

What New Jersey Needs To Know About Gas Drilling Along The Delaware River

Prepared by Damascus Citizens for Sustainability

DamascusCitizens.org Concerned about the Delaware River Basin and Beyond

-- New Jersey's drinking water is at risk:

- over half to 2/3 of New Jersey's population are dependent on water from the Delaware River Basin, including direct withdrawals from the Delaware River itself and recharge of the New Jersey Coastal Plain aquifer

If the Delaware River is contaminated from gas drilling or drilling related activities then New Jersey populations dependent on water either directly withdrawn from the River or sourced from aquifers recharged from the River will be impacted. The recharge area is connected to the Delaware River and its flood plain, as the geography indicates, then if there is direct discharge of chemicals, fracking liquid, produced fluids from the wells or other contaminated waste into surface waters flowing into the Delaware there would be a strong likelihood that some of this material would percolate into the aquifers and begin to bioaccumulate. Additionally the extensive water withdrawals and forest clearing related to the drilling will impact the River's water quantity and quality.

Summary of Potential Population Impact

Via two pathways - direct withdrawal and recharge of aquifers - water from the Delaware river Basin feeds New Jersey.

Direct water withdrawal is made from the Delaware River of approx. 100 million gallons a day of the total 225 million gallons a day used by the New Jersey Water Supply Authority (NJWSA). The NJWSA system would not function without this water from the Delaware River.

NJWSA serves approx. 2 million people (according to their website) or 1.5 million residents in central New Jersey as of 2005 (Raritan_Basin_Riverware_Model.pdf)

Direct withdrawals also serve

Camden 50,000 people

Trenton 205,00 people and there are other localities that do not give the amount of the direct withdrawal only say that they do make direct withdrawals in addition to municipal wells into aquifers being proportionally recharged by the Delaware River - these population numbers amount to another 678,000 people.

So the total for direct withdrawals is 933,000 people. SEE references DRBC FOIAs on page 10 and 11

The Coastal Plain Aquifers are being recharged from the Delaware River because of heavy pumping from the aquifers.

Coastal Plain Aquifer counties - population 4,205,600 (est for 2009)

3.15 million people in New Jersey drink Delaware River water

4.2 million additional people drink groundwater that gets recharge from the Delaware River

7.35 million people in New Jersey is the total that would be affected if the river became polluted

Total Population of New Jersey 8.7 million (2009 estimate)

Gas Drilling Presents a Catastrophic Threat to the DELAWARE RIVER WATERSHED - the source of over half of New Jersey's drinking water.

If gas drilling is permitted within the Delaware River Watershed area, the results will be catastrophic. In the Delaware River Basin alone, hundreds of billions of gallons of fresh water will be usurped and mixed with highly toxic chemicals in order to extract the gas from the shale rock. Then the waste water containing very high levels of salts, toxic metals, fracking chemicals and hydrocarbons - all of which have health effects - may be released into the Delaware River or its tributaries. Spills both legal and illegal happen regularly.

The Marcellus

Thirty-six percent of the Delaware River Watershed (4,928 square miles) lies within the Marcellus Shale region. This shale rock, up to a mile and a half deep, is said to be rich with natural gas, trillions of cubic feet worth. The gas industry says that the Marcellus Shale, spanning 600 miles across parts of four states (NY, PA, WV & OH), will become the nation's largest gas field.

Drilling in Delaware River Watershed

In both Pennsylvania and New York state extensive areas have been leased for drilling. Under current law, companies could end up putting a well every 40 acres in New York and Pennsylvania. This would result in over 30,000 wells within the Delaware River Watershed, in effect, transforming it into an industrial zone. The amounts of fresh water consumed and polluted could reach 400 billion gallons. (It takes between 3 and 5 million gallons of fresh water to fracture each horizontal well and they can be fractured multiple times.)

Second, under the 2005 Energy Policy Act, the gas industry gained exemptions to portions of the Clean Water Act, Safe Drinking Water Act (SDWA), Clean Air Act, Right-to-Know Act and Super-Fund Act. The "Halliburton Exemption" makes it possible for gas companies to keep secret the chemicals and other products used in fracking fluid and released as a result of the process.

