	526 W Broad St	No	BUST	C2	4/20/1999
65988	G000033315	Billingsport Road Bridge	Billingsport Rd	No	BFO-S	C2	1/6/1998
14643	4975	BP Oil Inc Paulsboro Terminal	303 Mantua Ave	No	BCM	D	2/3/1998
63764	G000004377	Citerco Asphalt Products	4 Paradise Rd	No	BISR	C3	4/15/1991
91707	133800	Dana Container Inc	51 Crown Point Rd	No	BFO-S	C1	10/19/2001
340080	420431	East Broad Street	E Broad St	No	BUST	C1	3/18/2008
120747	158843	East Broad Street	E Broad St	Yes	OBR	U	6/12/2002
45934	5438	Essex Chemical Corporation	100 Thomas Ln	No	OBR	C2	8/6/2008
63678	G000002406	Exxon Company USA	3rd St & Billingsport Rd	No	BISR	D	4/30/1990
15892	207508	ExxonMobil Oil Corp Paulsboro Terminal	7 N Delaware St	No	BCM	B	8/2/2003
7867	3771	Lukoil #57345	642 Broad St	No	BUST	C2	11/5/1997
14544	G000038461	Mobil Lube Plant Division of Mobil Corp	1001 Billingsport Rd	No	BFO-S	C2	5/13/2002
63955	G000006007	Paulsboro Coal Gas (PSE&G)	Jefferson St	No	BCM	D	10/2/2000
7856	30676	Paulsboro Packaging Inc	301 Mantua Ave	No	BISR	D	10/21/1993
7864	3272	Paulsboro Travel Centers	I-295 & Mt Royal Exit 18A	No	BUST	C2	8/14/2003
7857	16174	Paulsboro Valero Gas Station	1803 S Delaware St	No	BUST	C2	12/17/2004
40626	G000003458	Peabody Clean Industry Incorporated	85 Riverview Ave	No	BCM	C3	12/3/1997
57705	33269	St Johns School	712 Mantua Ave	No	INS	B	1/10/2006
15893	9238	Valero Refining Company New Jersey	800 Billingsport Rd	No	BCM	D	10/12/2006

Source: NJDEP, June 2010

Table 30: Pending Known Contaminated Sites

Site ID	PI Number	Name	Address	Home Owner	Bureau*	Remedial Level**	Status Date
7868	016913	Sun Paulsboro Term 0000-2154	825 Clonmell Rd	No	BFO-S	C2	10/15/1993
65245	G000028067	P & D Auto Restoration Incorporated	408 416 Broad St	No	BFO-S	C1	1/8/1998

Source: NJDEP, July 2010

Explanation of Codes:

*Bureau	Contact Agencies
BOMM	Bureau of Operation, Maintenance and Monitoring
BFO-S	Bureau of Field Operations – Southern Office
BCM / BUST	Bureau of Case Management (formerly BUST – Bureau of Underground Storage Tanks)
BDC	Bureau of Design and Construction
BISR	Bureau of Industrial Site Remediation
INS	Initial Notice Section
OBR	Office of Brownfield Redevelopment

**Remedial Level	Explanation of Site Complexity
B	A single-phase remedial action in emergency response; simple removal activities of contaminants; usually no impact to soil or groundwater.
C1	A remedial action with simple sites; one or two contaminants localized to soil and the immediate spill or discharge area.
C2	A remedial action with more complicated contaminant discharges; multiple site spills and discharges; more than one contaminant, with both soil and groundwater impacted or threatened.
C3	A multiphase remedial action with high complexity and threatening sites. Multiple contaminants, some at high concentrations with unknown sources continuing to impact soils, groundwater, and possibly surface waters and potable water resources. Dangerous for direct contact with contaminated soils.
D	Same conditions as C3 except that D levels are also usually designated federal “Superfund Sites.”
U	Not yet determined

Underground Storage Tanks

There are 43 regulated underground storage tank facilities containing hazardous substances located within or bordering Paulsboro, listed in **Table 31: Regulated Underground Storage Tank Facilities**. If there is a known release to soil and/or groundwater, a site will also be listed on **Table 29: Active Known Contaminated Sites**. These sites include industrial sites, gas stations, institutional buildings, and private residences. Many sites may include multiple tanks on the property. Tanks have been removed from those facilities with a Terminated status.

There may be additional private residences in Paulsboro that still have underground storage tanks, used primarily to hold home heating oil, which are unknown and unlisted. 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.

Table 31: Regulated Underground Storage Tank Facilities

PI Number	Name	Street Address	Status	Expiration Date
420431	200 East Broad Street	200 E Broad St	Terminated	
287117	400 West Broad Street	400 Broad St W	Terminated	
024423	6 Well	Lodge Ave	Terminated	12/31/1997
030057	Air Products & Chemicals Inc	675 Billingsport Rd	Terminated	12/31/2001
007138	Air Products & Chemicals Inc	675 Billingsport Rd	Terminated	11/16/2000
030647	Al's Bump & Grind	432 W Broad St	Terminated	12/31/1997
026227	Bennes Tire & Auto Inc	526 West Broad St	Effective	12/31/2012
026780	Billingsport School	5th & Greenwich Ave	Terminated	12/31/1997
020377	BP Oil Company Paulsboro Terminal	303 Mantua Ave	Terminated	12/31/1997
004975	BP Oil Inc Paulsboro Terminal	303 Mantua Ave	Terminated	12/31/2003
022700	BP Oil Pipeline Co	Thomas Ln	Expired	12/31/2003
508044	Burts Liquors	108 Broad St E	Terminated	
003468	Consumers Oil Ser Inc Office	541 Mantua Ave	Terminated	12/31/2001
005438	Essex Chemical Corporation	100 Thomas Ln	Terminated	11/16/2000
015009	Essex Industrial Chemical Co Inc	100 Thomas Ln	Terminated	11/16/2000
008367	Exxon Store 3-5547	Berkley Rd	Terminated	11/16/2000
026752	Loudenslager School	Swedesdoro & Baird Ave	Terminated	12/31/1997

PI Number	Name	Street Address	Status	Expiration Date
003771	Lukoil #57345	642 Broad St W	Effective	12/31/2012
000852	Mobil Oil Corp	800 Billingsport Rd	Terminated	11/16/2000
031345	Mobil Oil Corp - Paulsboro	Olive St	Terminated	12/31/1997
000581	Mobil Paulsboro Refinery	800 Billingsport Rd	Terminated	11/16/2000
010983	Municipal Garage	Baird Ave	Terminated	12/31/1997
007512	NJ Bell Telephone	S/E Corner Broad & Paul Sts	Terminated	11/16/2000
001047	Pacific Atlantic Terminal Paulsboro Fac.	3rd St & Billingsport Rd	Terminated	12/31/1997
022602	Pat Richards	1802 Delaware St	Terminated	11/16/2000
020864	Pat Richards Building	1802 Delaware St	Terminated	12/31/2003
010982	Paulsboro Administration Bldg	1211 Delaware St N	Terminated	12/31/1997
010781	Paulsboro Bd Of Ed	662 Delaware St N	Terminated	12/31/1997
156886	Paulsboro Bridgehouse	Rt 44	Terminated	
026751	Paulsboro High School	662 Delaware St N	Terminated	12/31/1997
030676	Paulsboro Packaging Inc	Universal Rd	Terminated	11/16/2000
023581	Paulsboro Pump Station	Adams St	Terminated	11/16/2000
031148	Paulsboro Service Station	I-295 & Berkley Rd	Effective	12/31/2012
003272	Paulsboro Travel Centers	I Rt 295 & Exit 18 Berkley Rd	Effective	12/31/2012
016174	Paulsboro Valero	1803 S Delaware St	Effective	12/31/2012
016174	Paulsboro Valero	1803 S Delaware St	Terminated	12/31/2001
030654	Rich's Garage	Broad & Commerce Sts	Terminated	1/31/1996
033105	Service Station (Former)	653 W Broad St	Terminated	12/31/2001
033269	St Johns School	712 Mantua Ave	Terminated	12/31/2001
016913	Sun Paulsboro Term 0000-2154	825 Clonmell Rd	Terminated	11/16/2000
022492	Timberlane Welding & Service Inc	1626 Commerce St S	Terminated	11/16/2000
009238	Valero Refining Company New Jersey	800 Billingsport Rd	Terminated	11/16/2000
024256	West End Auto Detailing/Sales	501 N Broad St	Terminated	12/31/2003

Source: NJDEP, 2010

Radon

Radon is a radioactive gas that comes from the natural decay of uranium found in nearly all soils. It is invisible, odorless, and tasteless. It moves up through the ground to the air above and into all types of homes through cracks and other holes in foundations. A build-up of radon-contaminated air within a home can pose a long-term health hazard to residents, specifically for lung cancer. The only method of detection is to conduct a test of the air within a home. Fortunately, radon testing is inexpensive.

NJDEP classifies municipalities into three categories as to the risk of having high radon levels. Paulsboro is listed as a Tier 3 municipality, indicating a low risk of high radon levels in homes. The radon concentration at which homeowners should take immediate action is 4.0 picocuries per liter in air. While state law does not require radon testing before a real estate transaction, NJDEP recommends that a contingency clause be included in a sales contract allowing the buyer to have the home tested for radon and address the problem before closing if an elevated level of radon gas is discovered. State law (N.J.A.C. 26:2D-73) does require, at the time of a real estate transaction, that the seller provide the buyer with a copy of the results of any radon testing if such testing was conducted during tenure.

If radon levels are high in a home, NJDEP suggests that the homeowner take the following actions: (1) prevent radon from entering the house by repairing cracks and insulation; and (2) dilute radon concentrations currently in the house. The latter can be done with an inexpensive pipe-and-fan system that draws radon out from under the foundation and vents it outside.

Pipelines

Several major petroleum distribution pipelines cross Paulsboro's territory, transporting refined materials from the Valero refinery and ExxonMobil station located within the borough. These pipelines were acquired in 2005 by Buckeye Partners from ExxonMobil and Valero, and continue to serve as crucial shipping infrastructure for these corporations. The Paulsboro-to-Malvern System, consisting of approximately 23.7 miles of 12-inch diameter pipe, extends under

Petroleum Storage by Fort Billings Park

the Delaware River from ExxonMobil's Paulsboro Station to ExxonMobil's Malvern Station and to storage tanks in Chester County, Pennsylvania. The Paulsboro to Philadelphia Airport jet fuel system consists of 2.6 miles of eight-inch diameter pipe extending under the Delaware River from ExxonMobil's Paulsboro Station to the Philadelphia Airport. Valero's Paulsboro to Colonial System consists of 0.4 miles of twelve-inch diameter pipe extending from the Valero Paulsboro Refinery to Colonial Pipeline Junction in Gloucester County. See **Figure 11** below for a map of pipelines in and near Paulsboro.

Figure 10: Map of Pipelines in Paulsboro

Source: Pipeline and Hazardous Materials Safety Administration, 2009

Delaware River Dredge Spoils

Paulsboro has been the recipient of many tons of sediments dredged from the bottom of the Delaware River. These dredge spoils have been deposited along almost the full length of the municipality's waterfront, with the largest concentration close to the mouth of the Mantua Creek. Dredge spoils are the consequence of historic deepening of the river bottom to make it more accessible by ever-larger freight vessels, and of ongoing maintenance of the current 40-foot depth of the main channel. These soils are classified as Udorthents in soil surveys. Further discussion of Udorthents soils can be found in the **Natural Resources: Soils** section.

Delaware River dredging is conducted under the auspices of the US Army Corps of Engineers, which generally subcontracts to private companies such as the Marine Weeks Corporation. In 1982 Congress authorized the US Army Corps of Engineers to deepen the Delaware from its current 40 feet to 45 feet in order to accommodate larger ships and oil tankers that could no longer dock at the Port of Philadelphia or at refinery wharves. Dredge spoils from the deepening were slated to be deposited in Gloucester and Salem

Counties. Initial studies and other delays postponed the dredging plan until the mid-1990's, by which time activist groups in New Jersey and Delaware began to oppose the deepening. Fears were expressed that toxins now held in the Delaware sediments would be released into groundwater beneath dredge spoil sites or into surface waters. Opposition to using the New Jersey shoreline as a dumping ground led to questions about the economic feasibility of the deepening. County, State and Congressional leaders began calling for a review of the project's economic benefit projections as well as its environmental impact. In June 2003, the U.S. Office of Management and Budget issued conclusions from their review of the project, finding that the economic forecasts were indeed flawed and did not justify the deepening.

In 2009, the State of New Jersey filed a lawsuit attempting to block dredging of the river by requiring the US Army Corps of Engineers to get state permits prior to dredging. This was followed by a ruling by a federal judge in Delaware who held that a permit was not necessary to begin the deepening project of the shores of Delaware. As of April 2010, the US Army Corps of Engineers has contracted Norfolk Dredging Company to begin dredging that section, barring an injunction from the federal appeals court.

Port of Paulsboro

The South Jersey Port Corporation and the Gloucester County Improvement Authority are currently redeveloping an abandoned industrial site within Paulsboro into a major port facility called the Paulsboro Marine Terminal (PMT), or simply the Port of Paulsboro. This project site is located along the Delaware River on the south side of Mantua Creek. This property once served as an oil storage and distribution center, commonly referred to as a “tank farm.” In 2005, BP leased all but six acres of the former terminal to the Borough at one dollar per year for 90 years. The former site of the BP Terminal has undergone a considerable environmental cleanup in order to recover and treat impacted groundwater. This remediation has involved the following:

Freight shipping along the Delaware River

- 182 groundwater monitoring wells, plus 40 third-party groundwater monitoring wells that BP monitors.
- Six active groundwater pumping wells.
- 56 active soil vapor extraction wells (15 offsite) to address impacts above the water.
- 15 air sparge wells.

This 150-acre BP property is located directly across the river from Philadelphia International Airport and is one of the largest available industrial/commercial sites in the area. The proposed development is set to include the following components:

- **Waterfront Port Development**, including a 900-foot wharf structure that can accommodate mid-sea ocean-going vessels up to 800 feet in length. The wharf has upland storage of 30 to 40 acres.
- **Industrial/Commercial Development** at the south end of the project site adjacent to existing industrial uses, consisting of five-acre parcels to be used individually or combined.
- **River Gateway**, a commercial/retail development with public access to the riverfront.
- An **Open Space** provision requiring a green buffer to separate the industrial uses from the surrounding neighborhood and creating a neighborhood park.

At the time of publication, the construction of a $15.7 million access road and overpass connecting the Port to I-295 has been approved. In addition, a $48 million contract has been approved to build a bulkhead for the marine terminal, develop a stormwater management system, and dredge the river 40 feet along the length of the port. A wind turbine assembly facility is planned for the new port, as is a solar power facility and an industrial park. It is anticipated that the port will open in 2012.

