# Delaware
# Water Supply Coordinating Council
# Report to the DRBC WMAC



West Trenton, NJ

Oct 24, 2017

Delaware DNREC
Division of Water
Dover, Del.

University of Delaware
Water Resources Center
Newark, Del.

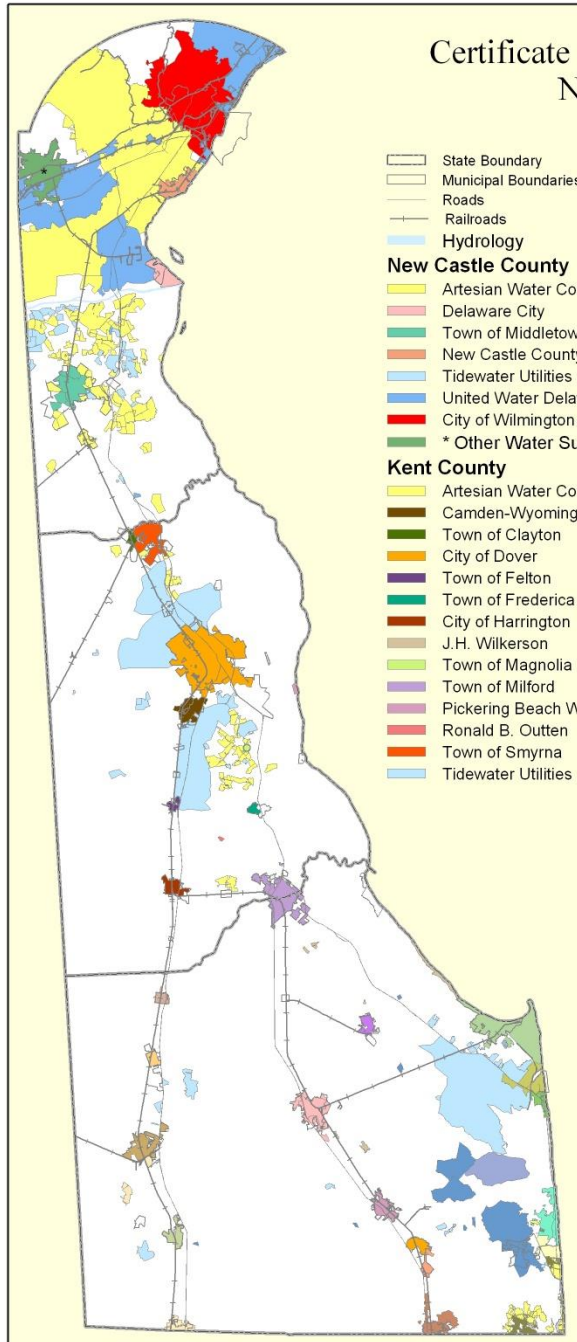
# Delaware Water Supply Coordinating Council

- In July 2000, Governor Carper signed HB 549 that formed the WSCC and designated Secretary of DNREC as Chair, DGS as technical advisor; and UD Water Resources Agency as “Temporary Water Master”.
- The WSCC is created by 26 Del. C. Sections 1305 - 1308 and 26 Del. C. Ch. 14.
- The 2003 law authorized the WSCC to publish water supply plans in Delaware.
- Since 2000, 13 plans have been submitted to the Governor and General Assembly
- In July 2014, Governor Markell signed amendments passed by 147$^{th}$ General Assembly that extended duties of the WSCC from Jan 1, 2016 to Jan 31, 2022.

# By State law, the following members are appointed to the Delaware WSCC:

a. The Secretary of the Department of Natural Resources and Environmental Control or Secretary's designee
b. The Secretary of the Department of Agriculture or the Secretary's designee
c. The Executive Director of the Public Service Commission or the Executive Director's designee
d. The Director of the Delaware Emergency Management Agency or the Director's designee
e. The Director of the Division of Public Health or the Director's designee
f. The Public Advocate or the Public Advocate's designee
g. The Director of the Delaware Geological Survey or the Director's designee
h. The Director of the Water Resources Agency at the University of Delaware or the Director's designee
i. The Executive Director of the Delaware River Basin Commission or the Executive Director's designee
j. A representative of the office of the Governor
k. A representative of each of the governments of New Castle County, Kent County and Sussex County
l. A representative of each public and private water utility serving New Castle County
m. A representative of public water supply utilities from the Sussex County Association of Towns (SCAT)
n. A representative of public water supply utilities of Kent County from the League of Local Governments
o. A representative from the Delaware Rural Water Association
p. A representative from the Delaware Chapter of the National Association of Water Companies
q. One representative from Chambers of Commerce in New Castle County, Kent County and Sussex County
r. A representative of the Delaware State Chamber of Commerce
s. A representative of the New Castle County Chamber of Commerce
t. A representative of the Delaware Nursery and Landscape Association
u. A representative of the Delaware Grounds Management Association
v. A representative of the Delaware State Golf Association
w. A representative of the Delaware Nature Society
x. A representative from the Delaware Farm Bureau
y. A representative from the Center for Inland Bays
z. The State Fire Marshal or the State Fire Marshal's designee
aa. A representative from the Civic League of New Castle County
bb. A representative from the Coalition of Natural Stream Valleys
cc. The State Climatologist or State Climatologist's designee.