The process of hydraulic fracturing is inherently polluting and contributes to global climate change. In the face of a global water shortage, it also has a devastating effect on the world's remaining sources of potable water. As New York City Council Environmental Protection Committee Chair James F. Gennaro stated: "Gas drilling and exploration is an activity that cannot be allowed within any drinking water supply watershed, as it will inexorably lead to significant drinking water contamination."

New Jersey water supply from the Delaware River

New Jersey has special danger in this regard as its aquifers are recharged from both direct water movement from the Upper Delaware Basin and from seepage recharge directly from the Delaware River.

There are direct Municipal Water Supply withdrawals in Camden and Trenton and additionally the New Jersey Water Supply Authority gets close to half of its water from the Delaware River

via withdrawals that go into the Delaware Raritan Canal and from there into a complex system that feeds more than 1.5 million residents in central New Jersey(as of 2005).

In certain areas (e.g., along the Delaware River) heavy pumping has caused a reversal in the normal discharge from the aquifer (Raritan-Magothy) such that the surface stream (Delaware River) now recharges the aquifer. **This phenomenon implies that, in addition to the New Jersey Coastal Plain Area, the Delaware River Basin within Delaware, New Jersey, Pennsylvania and New York must be regarded as a streamflow source zone (an upstream headwaters area which drains into a recharge zone), which flows into the Coastal Plain Area.**

Potomac-Raritan- Magothy aquifer system

Model studies have indicated that about forty three percent (43%) of the total inflow to the Potomac-Raritan- Magothy aquifer system in 1973 was induced recharge from the Delaware River (Luzier, 1980).

Also in this section are details - maps,etc - of where direct withdrawals are made from the Delaware River for municipal water supplies.

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The following is on the Delaware Raritan Canal

from http://www.njwsa.org/html/d__r_canal.html

The Delaware & Raritan Canal Transmission Complex is an integral part of a water supply system that also consists of Round Valley Reservoir and Spruce Run Reservoir which together have the capability of delivering 225 million gallons of raw water per day to the water utilities that **serve central New Jersey.**

SEE page 15 of [Raritan_Basin_Riverware_Model.pdf](#)
available HERE--> http://www.njwsa.org/Raritan_Basin_Riverware_Model.pdf