Oil Spills

Due to the petroleum industry infrastructure within and surrounding Paulsboro, the borough is at significant risk for oil spills. Petroleum entering waterways from oil spills can contaminate the plumage of marine birds and the fur of aquatic mammals, impacting their mobility. It can also poison the liver and kidneys of animals that ingest the petroleum. In addition, the oil can block light from reaching the lower reaches of the affected water. Oil spills can take years to clean up, and weather conditions, shoreline conditions, tides, water currents, and several other environmental factors all contribute to the severity of oil spills. In addition, the surface tension, specific gravity, and viscosity of the petroleum product also affect the rate at which the spill spreads. Light refined products such as gasoline can spread quickly and are hard to contain, but they also evaporate, lessening their toxic effect. On the other hand, crude oil and heavier products such as asphalt are easier to contain, but their effects tend to linger. Since the Delaware River is a tidal body

of water, it contains natural cleaning mechanisms. Therefore, oils spills near Paulsboro are less likely to be as severe as oil spills within lakes or on the open sea, where the remoteness of the location can hinder response by the US Coast Guard and EPA. However, when oil spills occur, they are still likely to cause significant environmental damage.

Within the past few years, Paulsboro has been impacted by two oil spills. In November 2004, a single-hulled Greek oil tanker, the Athos I, twice struck a rusting ship's anchor as it prepared to dock at the CITGO Asphalt Refinery near Paulsboro. The ship spilled 265,000 gallons of heavy crude oil into the river, requiring a massive cleanup and a bird rescue. In October 2009, a small oil spill was reported near the NuStar asphalt refinery in Paulsboro. The ship was surrounded by a containment boom, part of the refinery's routine offloading process. That boom trapped the oil and prevented it from further contaminating the river.

CHAPTER 8

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Appendices

APPENDIX A

Monitoring Schedules for Public Water Supply Wells

Water Facility	Contaminant	Safe Drinking Water Information System Code	Monitoring Frequency	Population
Paulsboro Water Department (NJ0814001)				
Distribution System (DS)	Total coliform bacteria		Month	6,200 Sample Months: From 1/1 To 12/31
	Iron-manganese		Annual	
	Lead/Copper		20 samples per 3 year period	
	Total THM-HAA5 (Stage 1)		3 residence samples annually	
Well # (TP001002)	Inorganics		Triennial	
	Nitrate	1040	Annual	
	Radiological compounds		Triennial	
	Secondarys		Triennial	
	Volatile organic compounds		Annual	
Well # (TP002005)	Inorganics		Triennial	
	Nitrate	1040	Annual	
	Radiological compounds		6 Years	
	Secondarys		Triennial	
	Volatile organic compounds		Annual	
Well # (TP003008)	Inorganics		Triennial	
	Nitrate	1040	Annual	
	Radiological compounds		6 Years	
	Secondarys		Triennial	
	Volatile organic compounds		Annual	

Source: NJDEP, 2010

2008 Air Quality Emission Statements

PI Number	Facility Name	Facility Address	Facility City
55758	**ExxonMobil Research & Engineering Co**	**Paulsboro Technical Center**	**Paulsboro**
Pollutant Name	Ozone-Pounds per day	Tons per year	CO-Pounds per day
Acrolein		0.018	
Ammonia		0.1	
Butadiene (1,3-)		0.001	
CO	199.57	18.8	162.4
CO2		3420	
Formaldehyde		0.185	
Methane		3.9	
NOx (Total)	224.3	15.39	
Pb		0	
PM-10 (Total)		0.64	
PM-2.5 (Total)		3.10e-04	
Propylene Dichloride		9.30e-04	
SO2		0.421	
TSP		0.67	
VOC (Total)	124.89	8.61	

PI Number	Facility Name	Facility Address	Facility City
55127	**ExxonMobil Research And Engineering Co. - PTC**	**600 Billingsport Road**	**Paulsboro**
Pollutant Name	Ozone-Pounds per day	Tons per year	CO-Pounds per day
CO	0	0	0
NOx (Total)	0	0	
PM-10 (Total)		3.18	
PM-2.5 (Total)		0.002	
TSP		3.18	
VOC (Total)	21.76	3.12	

PI Number	Facility Name	Facility Address	Facility City
55795	**Plains Products Terminals, LLC**	**3rd St & Billingsport Rd**	**Paulsboro**
Pollutant Name	Ozone-Pounds per day	Tons per year	CO-Pounds per day
Ammonia		0.05	
Benzene		0.252	
CO	0.42	0.09	2.42
CO2		1730	
Methane		0.03	
NOx (Total)	5.11	1.69	
Pb		0	
PM-10 (Total)		0.17	
PM-2.5 (Total)		8.50e-05	
SO2		0.02	
TSP		0.17	
VOC (Total)	15.95	59.81	

PI Number	Facility Name	Facility Address	Facility City
55826	Air Products And Chemicals, Inc.	675 Billingsport Rd	Paulsboro

Pollutant Name	Ozone-Pounds per day	Tons per year	CO-Pounds per day
Ammonia		0.23	
CO	12.42	3.37	45.83
CO2		11,790	
Methane		0.12	
NOx (Total)	41.16	22.11	
Pb		0	
PM-10 (Total)		0.75	
PM-2.5 (Total)		4.10e-04	
SO2		0.56	
TSP		0.85	
VOC (Total)	11.07	2.83	

PI Number	Facility Name	Facility Address	Facility City
55831	NuStar Asphalt Refining, LLC	4 Paradise Rd	Paulsboro

Pollutant Name	Ozone-Pounds per day	Tons per year	CO-Pounds per day
Ammonia		2.53	
Benzene		1.014	
CO	105.13	27.19	174
CO2		94,640	
Methane		1.79	
NOx (Total)	464.02	87.06	
Pb		0	
PM-10 (Total)		21.02	
PM-2.5 (Total)		0.01	
SO2		16.8	
Trichloroetha Ne (1,1,1)		0	
TSP		21.26	
VOC (Total)	229.48	37.62	

PI Number	Facility Name	Facility Address	Facility City
55829	Valero Refining Co NJ	Valero Refining Co NJ	Paulsboro

Pollutant Name	Ozone-Pounds per day	Tons per year	CO-Pounds per day
Acrolein		0.206	
Ammonia		3.23	
Benzene		8.101	
Cadmium Compounds		0.004	
CO	1,663.81	272.79	1,085.61
CO2		1,806,108	
Formaldehyde		5.207	
Manganese Compounds		0.015	
Mercury Compounds		0.005	
Methane		25.73	
NOx (Total)	3,655.26	735.89	
Pb		0.03	
PM-10 (Total)		218.86	
PM-2.5 (Total)		0.111	
Polycyclic Organic Matter		0.078	
SO2		802.15	
TSP		153.21	
VOC (Total)	1548.46	246.12	

PI Number	Facility Name	Facility Address	Facility City
55938	NuStar Logistics, L.P.	7 North Delaware St	Paulsboro
Pollutant Name	Ozone-Pounds per day	Tons per year	CO-Pounds per day
Benzene		0.136	
CO	0	0.02	0.18
CO2		70	
NOx (Total)	0	0.06	
Pb		0	
PM-10 (Total)		0	
PM-2.5 (Total)		0	
SO2		0.09	
TSP		0.01	
VOC (Total)	222.63	35.91	

Source: NJDEP, 2009

APPENDIX C

Vertebrate Animals Known or Probable in Paulsboro

Fish

Common Name	Scientific Name	Historical Presence
Longnose Gar	*Lepisosteus osseus*	Native
American Eel	*Anguilla rostrata*	Native
Blueback Herring	*Alosa aestivalis*	Native
American Shad	*Alosa sapidissima*	Native
Satinfin Shiner	*Cyprinella analostana*	Native
Common Carp	*Cyprinus carpio*	Introduced
Eastern Silvery Minnow	*Hybognathus regius*	Native
Spottail Shiner	*Notropis hudsonius*	Native
White Sucker	*Catostomus commersonnii*	Native
White Catfish	*Ameiurus catus*	Native
Brown Bullhead	*Ameiurus nebulosus*	Native
Channel Catfish	*Ictalurus punctatus*	Introduced
Margined Madtom	*Noturus insignis*	Native
Banded Killifish	*Fundulus diaphanus*	Native
Mummichog	*Fundulus heteroclitus*	Native
White Perch	*Morone americana*	Native
Striped Bass	*Morone saxatilis*	Native
Redbreast Sunfish	*Lepomis auritus*	Native
Pumpkinseed	*Lepomis gibbosus*	Native
Bluegill	*Lepomis macrochirus*	Introduced
Largemouth Bass	*Micropterus salmoides*	Introduced
Black Crappie	*Pomoxis nigromaculatus*	Introduced

Common Name	Scientific Name	Historical Presence
Tessellated Darter	*Etheostoma olmstedi*	Native
Yellow Perch	*Perca flavescens*	Native

Source: Arndt, 2004 and NJDEP, 2005

Birds

Common Name	Scientific Name	Statewide Status	
Great Blue Heron	*Ardea herodias*	SC	bmw
Cattle Egret	*Bubulcus ibis*	RP	bm
Turkey Vulture	*Cathartes aura*	INC	bmw
Canada Goose	*Branta canadensis*	INC	bmw
Mallard	*Anas platyrhynchos*	INC	bmw
Red-tailed Hawk	*Buteo jamaicensis*	INC	bmw
Northern Bobwhite	*Colinus virginianus*	RP	bw
Killdeer	*Charadrius vociferus*	SC	bmw
Rock Dove	*Columba livia*	I	bmw
Mourning Dove	*Zenaida macroura*	S	bmw
Black-billed Cuckoo	*Coccyzus erythropthalmus*	RP	bm
Yellow-billed Cuckoo	*Coccyzus americanus*	RP	bm
Eastern Screech-Owl	*Otus asio*	RP	bw
Great Horned Owl	*Bubo virginianus*	S	bw
Chimney Swift	*Chaetura pelagica*	RP	bm
Ruby-throated Hummingbird	*Archilochus colubris*	D	bm
Red-bellied Woodpecker	*Melanerpes carolinus*	INC	bw
Downy Woodpecker	*Picoides pubescens*	S	bw
Hairy Woodpecker	*Picoides villosus*	D	bw
Eastern Wood-Peewee	*Contopus virens*	RP	bm
Eastern Phoebe	*Sayornis phoebe*	S	bm
Great Crested Flycatcher	*Myiarchus crinitus*	RP	bm
Eastern Kingbird	*Tyrannus tyrannus*	RP	bm
White-eyed Vireo	*Vireo griseus*	D	bm
Red-eyed Vireo	*Vireo olivaceus*	S	bm

Common Name	Scientific Name	Statewide Status	
Blue Jay	*Cyanocitta cristata*	D	bmw
American Crow	*Corvus brachyrhynchos*	S	bmw
Fish Crow	*Corvus ossifragus*	S	bmw
Purple Martin	*Progne subis*	S	bm
Tree Swallow	*Tachycineta bicolor*	INC	bm
No. Rough-winged Swallow	*Stelgidopteryx serripennis*	S	bm
Barn Swallow	*Hirundo rustica*	S	bm
Carolina Chickadee	*Poecile carolinensis*	S	bm
Tufted Titmouse	*Baeolophus bicolor*	INC	bw
White-breasted Nuthatch	*Sitta carolinensis*	INC	bw
Carolina Wren	*Thryothorus ludovicianus*	INC	bw
House Wren	*Troglodytes aedon*	S	bm
Marsh Wren	*Cistothorus palustris*	RP	bmw
Wood Thrush	*Hylocichla mustelina*	RP	bm
American Robin	*Turdus migratorius*	S	bmw
Gray Catbird	*Dumetella carolinensis*	RP	bmw
Northern Mockingbird	*Mimus polyglottos*	D	bmw
Brown Thrasher	*Toxostoma rufum*	RP	bmw
European Starling	*Sturnus vulgaris*	I	bmw
Cedar Waxwing	*Bombycilla cedrorum*	S	bmw
Yellow Warbler	*Dendroica petechia*	S	bm
Common Yellowthroat	*Geothlypis trichas*	D	bm
Eastern Towhee	*Pipilo erythrophthalmus*	RP	bmw
Chipping Sparrow	*Spizella passerina*	S	bmw
Field Sparrow	*Spizella pusilla*	RP	bmw
Song Sparrow	*Melospiza melodia*	D	bmw
Northern Cardinal	*Cardinalis cardinalis*	INC	bw
Blue Grosbeak	*Guiraca caerulea*	INC	bm
Indigo Bunting	*Passerina cyanea*	RP	bm
Red-winged Blackbird	*Agelaius phoeniceus*	S	bmw
Common Grackle	*Quiscalus quiscula*	D	bmw
Brown-headed Cowbird	*Molothrus ater*	S	bmw
Orchard Oriole	*Iceterus spurius*	S	bm

Common Name	Scientific Name	Statewide Status	
Baltimore Oriole	*Iceterus galbula*	RP	bm
House Finch	*Carpodacus mexicanus*	S	bmw
American Goldfinch	*Carduelis tristis*	INC	bmw
House Sparrow	*Passer domesticus*	I	bmw
Belted Kingfisher	*Ceryle alcyon*	S	bmw
Great Egret	*Casmerodius albus*	RP	bm
Common Merganser	*Mergus merganser*	S	bmw
Red-breasted Merganser	*Mergus serrator*	S	bmw
Bufflehead	*Bucephala albeola*	RP	mw
Great Cormorant	*Phalacrocorax carbo*	U	mw
Double-crested Cormorant	*Phalacrocorax auritus*	S	bmw
American Black Duck	*Anas rubripes*	RP	bmw
Wood Duck	*Aix sponsa*	RP	bmw
Bald Eagle	*Haliaeetus leucocephalus*	E	bmw
Osprey	*Pandion haliaetus*	T	bm
American Kestrel	*Falco sparverius*	SC	bmw
Eastern Wild Turkey	*Meleagris gallopavo*	INC	bw

Source: Walsh, Joan, et al. *Birds of New Jersey*, 1999; NJDEP Division of Fish and Wildlife, 2005; Paulsboro Environmental Commission.