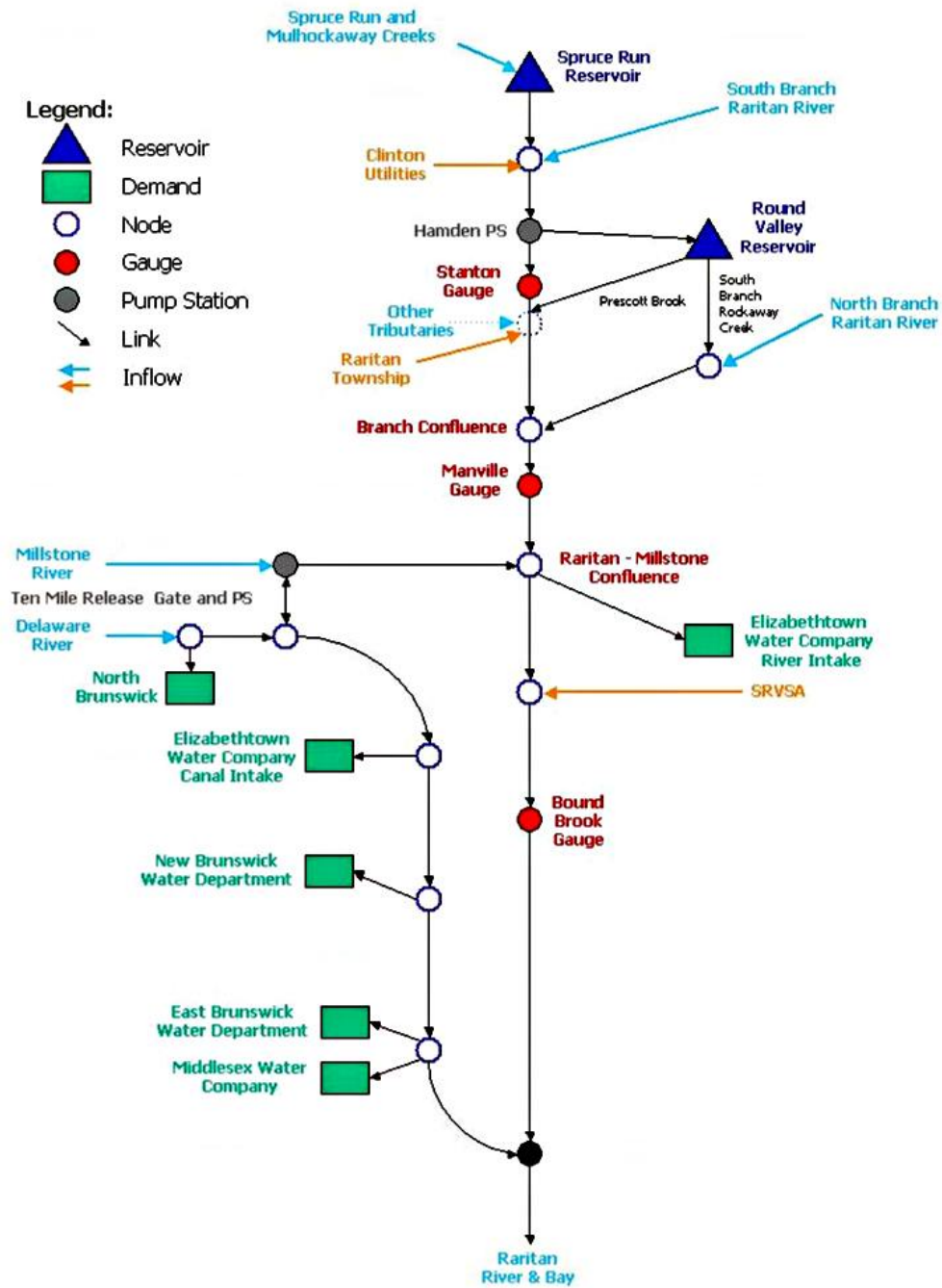
Pg 8 DIAGRAM of [Raritan_Basin_Riverware_Model.pdf](#) IS PRINTED ON PAGE 5
The Raritan River Basin system provides drinking water for more than 1.5 million residents in central New Jersey.(from Executive Summary)

Delaware Basin water is transferred to the Raritan Basin via the Delaware and Raritan Canal. ... 100 million gallons per day in 2005 from the Delaware River ... to the Raritan Basin. (from pg.22)

The Delaware and Raritan Canal is an inter-basin transfer of up to 100 mgd from the Delaware River. Water is diverted from the Delaware into the Canal at Bull's Island, near Stockton, New Jersey, and travels 60 miles to New Brunswick where the water is discharged to the Raritan River. Water purveyors withdraw water from the Canal at several locations along the route. Water not withdrawn by water purveyors is either discharged to the Millstone River at the Ten Mile Lock release gate²¹ or to the Raritan River at the downstream terminus at the Route 18 spillway.

Per the Delaware River Compact,²⁶ flow from the Delaware River is diverted to the Raritan Basin via the Delaware and Raritan Canal. The Canal, originally built in the 1800s for the conveyance of goods between New York and Philadelphia, is currently maintained for water supply and recreational purposes. During “normal” operations, 100 mgd may be diverted into the Canal from the Delaware with not more than 120 mgd to be diverted on any single day. During drought warning, 70 mgd may be diverted and during drought emergency 65 mgd may be diverted. Drought is defined by Delaware River Basin conditions and not by Raritan Basin conditions. The Authority monitors Canal flows through gates, skimmers and weirs and major points along the Canal, including Port Mercer (upstream of all the Canal purveyor intakes) and through the river interconnection (waste gate) at Ten Mile. The USGS also monitors flows at Port Mercer and has only rated their data as “fair” with poor records at low flow²⁷. To the extent possible, these data were used, but suspect periods in the record were modified to better reflect other observed conditions.

Figure 2. Raritan Basin Water Supply System Schematic



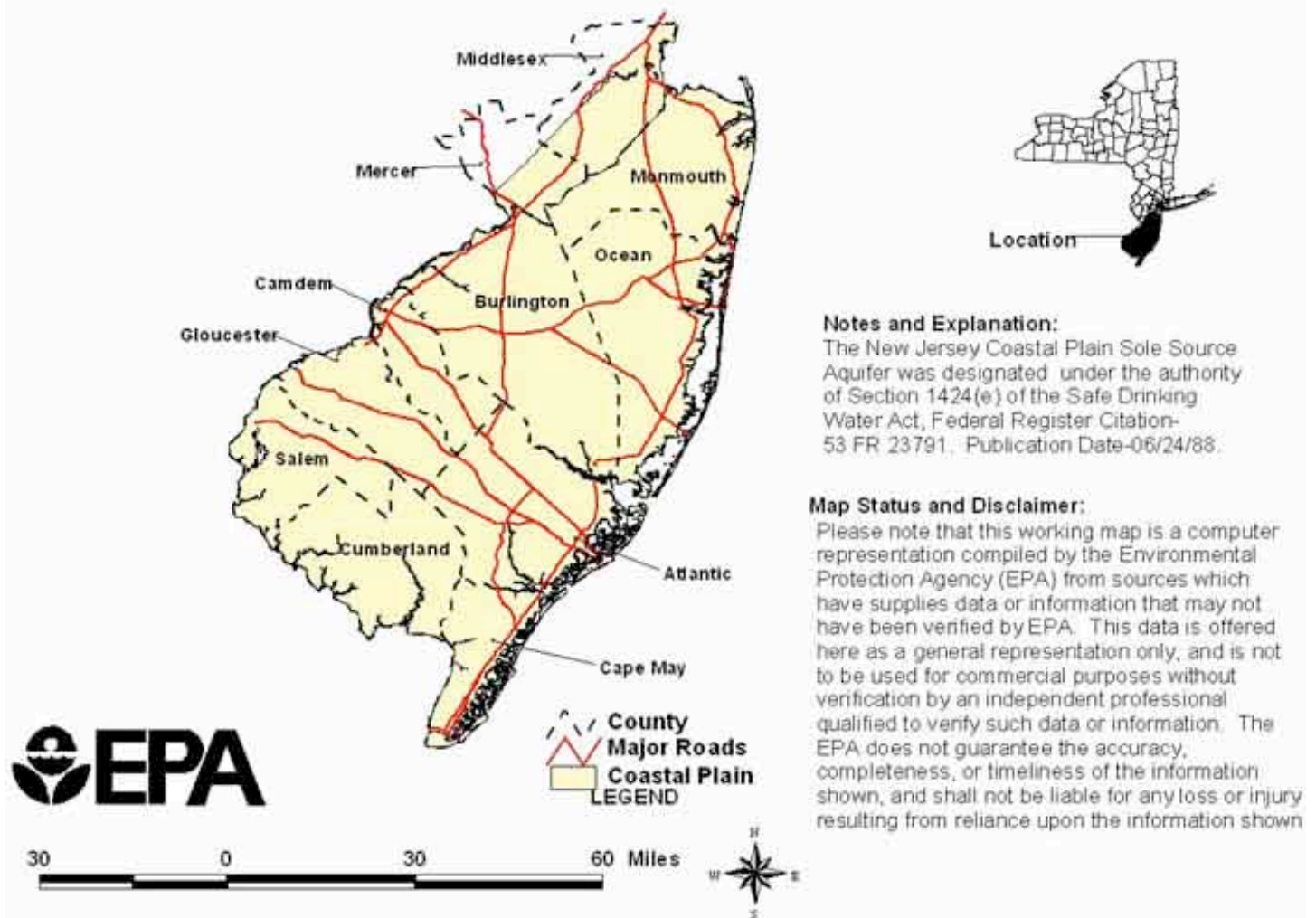
Re: the recharging of the NJ coastal aquifers US EPA <http://www.epa.gov/region02/water/aquifer/coast/coastpln.htm#112>

On December 4, 1978 the Environmental Defense Fund, Inc. and Sierra Club New Jersey Chapter petitioned the U.S. Environmental Protection Agency (EPA) Administrator to determine that the Counties of Monmouth, Burlington, Ocean, Camden, Gloucester, Atlantic, Salem, Cumberland, Cape May and portions of Mercer and Middlesex Counties, New Jersey, constitute an area whose aquifer system is "the sole or principal drinking water source for the area and which, if contaminated, would create a significant hazard to public health".