Statewide Status Codes	
E - Endangered	b - breeding
T - Threatened	m - migrant
SC - Special Concern	w - winters
D - Decreasing	
INC - Increasing	
RP - Regional Priority	
P - Peripheral	
S - Stable	
U - Undetermined	
I - Introduced	

APPENDIX D

Closed Known Contaminated Sites in Paulsboro

Site ID	PI Number	PI Name	Address	Home Owner
73040	G000029674	357 Mantua Ave.	357 Mantua Ave	No
74639	G000040419	443 Billingsport Rd.	443 Billingsport Rd	No
54802	24423	6 Well	Lodge Ave	No
14378	7138	Air Products & Chemicals, Inc *	675 Billingsport Rd	No
65840	G000032356	Coastal Services Incorporated *	85 Riverview Ave	No
75960	G000000635	Conrail Paulsboro Yard	Penn Line Rd and Jefferson St	No
41556	3468	Consumers Oil Service Inc. Office	541 Mantua Ave	No
258755	331415	East Wood St.	East Wood St	Yes
45934	5438	Essex Chemical Corporation *	100 Thomas Ln	No
7867	3771	Lukoil #57345 *	642 Broad St	No
14641	1047	Pacific Atlantic Terminal Paulsboro Fac	3rd St. and Billingsport Rd	No
48806	22602	Pat Richards	1802 South Delaware St	No
44716	10982	Paulsboro Administration Bldg.	1211 North Delaware St	No
7848	26751	Paulsboro High School	7th St. and North Delaware St	No
7864	3272	Paulsboro Travel Centers *	1-295 & Mt Royal Exit 18A	No
7857	16174	Paulsboro Valero	501 N Broad St	No
57616	33105	Service Station (Former)	63 West Broad St	No
125030	165047	Thomson Ave.	Thomson Ave	Yes
196672	258195	Thomson Ave.	Thomson Ave	Yes
7845	22492	Timberlane Welding and Service Inc.	1626 South Commerce St	No
76678	G000006240	United Erectors Inc.	105 Riverview Ave	No
54720	24256	West End Auto Detailing/Sales	501 North Broad St	No

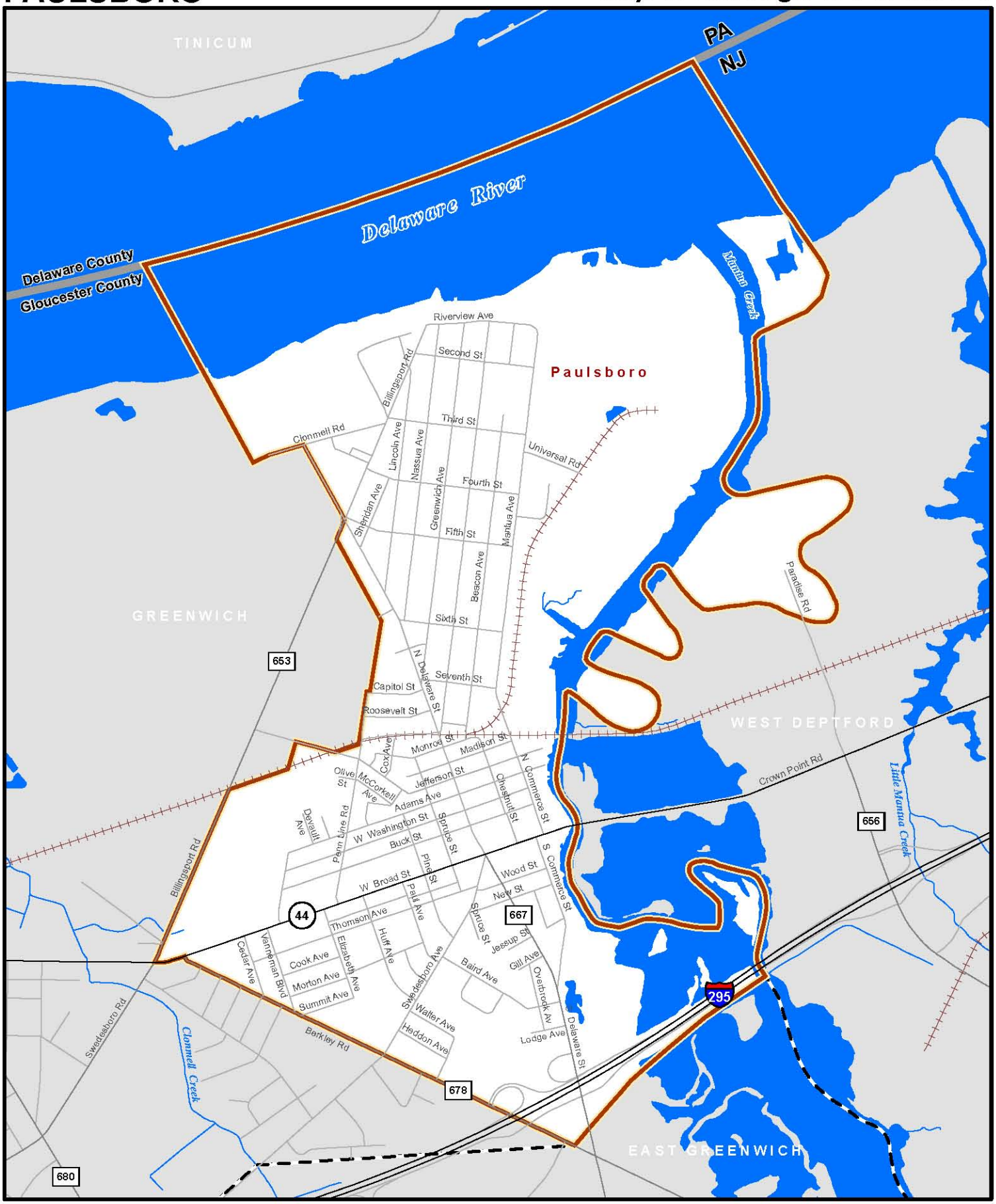
* Facility or address is also listed as an Active Known Contaminated Site. This may be because a contamination case at the facility has been remediated (closed), although there may be other contamination that has not been remediated yet.

Source: NJDEP, June 2010

Maps

PAULSBORO

Map 1: Borough of Paulsboro



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Paulsboro

Municipal Boundary

N

0.2 0.1 0 0.2

Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

PAULSBORO

Map 2: Aerial Photo (2007)

Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Paulsboro

Municipal Boundary

N

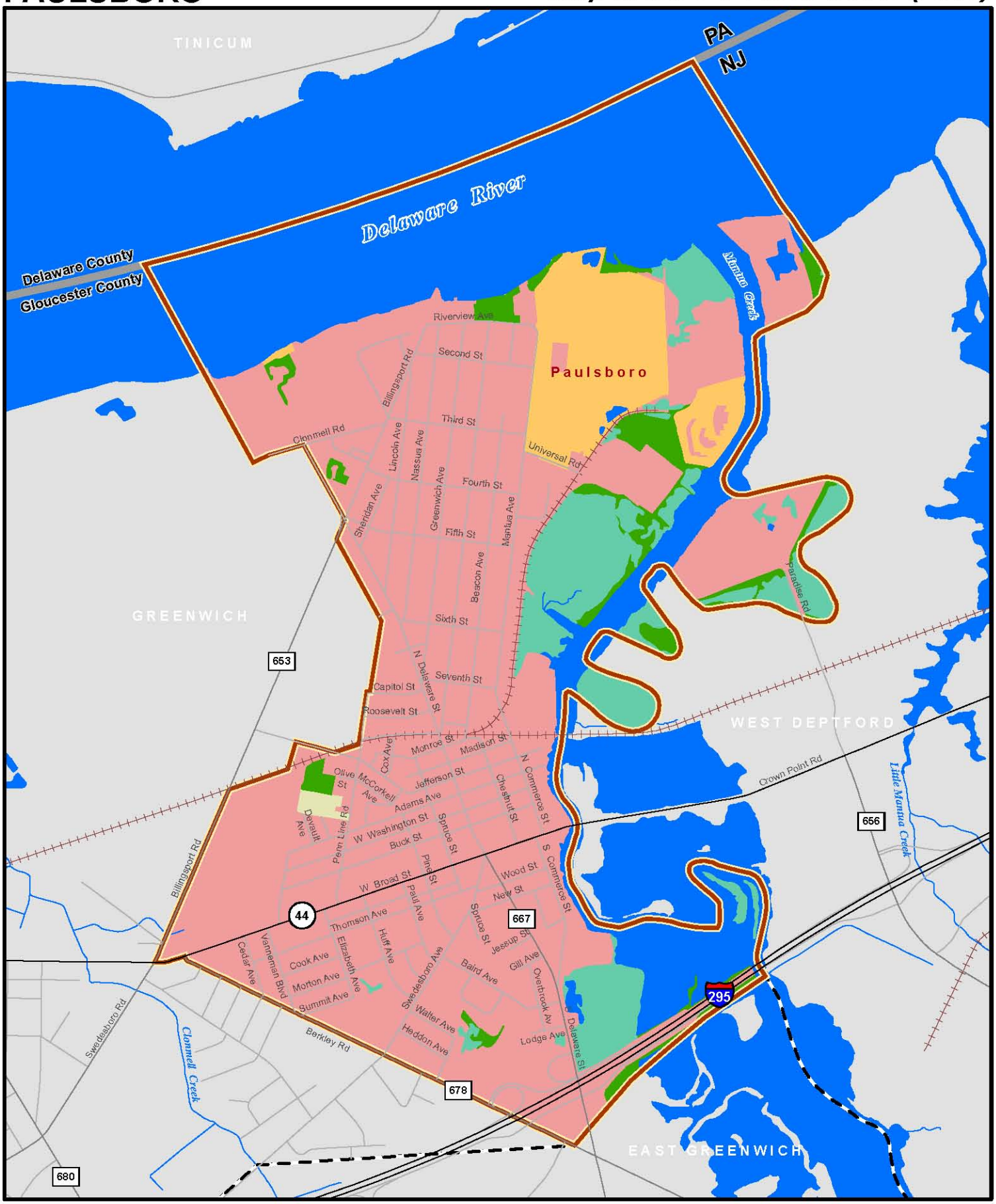
0.2 0.1 0 0.2

Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

PAULSBORO

Map 3: NJDEP Land Cover (2007)



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Land Cover Categories

Agriculture	Forest	Water
Barren Land	Developed	Wetlands

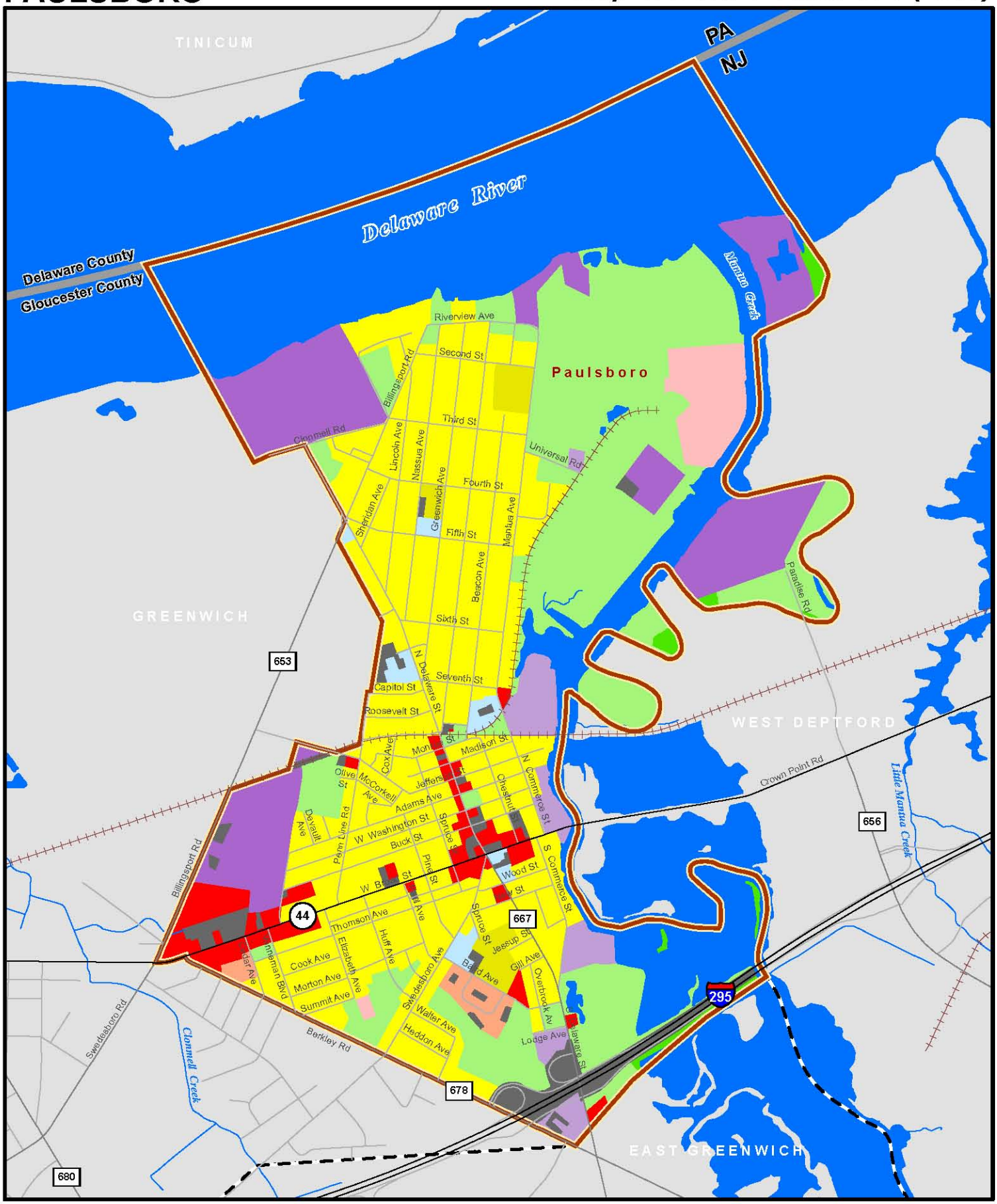
N

0.2 0.1 0 0.2
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

PAULSBORO

Map 4: DVRPC Land Use (2005)



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Land Use Type

- Agriculture
- Commercial
- Community
- Heavy Manufacturing
- Light Manufacturing
- Parking & Transportation
- Residential: Mobile Home
- Residential: Multi-Family
- Residential: Single-Family
- Recreation
- Utility
- Vacant
- Water
- Wooded