Figure 1. The Coastal Plain of New Jersey <http://www.epa.gov/region02/water/aquifer/coast/coastfig.htm>

Figure 1. The Coastal Plain of New Jersey

NJ Coastal Plain Sole Source Aquifer



The streamflow source zone for the New Jersey Coastal Plain Aquifer System includes upstream portions of the Delaware River Basin in the States of Delaware (New Castle County), New Jersey (Mercer-part, Hunterdon-part, Sussex-part, and Warren Counties), New York (Delaware, Orange, Sullivan and Ulster counties), and Pennsylvania (Berks-part, Bucks, Carbon-part, Chester-part, Delaware, Lackawanna-part, Lancaster, Lehigh, Luzerne-part, Monroe, Montgomery, Northampton, Philadelphia, Pike, Schuylkill and Wayne Counties). (**NOTE**; many of these areas are where gas drilling is planned by gas/oil industry)

The Delaware River and Estuary, Sandy Hook Bay, the Atlantic Coast and the older, harder rocks of the Piedmont province constitute the recharge boundaries of the New Jersey Coastal Plain aquifers. These hydrographic features represent the interfaces across which water either moves into or out of the ground water reservoir. Natural recharge occurs primarily through direct precipitation on the outcrop area of the geologic formations. A smaller component of natural recharge to the deeper layers of the system occurs by vertical leakage from the upper layers. This accounts for a small percentage of the total amount of recharge; however, over a large area and a long period of time the amount of water transmitted can be significant.

Natural recharge to the New Jersey Coastal Plain Area occurs primarily through direct precipitation on the outcrop area of the geologic formations. Based primarily on estimates of ground water contributing to streamflow and basin runoff, several estimates of ground water recharge in the Coastal Plain have been made. In the outcrop areas of the Potomac - Raritan - Magothy aquifer system, where it is unconfined, recharge to the aquifer is about twelve (12) inches per year (in/yr). In the outcrop area of the Farrington aquifer, the recharge to ground water is twelve (12) in/yr. Recharge ranges from twelve to twenty (12 - 20) in/yr in the outcrop of the Old Bridge aquifer.

Model studies have indicated that about forty three percent (43%) of the total inflow to the Potomac-Raritan- Magothy aquifer system in 1973 was induced recharge from the Delaware River (Luzier, 1980).

Another component of natural recharge to deep, confined aquifers is primarily by vertical leakage from the upper layers. Only a small percentage of the water within the unconfined ground water system leaks to the confined aquifers; but over a large area and a long period of time, the amount of water transmitted can be significant.

The New Jersey Coastal Plain Aquifer discharges to the surface through streams, springs and evapotranspiration. Many streams ultimately flow into bays or directly into the ocean.

Development of the ground water reservoir as a water supply source constitutes another discharge component which today accounts for a significant portion of discharge from the overall system. In certain areas (e.g., along the Delaware River) heavy pumping has caused a reversal in the normal discharge from the aquifer (Raritan-Magothy) such that the surface stream (Delaware River) now recharges the aquifer. **This phenomenon implies that, in addition to the New Jersey Coastal Plain Area, the Delaware River Basin within Delaware, New Jersey, Pennsylvania and New York must be regarded as a streamflow source zone (an upstream headwaters area which drains into a recharge zone), which flows into the Coastal Plain Area.**

New Jersey Source Water Assessment Program (SWAP)

http://www.nj.gov/dep/swap/reports/appendixb_attachment3.pdf

Potential Contaminant Source Inventory (PCSI)

“An essential component in determining susceptibility ratings for drinking water sources was the PCSI. The PCSI is a catalog of the “sensitivity” and the “intensity” factors in the delineated areas for each drinking water source. These contaminants may impact a drinking water source either through point or non-point contamination.”

NOTE:does not include the contaminants released from gas drilling. Mining of any sort is not addressed

Direct withdrawals of water for drinking water supplies from the Delaware River shown here
http://water.usgs.gov/orh/nrwww/Regional_sparrow_Fischer_de.pdf PAGE 6



Delaware River Basin

Area > 12,000 square miles

Population over 7 million.

An additional 7 million people outside the basin rely on the Delaware for drinking water.

Delaware River is tidal up to Trenton

AND here from same source on page 14

From this source: <http://www.state.nj.us/pinelands/infor/broch/Kirkwood-Cohansey%20Project%20Work%20Plan.pdf>



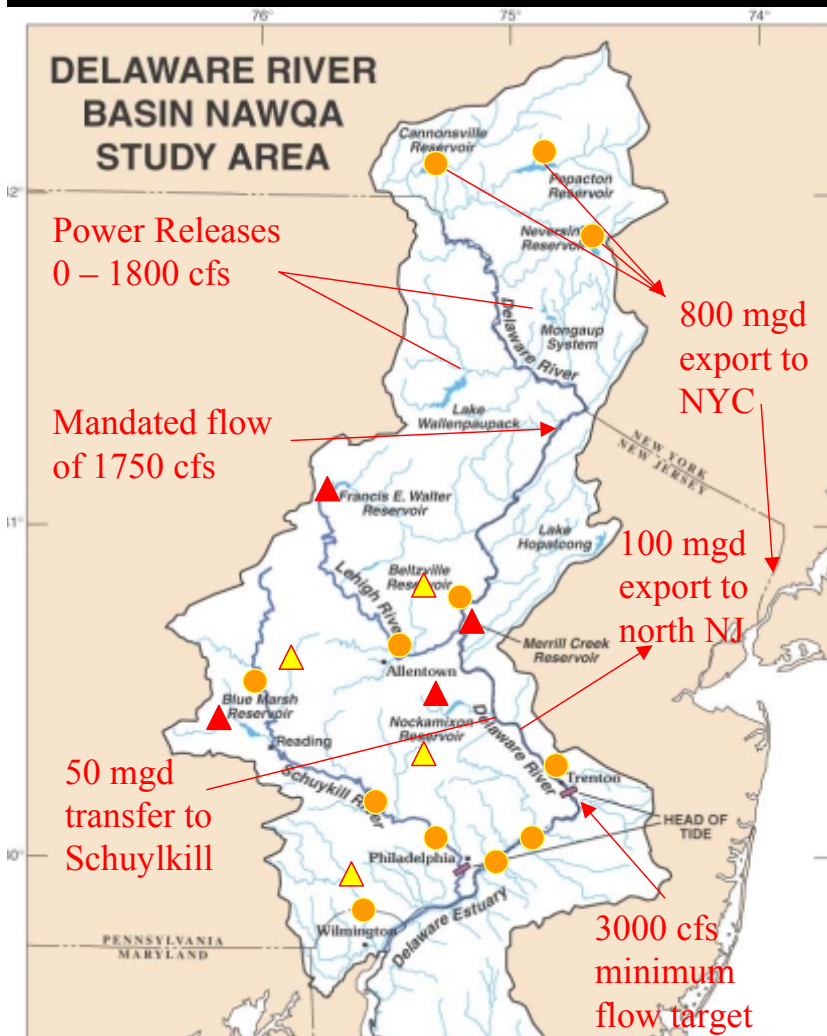
FLOW CORRECTIONS

Reservoirs control mainstem flow and are used to export water from the basin.

Drinking water withdrawals at major metropolitan areas.

Many large STPs discharge to Estuary.

- Major drinking water intakes
- ▲ Flood control & flow augmentation
- ▲ Water Supply Reservoirs



AND

Titled: THE KIRKWOOD-COHANSEY PROJECT WORK PLAN

Opens with this statement: “New Jersey Public Law 2001, Chapter 165 directs the Pinelands Commission to assess and prepare a report on the key hydrologic and ecological information needed to determine how the current and future water-supply needs within the Pinelands area may be met while protecting the Kirkwood- Cohansey aquifer system and avoiding any adverse ecological impact on the Pinelands area.”