N

0.2 0.1 0 0.2

Miles

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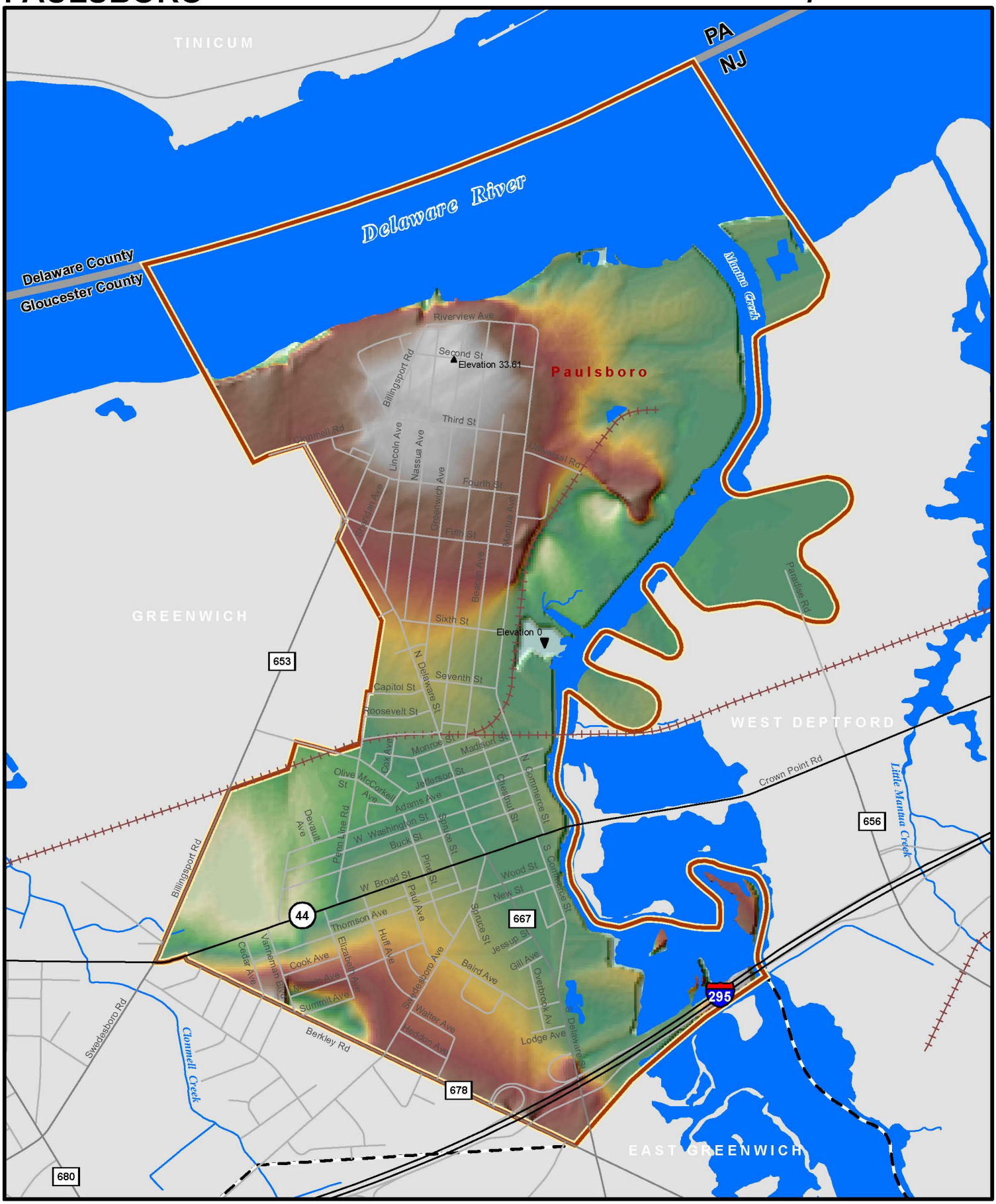
Map 5: Elevation



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Value

High : 33.613

Low : 0

N

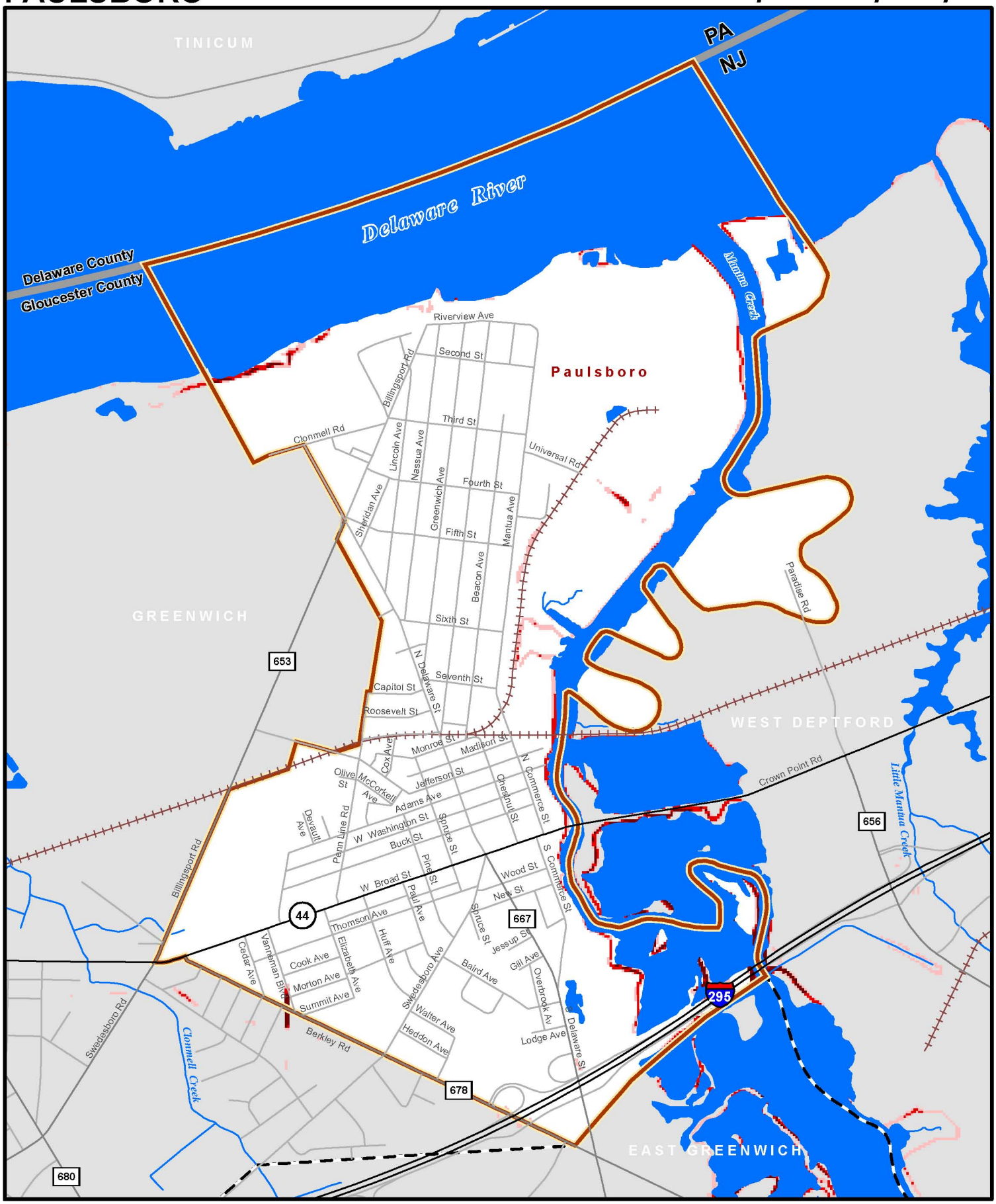
0.2 0.1 0 0.2

Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

PAULSBORO

Map 6: Steep Slopes



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Steep Slopes

- Slope < 10%
- Slope = 10% - 14.99%
- Slope = 15% - 19.99%
- Slope ≥ 20%

N

0.2 0.1 0 0.2

Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

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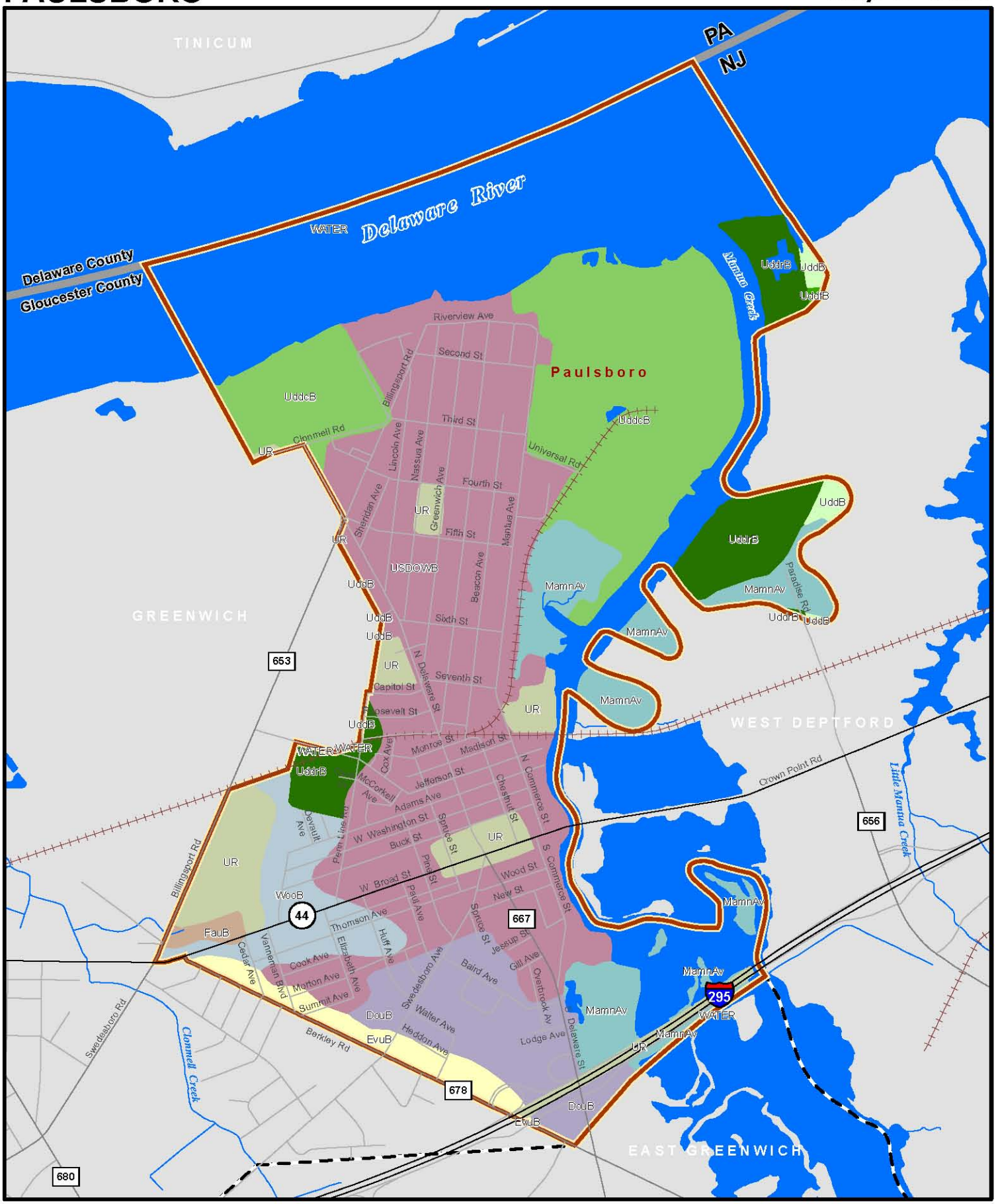
Map 7: Soils



Sources : NJDEP, NJDOT, DVRPC, NRCS. This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Soils

DouB	MamnAv	UddB	UddrB
EvuB	UR	UddcB	WATER
FauB	USDOWB	UddfB	WooB

N

0.2 0.1 0 0.2

Miles

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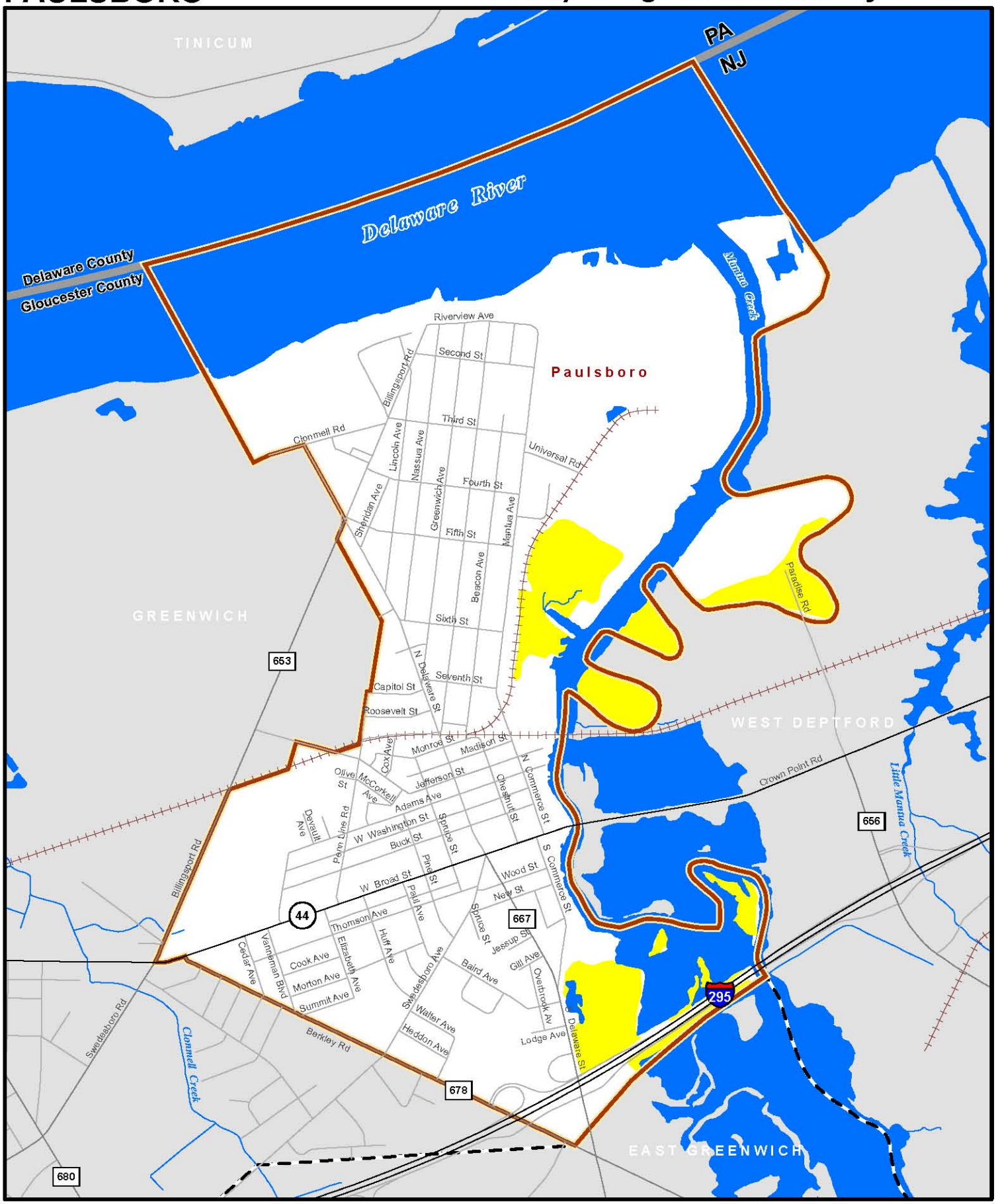
Map 8: Agricultural Quality of Soils



Sources : NJDEP, NJDOT, DVRPC, NRCS. This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Soil Designation

- Unique Farmland
- Not Rated for Agricultural Use

N

0.2 0.1 0 0.2

Miles

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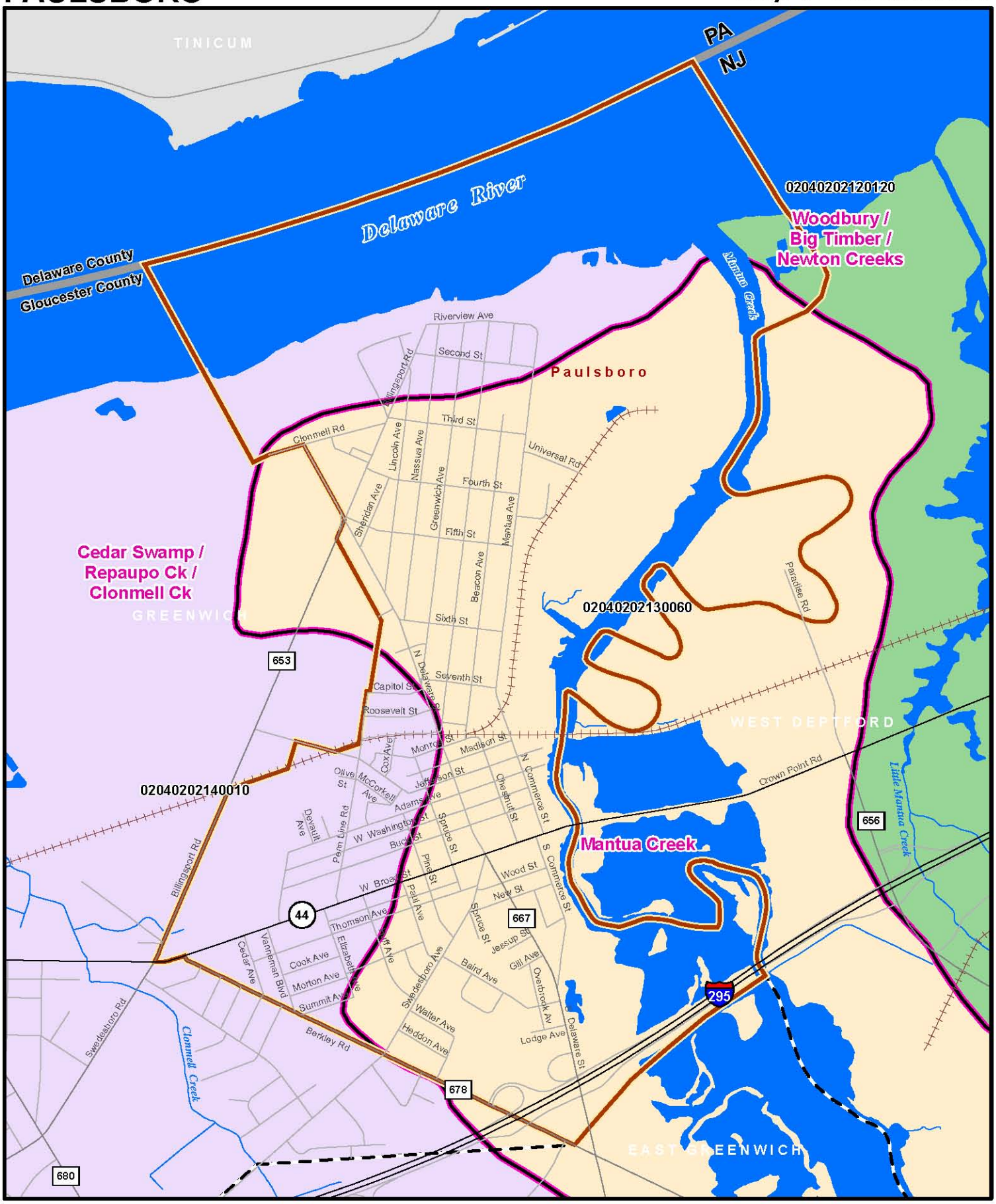
Map 9: Watersheds



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Paulsboro Borough

Watershed

N

0.2 0.1 0 0.2

Miles

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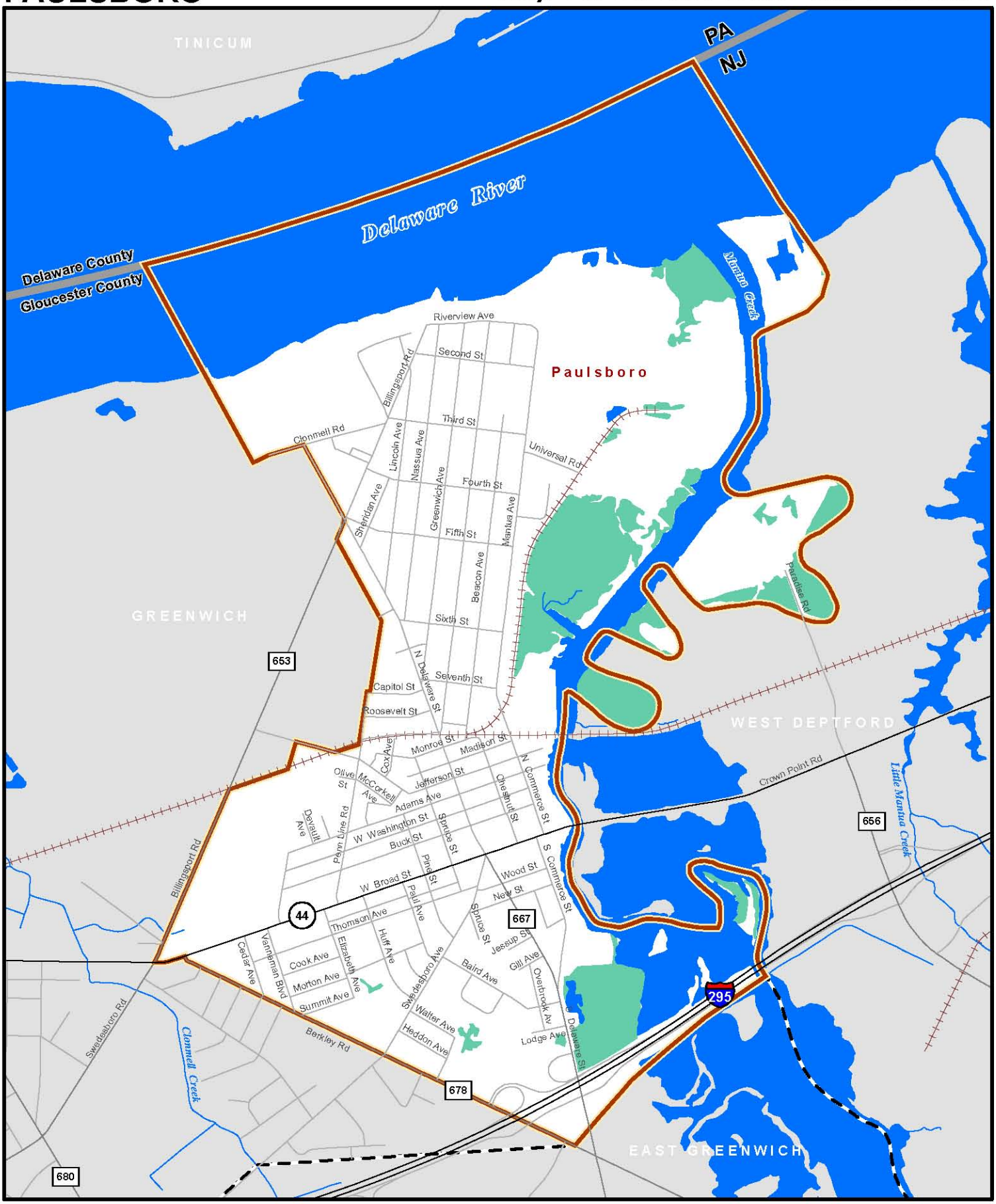
Map 10: Surface Water and Wetlands



Sources : NJDEP, NJDOT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Wetlands
Lake
Stream

N

0.2 0.1 0 0.2
Miles

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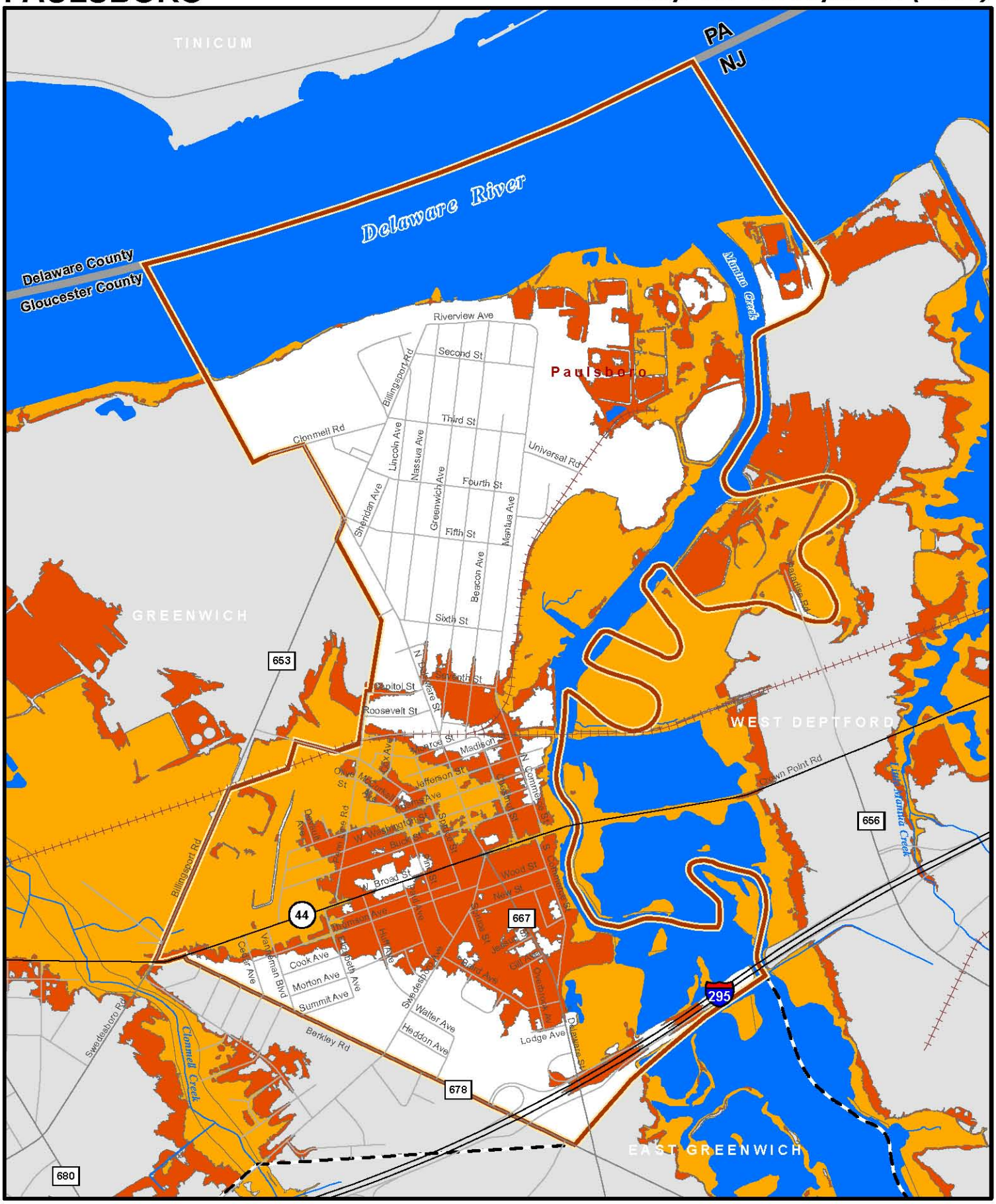
Map 11: Floodplains (2010)



Sources : NJDEP, NJDOT, DVRPC, FEMA. This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

100-Year Floodplain

500-Year Floodplain

N

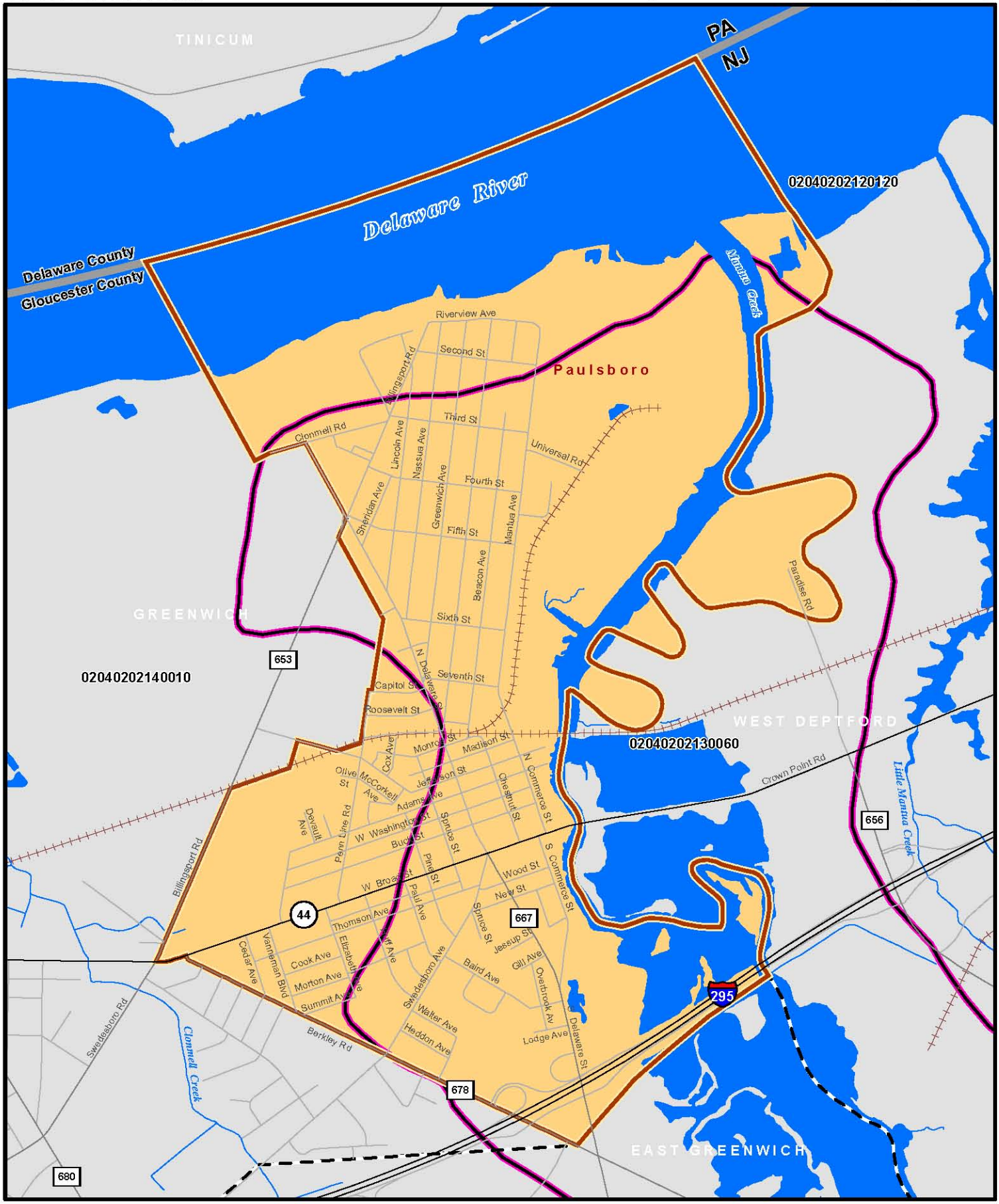
0.2 0.1 0 0.2

Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

PAULSBORO

Map 12: Water Quality (2008)



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Subwatershed Boundary (HUC 14)

2008 Integrated Water Quality Report

General Aquatic

Sublist 3 - Insufficient data to determine if designated use is attaining.