Kirkwood-Cohansey Project Database and webpage if completed should give a good baseline that could be used to evaluate the contamination produced by gas drilling in the watersheds feeding the aquifer - the Delaware River Basin in particular as gas drilling is planned by the gas/oil industry for that area.

The list below contains municipalities bordering the main stem of the Delaware River. Each is served potable water by a Public Water Supplier that withdraws water directly from the Delaware River. Please note that there are other municipalities that are served by Delaware River water that do not appear on this list because they do not border the main stem of the Delaware River. These can be provided on request.

Municipality	County	State
Beverly City	Burlington	New Jersey
Bordentown Township	Burlington	New Jersey
Burlington City	Burlington	New Jersey
Burlington Township	Burlington	New Jersey
Cinnaminson Township	Burlington	New Jersey
Delanco Township	Burlington	New Jersey
Delran Township	Burlington	New Jersey
Edgewater Park Township	Burlington	New Jersey
Palmyra Boro	Burlington	New Jersey
Riverton Boro	Burlington	New Jersey
Camden City	Camden	New Jersey
Gloucester City	Camden	New Jersey
Pennsauken Township	Camden	New Jersey
Bensalem Township	Bucks	Pennsylvania
Bristol Borough	Bucks	Pennsylvania
Bristol Township	Bucks	Pennsylvania
Falls Township	Bucks	Pennsylvania
Lower Makefield Township	Bucks	Pennsylvania
Morrisville Borough	Bucks	Pennsylvania
New Hope Borough	Bucks	Pennsylvania
Solebury Township	Bucks	Pennsylvania
Tullytown Borough	Bucks	Pennsylvania
Yardley Borough	Bucks	Pennsylvania
Tinicum Township	Delaware	Pennsylvania
Easton City	Northampton	Pennsylvania
Forks Township	Northampton	Pennsylvania
Lower Mt Bethel Township	Northampton	Pennsylvania
Williams Township	Northampton	Pennsylvania
Philadelphia City	Philadelphia	Pennsylvania

Only populations from the New Jersey municipalities in the chart below were counted.

The list below contains municipalities that are served potable water by a Public Water Supplier that withdraws water directly from the Delaware River.

Municipality	County	State
Beverly City	Burlington	New Jersey
Bordentown Township	Burlington	New Jersey
Burlington City	Burlington	New Jersey
Burlington Township	Burlington	New Jersey
Chesterfield Township	Burlington	New Jersey
Cinnaminson Township	Burlington	New Jersey
Delanco Township	Burlington	New Jersey
Delran Township	Burlington	New Jersey
Edgewater Park Township	Burlington	New Jersey
Evesham Township	Burlington	New Jersey
Maple Shade Township	Burlington	New Jersey
Moorestown Township	Burlington	New Jersey
Mount Laurel Township	Burlington	New Jersey
Palmyra Boro	Burlington	New Jersey
Riverside Township	Burlington	New Jersey
Riverton Boro	Burlington	New Jersey
Willingboro Township	Burlington	New Jersey
Audubon Boro	Camden	New Jersey
Audubon Park Boro	Camden	New Jersey
Barrington Boro	Camden	New Jersey
Bellmawr Boro	Camden	New Jersey
Camden City	Camden	New Jersey
Cherry Hill Township	Camden	New Jersey
Clementon Boro	Camden	New Jersey
Collingswood Boro	Camden	New Jersey
Gibbsboro	Camden	New Jersey
Gloucester City	Camden	New Jersey
Gloucester Township	Camden	New Jersey
Haddon Heights Boro	Camden	New Jersey