N

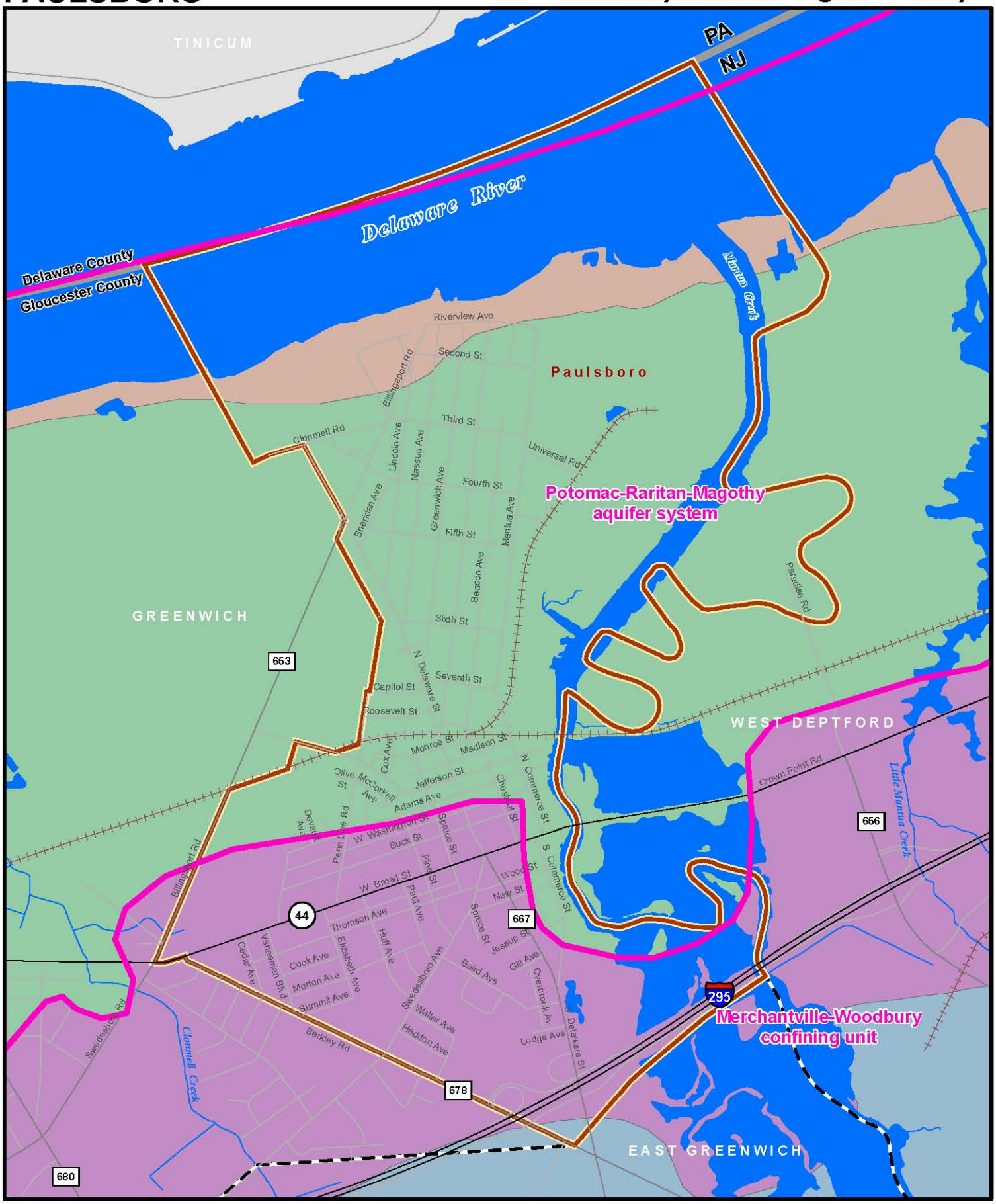
0.2 0.1 0 0.2

Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

PAULSBORO

Map 13: Geologic Outcrops



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Bed Outcrop Formations

- Aquifer
- Magothy
- Potomac
- Merchantville
- Woodbury

N

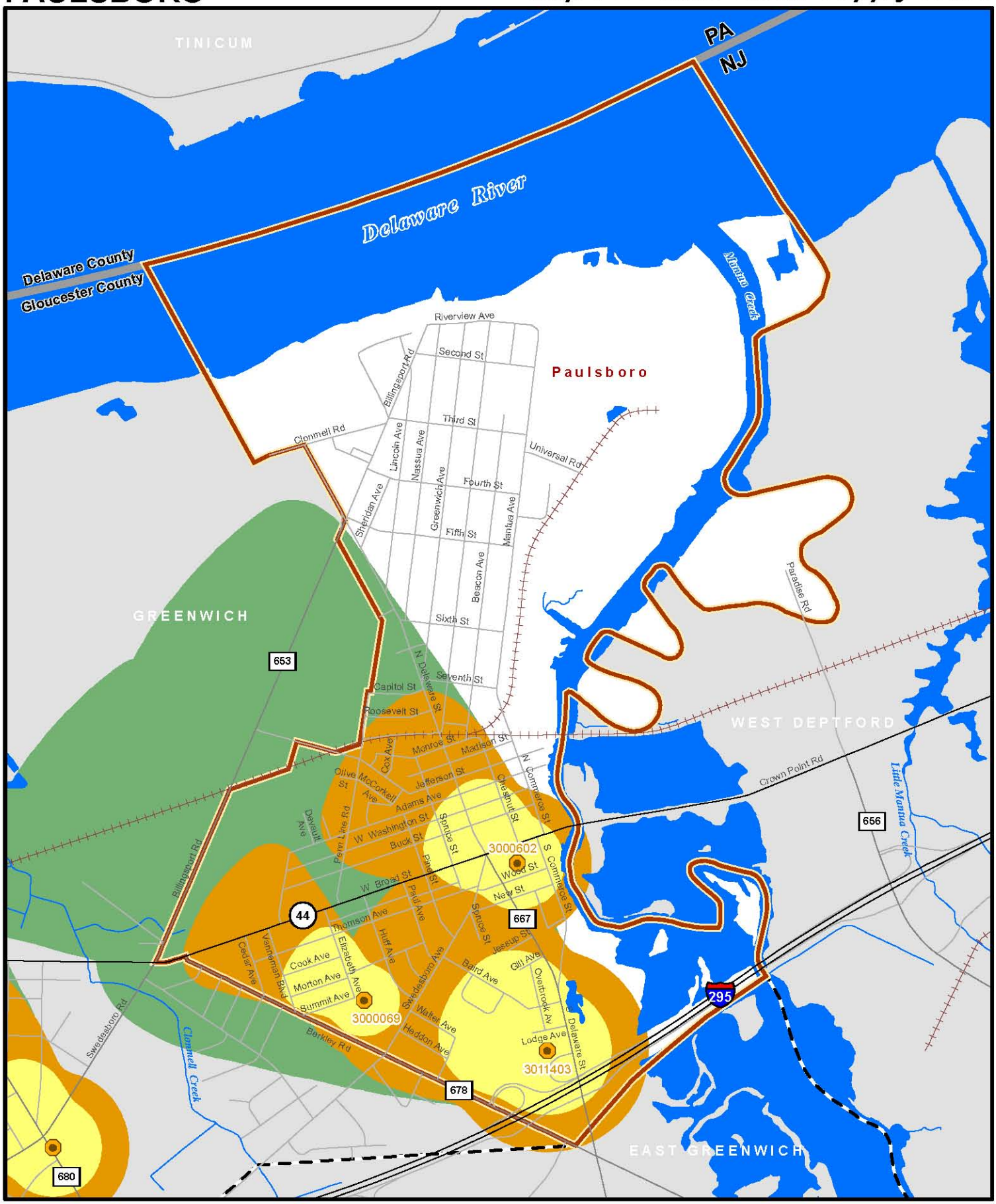
0.2 0.1 0 0.2

Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

PAULSBORO

Map 14: Public Water Supply Wells



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Public Community Well

Wellhead Protection Areas
Public Community, 2006
Public Non-Community, 2004
- 2-year time of travel
- 5-year time of travel
- 12-year time of travel

N

0.2 0.1 0 0.2
Miles

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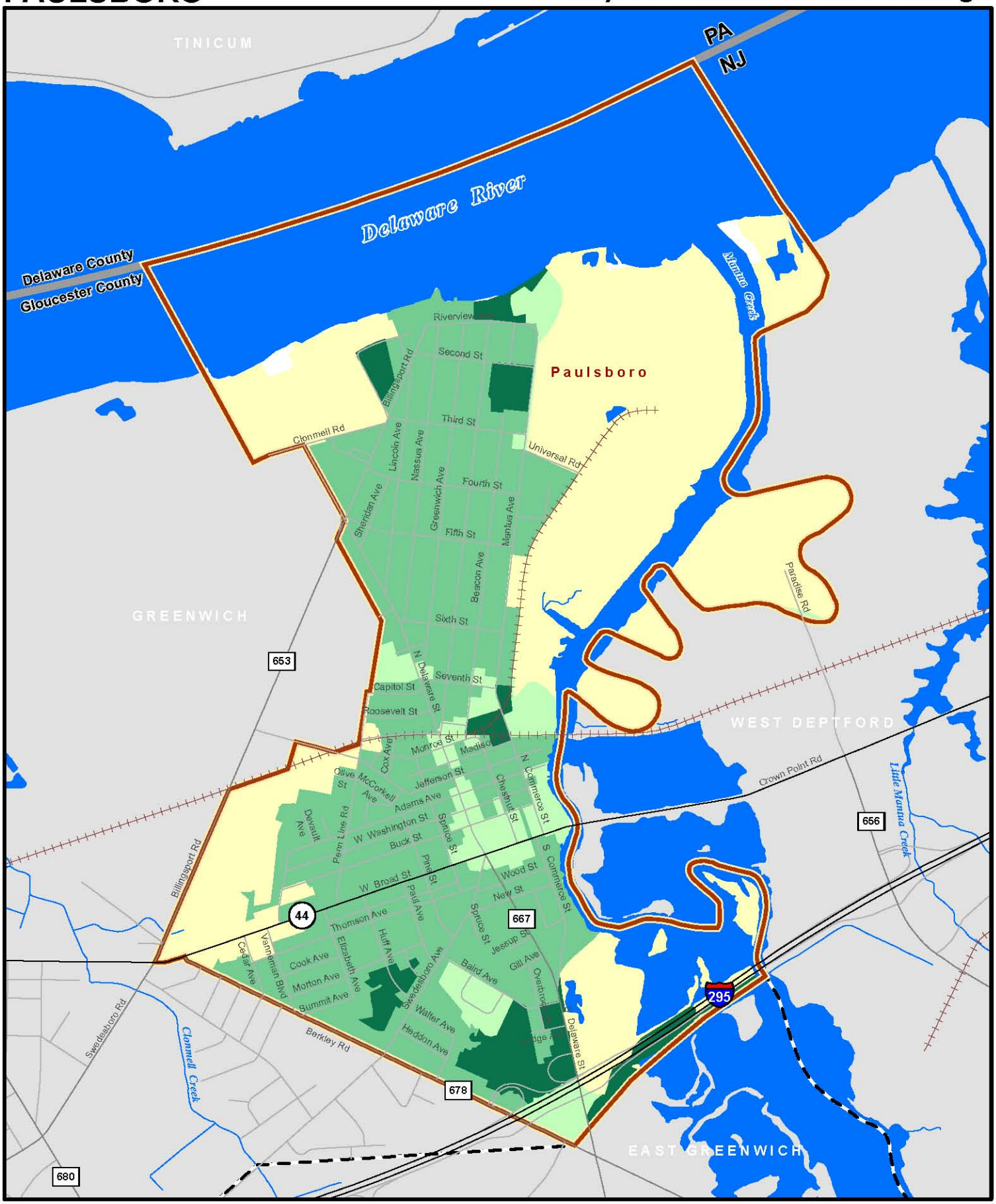
Map 15: Groundwater Recharge



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Inches per Year

0 - 1	7 - 10
2 - 6	11 - 18

N

0.2 0.1 0 0.2

Miles

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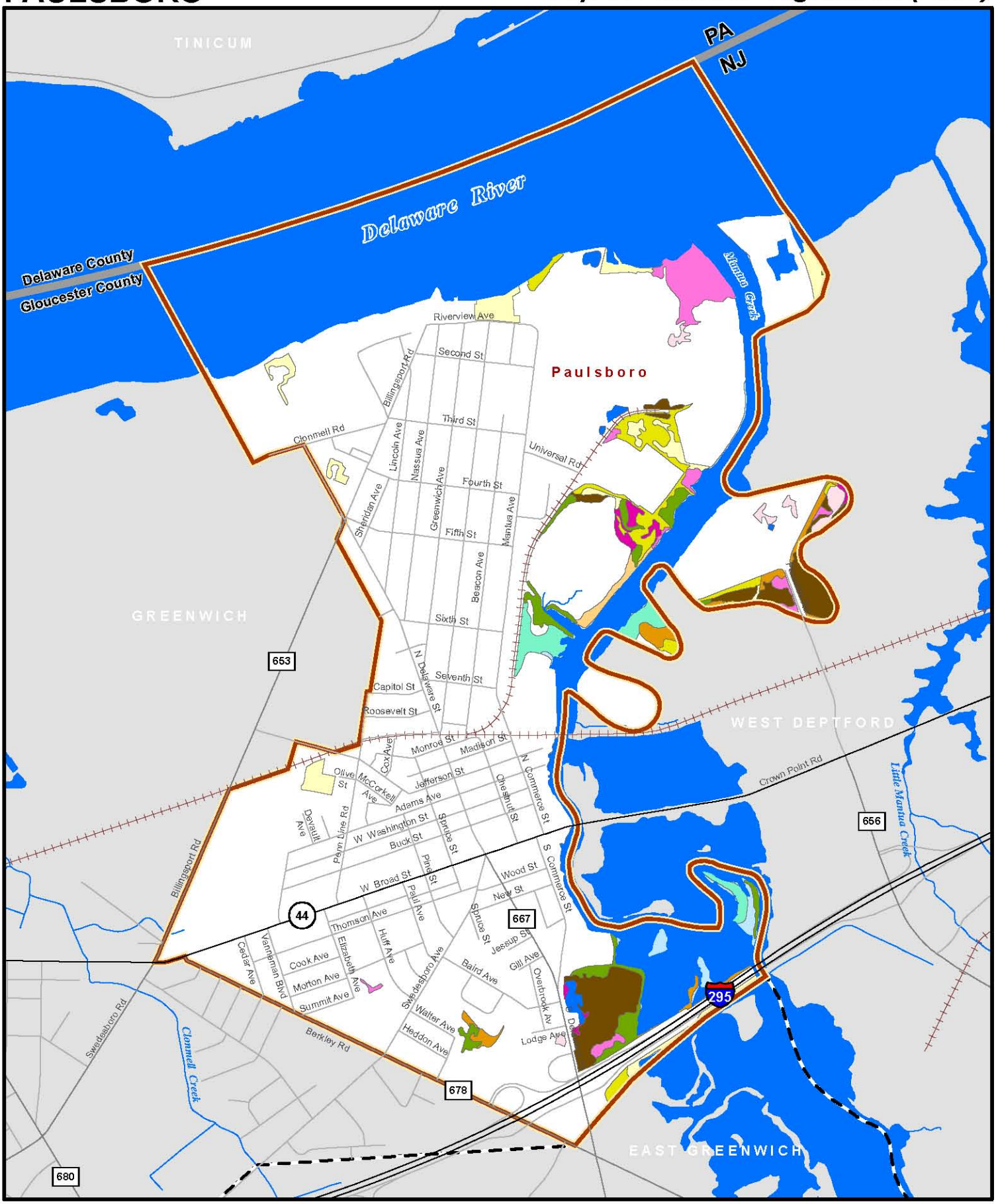
Map 16: Natural Vegetation (2007)



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Vegetation

- Brush/Shrubland
- Brush/Shrubland - Oldfield
- Upland Forest - Deciduous
- Upland Forest - Mixed (Decid. Dom.)
- Water
- Tidal Waters
- Tidal Marshes - Freshwater
- Wetlands - Modified
- Wetlands - Scrub/Shrub
- Wetlands - Herbaceous
- Wetlands - Phragmites Dominated
- Wetlands - Wooded - Deciduous
- All other land cover

N

0.2 0.1 0 0.2

Miles

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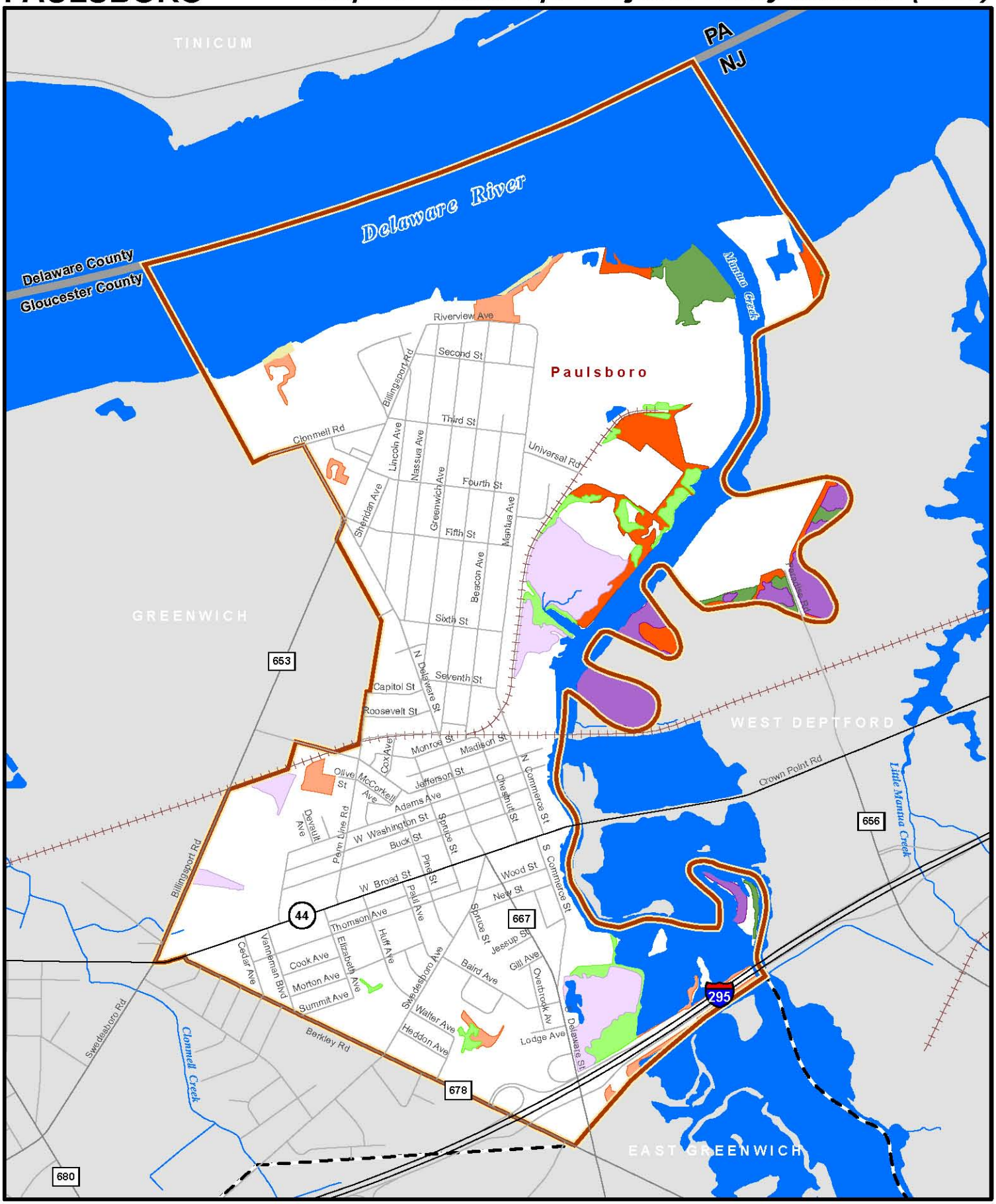
Map 17: Landscape Project Priority Habitats (2007)



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Conservation Priority Type

Upland Forest	Forested Wetlands	Emergent Wetlands	Beach
Critical Habitat	Critical Habitat	Critical Habitat	Suitable Habitat
Suitable Habitat	Suitable Habitat	Suitable Habitat	

N

0.2 0.1 0 0.2
Miles

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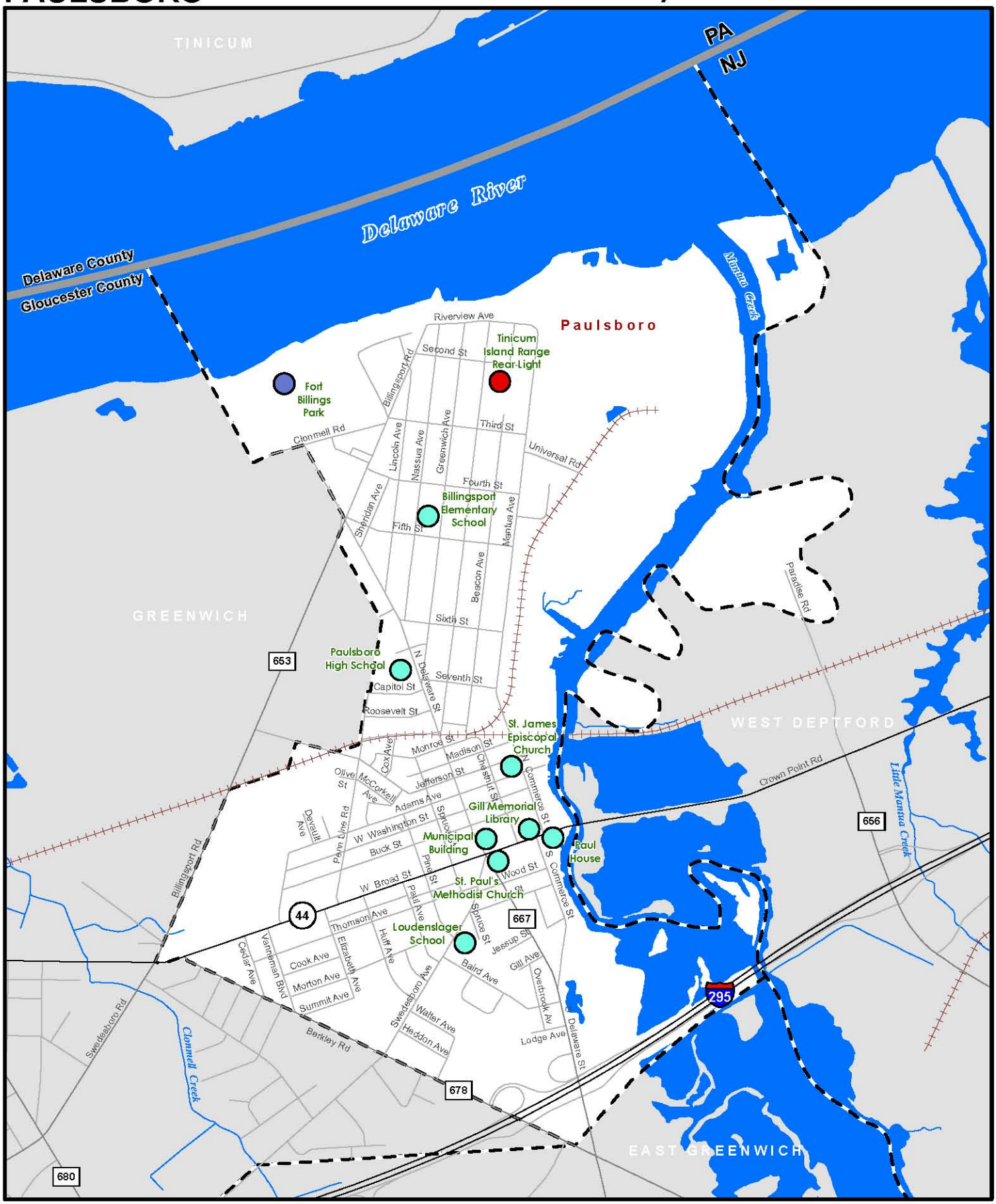
Map 18: Historic Resources



Sources : NJDEP, NJDOT, DVRPC, NJHPO. This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

- Site on National & State Registers of Historic Places
- Site on State Registers of Historic Places
- Locally Important Historic Site

N

0.2 0.1 0 0.2

Miles

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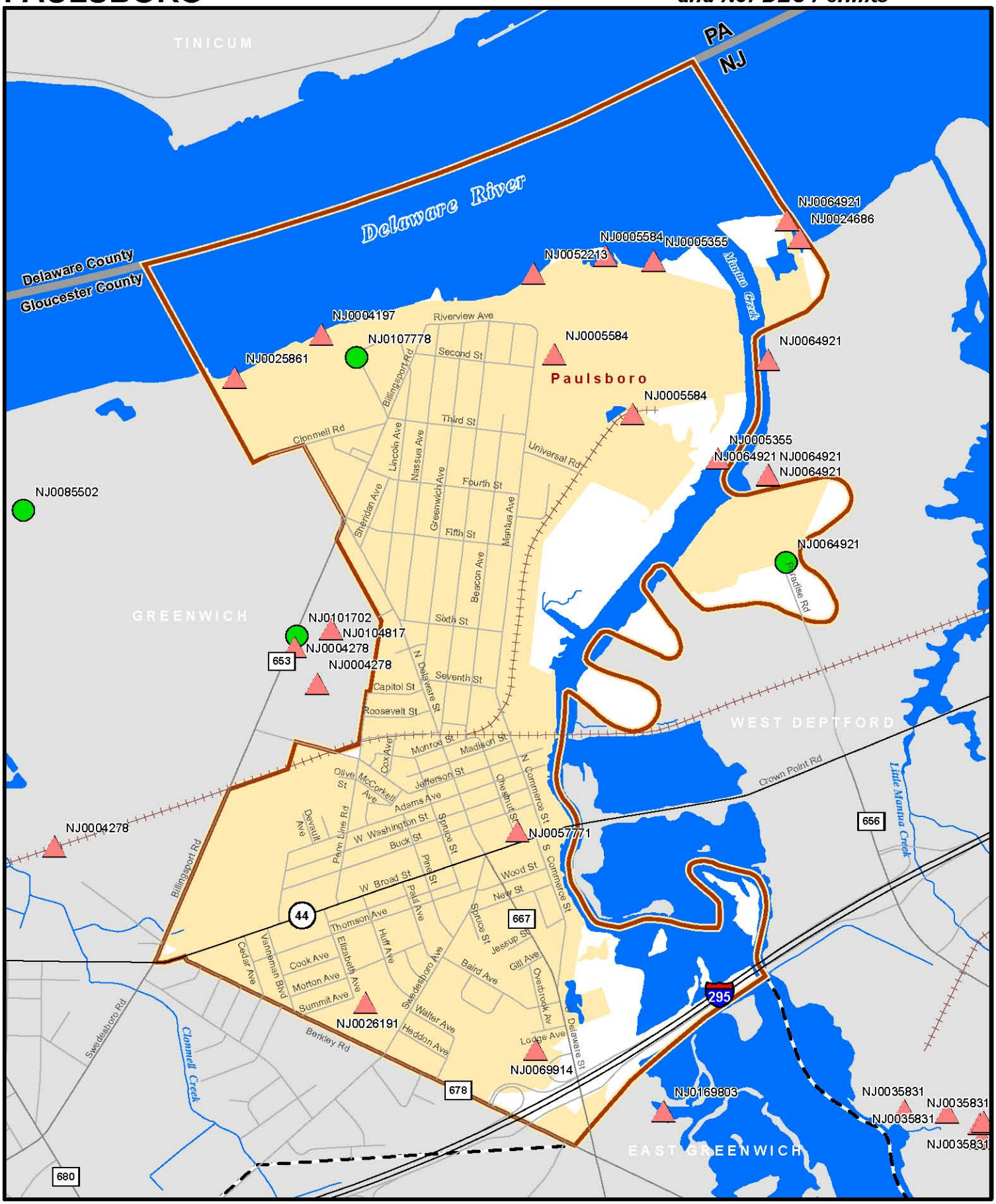
Map 19: Approved Sewer Service Area and NJPDES Permits