Haddon Township (East)	Camden	New Jersey
Haddon Township (North)	Camden	New Jersey
Haddon Township (South)	Camden	New Jersey
Haddonfield Boro	Camden	New Jersey
Hi-nella Boro	Camden	New Jersey
Laurel Springs Boro	Camden	New Jersey
Lawnside Boro	Camden	New Jersey
Lindenwold Boro	Camden	New Jersey
Magnolia Boro	Camden	New Jersey
Mount Ephraim Boro	Camden	New Jersey
Oaklyn Boro	Camden	New Jersey
Pennsauken Township	Camden	New Jersey
Runnemede Boro	Camden	New Jersey
Somerdale Boro	Camden	New Jersey
Stratford Boro	Camden	New Jersey
Tavistock Boro	Camden	New Jersey
Voorhees Township	Camden	New Jersey
Ewing Township	Mercer	New Jersey
Hamilton Township	Mercer	New Jersey
Hopewell Township	Mercer	New Jersey
Lawrence Township	Mercer	New Jersey
Trenton City	Mercer	New Jersey
Bensalem Township	Bucks	Pennsylvania
Bristol Borough	Bucks	Pennsylvania
Bristol Township	Bucks	Pennsylvania
Chalfont Borough	Bucks	Pennsylvania
Doylestown Township	Bucks	Pennsylvania
Falls Township	Bucks	Pennsylvania
Hilltown Township	Bucks	Pennsylvania
Lower Makefield Township	Bucks	Pennsylvania
Lower Southampton Township	Bucks	Pennsylvania
Middletown Township	Bucks	Pennsylvania
Morrisville Borough	Bucks	Pennsylvania
New Britain Borough	Bucks	Pennsylvania
New Britain Township	Bucks	Pennsylvania
New Hope Borough	Bucks	Pennsylvania
Newtown Township	Bucks	Pennsylvania
Solebury Township	Bucks	Pennsylvania
Telford Borough	Bucks	Pennsylvania
Tullytown Borough	Bucks	Pennsylvania
Warrington Township	Bucks	Pennsylvania
West Rockhill Township	Bucks	Pennsylvania
Yardley Borough	Bucks	Pennsylvania
Darby Township	Delaware	Pennsylvania
Folcroft Borough	Delaware	Pennsylvania
Millbourne Borough	Delaware	Pennsylvania
Tinicum Township	Delaware	Pennsylvania

Upper Darby Township	Delaware	Pennsylvania
Yeadon Borough	Delaware	Pennsylvania
Cheltenham Township	Montgomery	Pennsylvania
East Norriton Township	Montgomery	Pennsylvania
Franconia Township	Montgomery	Pennsylvania
Hatfield Borough	Montgomery	Pennsylvania
Hatfield Township	Montgomery	Pennsylvania
Horsham Township	Montgomery	Pennsylvania
Lansdale Borough	Montgomery	Pennsylvania
Lower Gwynedd Township	Montgomery	Pennsylvania
Lower Providence Township	Montgomery	Pennsylvania
Lower Salford Township	Montgomery	Pennsylvania
Montgomery Township	Montgomery	Pennsylvania
North Wales Borough	Montgomery	Pennsylvania
Perkiomen Township	Montgomery	Pennsylvania
Salford Township	Montgomery	Pennsylvania
Skippack Township	Montgomery	Pennsylvania
Souderton Borough	Montgomery	Pennsylvania
Springfield Township	Montgomery	Pennsylvania
Telford Borough	Montgomery	Pennsylvania
Towamencin Township	Montgomery	Pennsylvania
Upper Dublin Township	Montgomery	Pennsylvania
Upper Gwynedd Township	Montgomery	Pennsylvania
Upper Salford Township	Montgomery	Pennsylvania
Whitemarsh Township	Montgomery	Pennsylvania
Whitpain Township	Montgomery	Pennsylvania
Worcester Township	Montgomery	Pennsylvania
Bethlehem Township	Northampton	Pennsylvania
Easton City	Northampton	Pennsylvania
Forks Township	Northampton	Pennsylvania
Glendon Borough	Northampton	Pennsylvania
Lower Mt Bethel Township	Northampton	Pennsylvania
Lower Nazareth Township	Northampton	Pennsylvania
Lower Saucon Township	Northampton	Pennsylvania
Nazareth Borough	Northampton	Pennsylvania
Palmer Township	Northampton	Pennsylvania
Plainfield Township	Northampton	Pennsylvania
Stockertown Borough	Northampton	Pennsylvania
Upper Nazareth Township	Northampton	Pennsylvania
West Easton Borough	Northampton	Pennsylvania
Williams Township	Northampton	Pennsylvania
Wilson Borough	Northampton	Pennsylvania
Philadelphia City	Philadelphia	Pennsylvania