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

- NJPDES Permit for Discharge to Ground Water (2007)
- NJPDES Permit for Discharge to Surface Water (2009)

Approved Sewer Service Area (2008)

Type of Wastewater Disposal

- Surface Water Discharge

N

0.2 0.1 0 0.2

Miles

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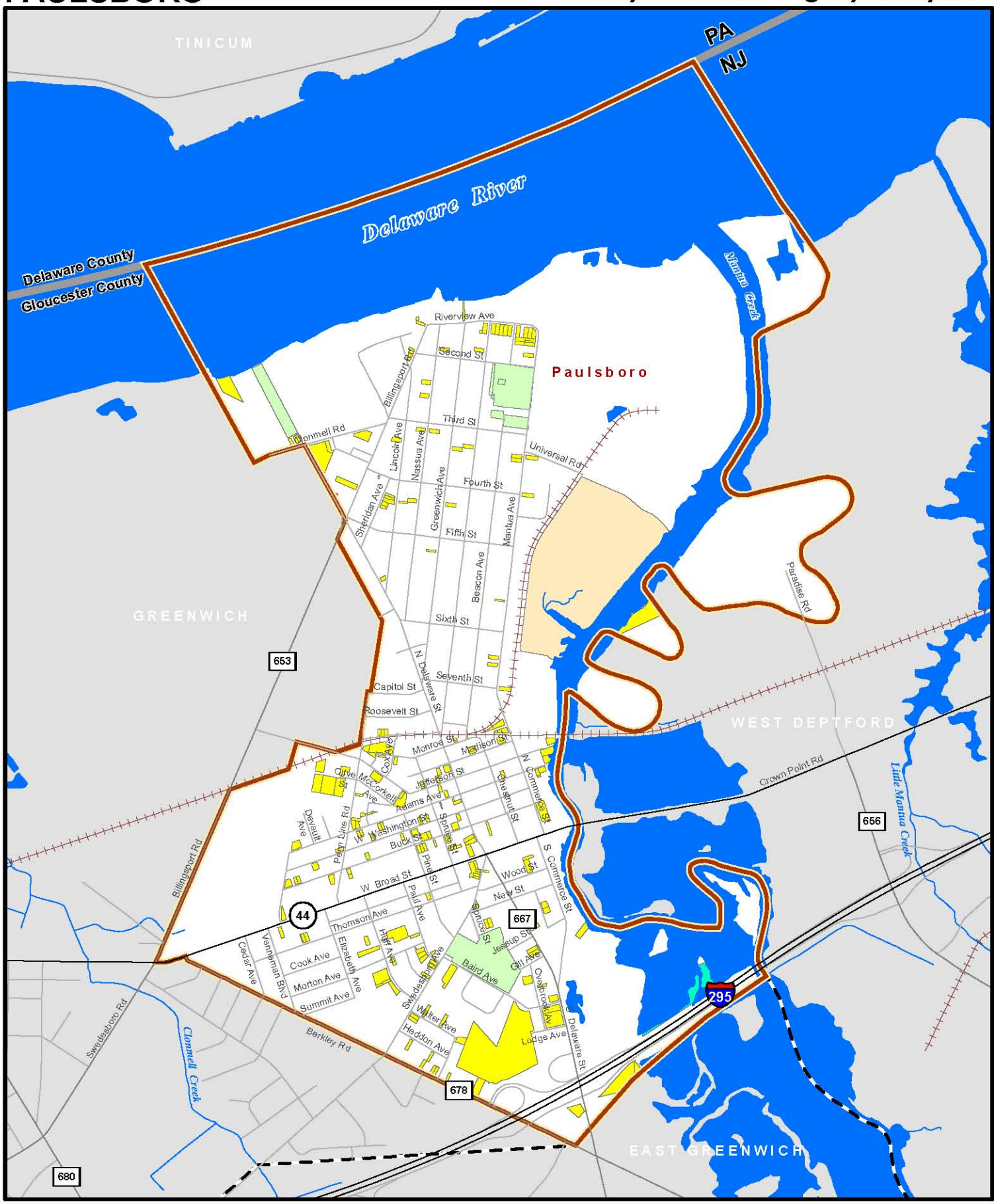
Map 20: Exisiting Open Space



Sources : NJDEP, NJDOT, DVRPC, NJCF, Gloucester County.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Protected Open Space
- Municipal
- State

Property Class
- 1 - Vacant
- 3B - Farm Assessed

N

0.2 0.1 0 0.2
Miles

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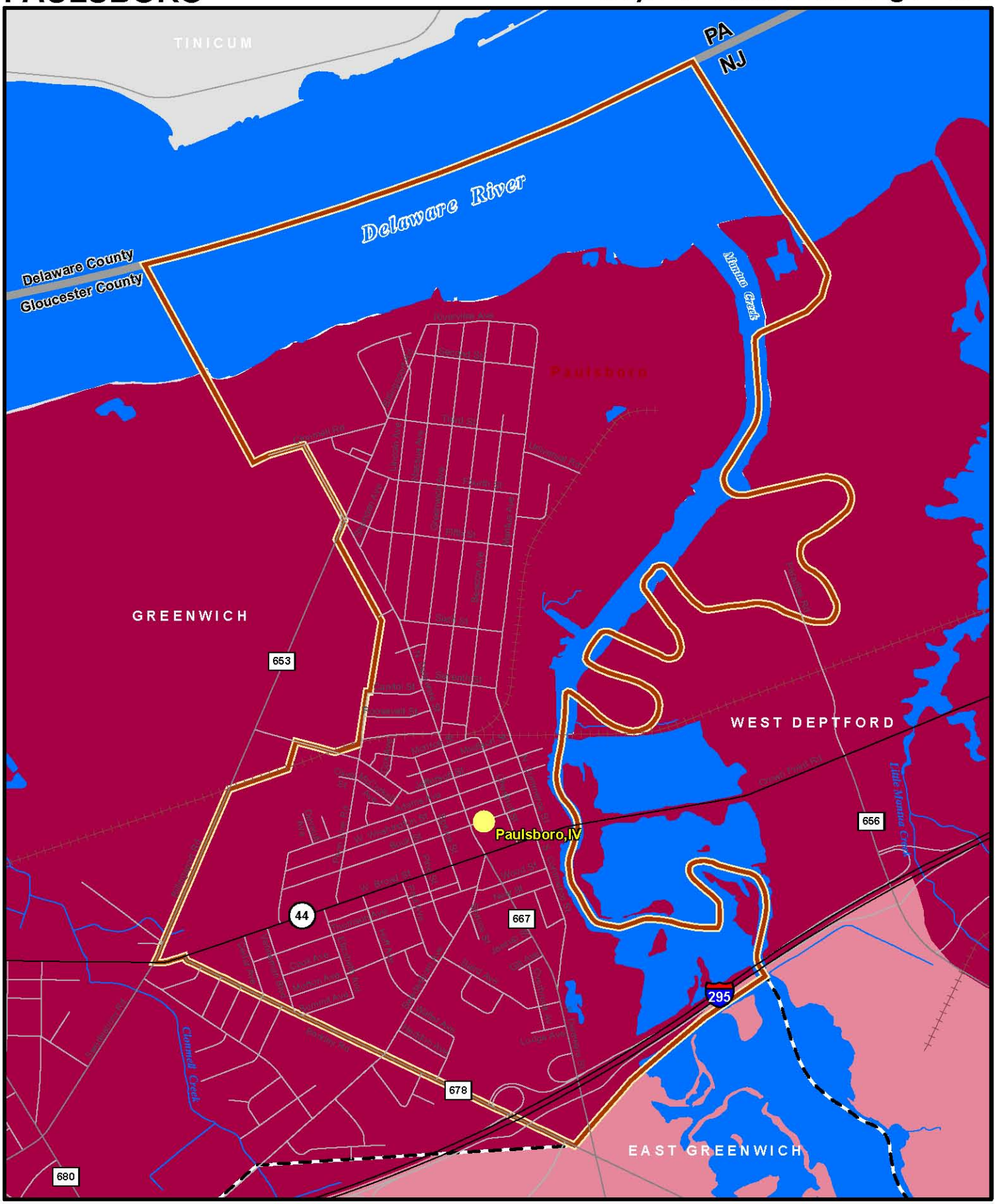
Map 21: State Planning Areas



Sources : NJDEP, NJDOT, DVRPC.
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

Identified Center

Planning Areas

- Metropolitan
- Suburban
- Water

N

0.2 0.1 0 0.2

Miles

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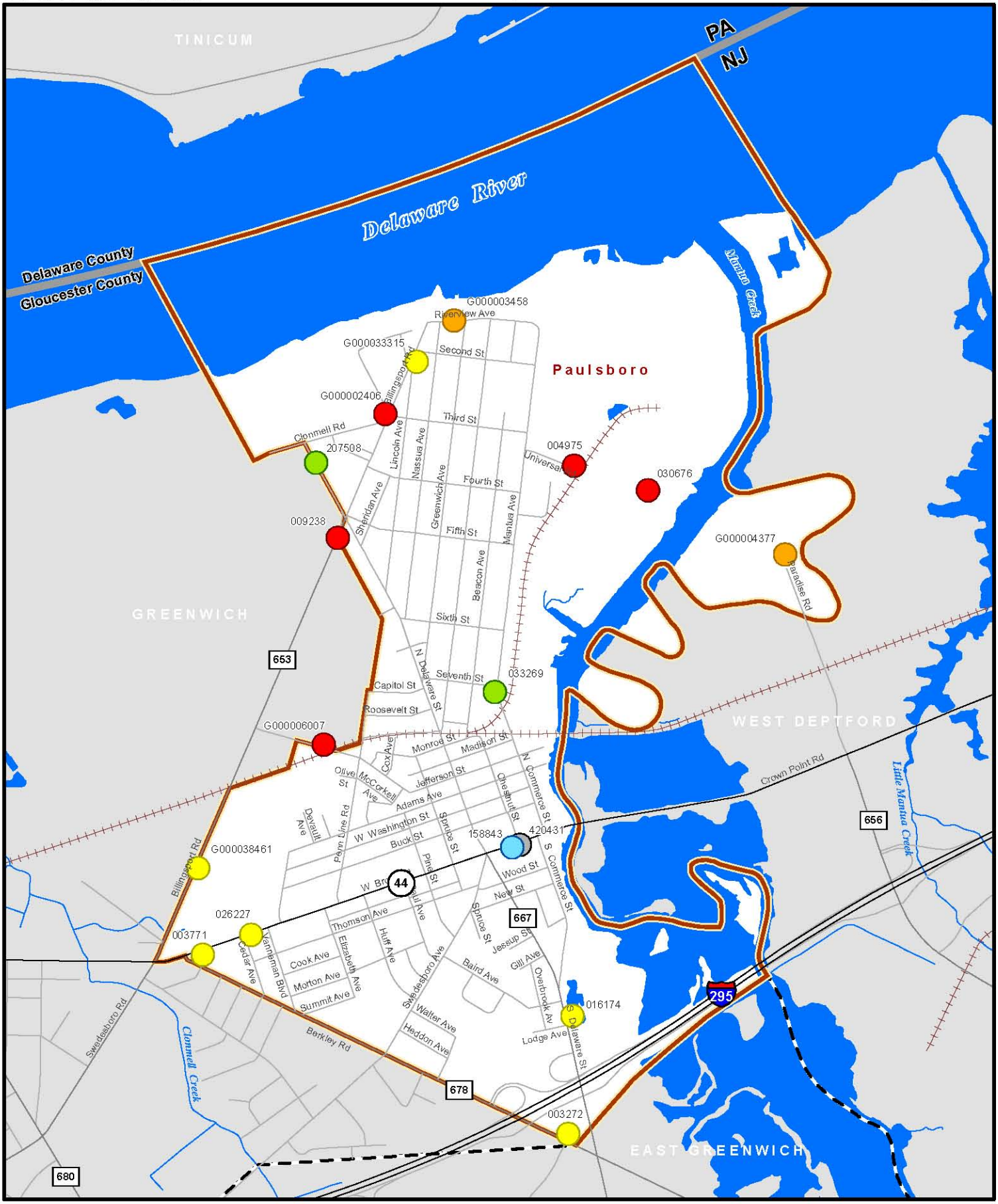
Map 22: Known Contaminated Sites (2009)



Sources : NJDEP, NJDOT, DVRPC
This map was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

- **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
- **U:** Not Yet Determined

N

0.2 0.1 0 0.2
Miles

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Air, aquifers, biological resources, built environment, climate, Delaware River, dredge spoils, Gloucester County, development, endangered species, environmental issues, environmental resource inventory, floodplains, forests, grasslands, groundwater, habitat, known contaminated sites, land preservation, Landscape Project, Mantua Creek, master planning, natural resources, New Jersey, open space, population, soils, steep slopes, topography, US Census, water quality, watersheds, wetlands.

Abstract

This publication documents the natural and community resources of the Borough of Paulsboro, Gloucester County, New Jersey. The natural resource information includes descriptions, tables, figures, and maps of: land use; soils; drinking water, aquifers, and wells; surface waters, including watersheds, streams, lakes, wetlands, and floodplains; impacts on water resources and surface water quality; impervious coverage; vegetation, including wetlands, forests, beach, and grasslands; animal communities; threatened and endangered species; Landscape Project Priority Habitats; and known contaminated sites. Community resources that are briefly described include population, transportation, borough utilities and services, historic buildings and structures, and protected open space. A short history of the community is also included.

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