# Certificate of Public Convenience and Necessity (CPCNs)



State Boundary
Municipal Boundaries
Roads
Railroads
Hydrology

**New Castle County**
- Artesian Water Company
- Delaware City
- Town of Middletown
- New Castle County Water & Light Company
- Tidewater Utilities
- United Water Delaware
- City of Wilmington
- * Other Water Supply Service Area

**Kent County**
- Artesian Water Company
- Camden-Wyoming Sewer
- Town of Clayton
- City of Dover
- Town of Felton
- Town of Frederica
- City of Harrington
- J.H. Wilkerson
- Town of Magnolia
- Town of Milford
- Pickering Beach Water
- Ronald B. Outten
- Town of Smyrna
- Tidewater Utilities

**Sussex County**
- Artesian Water Company
- Town of Bethany Beach
- Town of Blades
- Town of Bridgeville
- Town of Dagsboro
- Town of Delmar
- Town of Frankford
- Town of Georgetown
- Town of Greenwood
- J.H. Wilkerson
- Town of Laurel
- Lewes Board of Public Works
- City of Lewes
- Long Neck Water Company
- Town of Milford
- Town of Millsboro
- Town of Milton
- Public Water Supply
- City of Rehoboth
- Sea Colony Water Company
- City of Seaford
- Town of Selbyville
- Sussex County Council
- Sussex Shores Water
- Tidewater Utilities

February 2004

0 3 6 12 18 24 Miles

*Sources:*
*Certificate of Public Convenience and Neccessity (CPCNs) - Delaware Department of Natural Resources and Environmental Control, Public Service Commission, February 2004*
*Municipal Boundaries - Office of State Planning Coordination (OSPC), February 2004*

www.wr.udel.edu WRA water resources agency
UNIVERSITY OF DELAWARE
institute for Public Administration
COLLEGE OF HUMAN SERVICES, EDUCATION & PUBLIC POLICY

# Northern New Castle County
# Delaware

# THIRTEENTH REPORT TO THE GOVERNOR AND GENERAL ASSEMBLY

Regarding the Progress of the:

## DELAWARE WATER SUPPLY COORDINATING COUNCIL

Water Supply and Demand Projections for Northern New Castle County through 2030

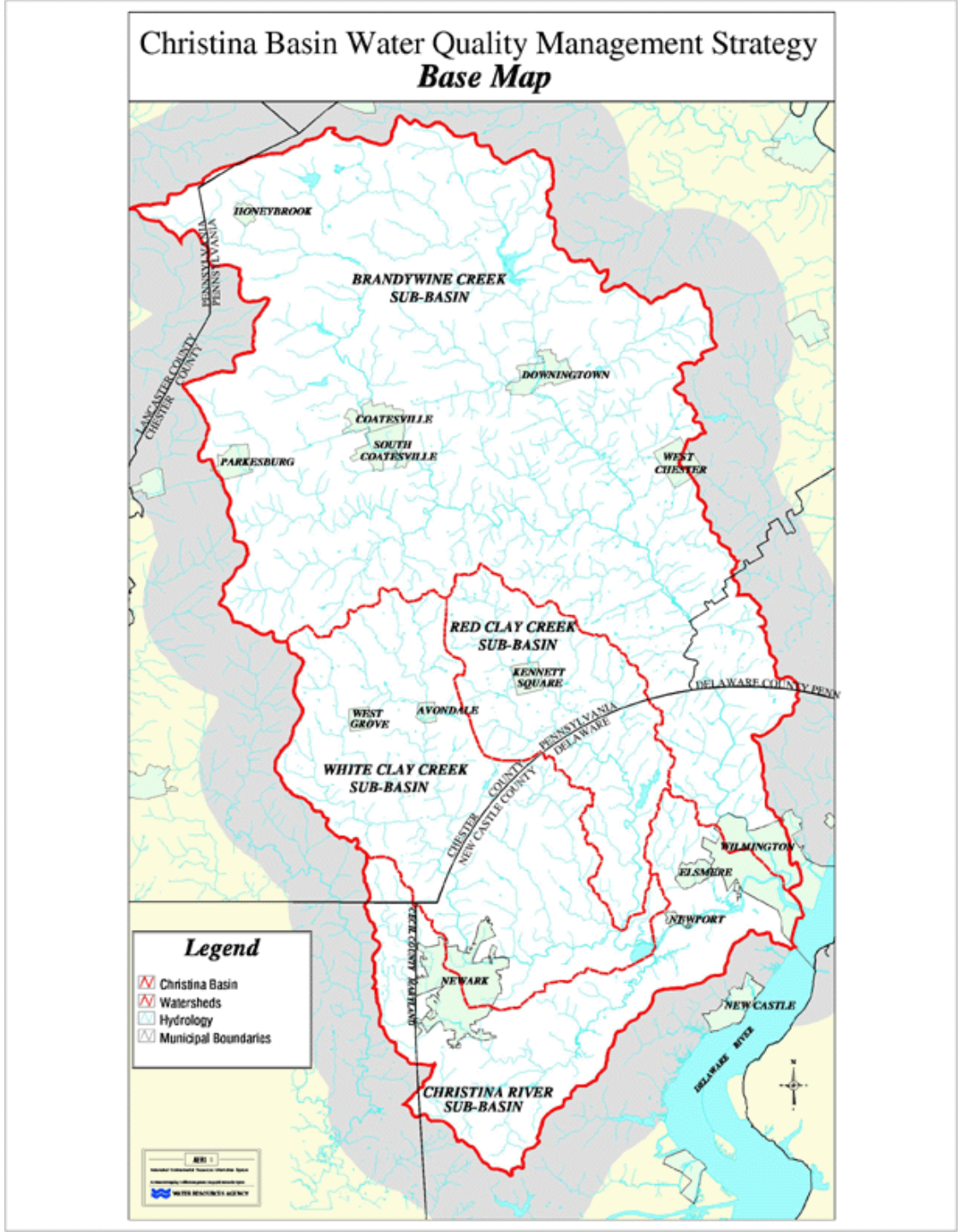
**Draft October 19, 2017**


Prepared by the:

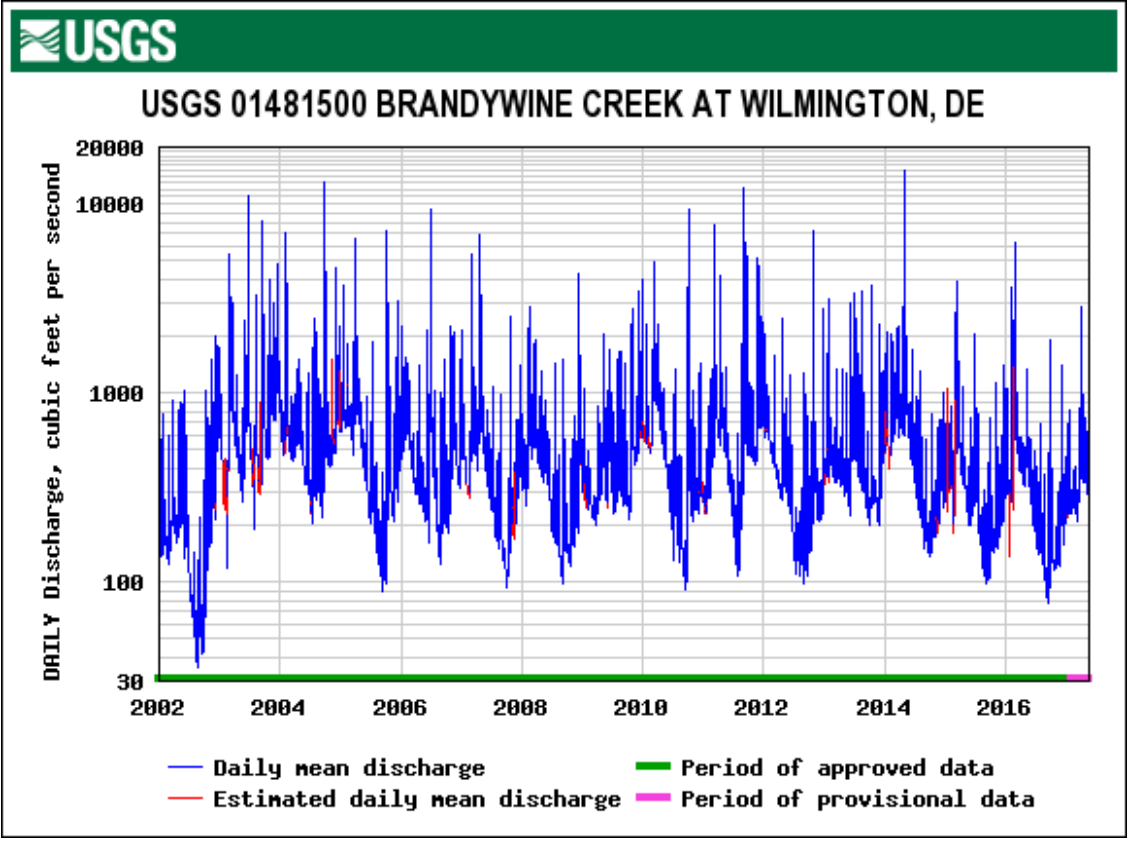
Delaware Department of Natural Resources and Environmental Control

Delaware Geological Survey

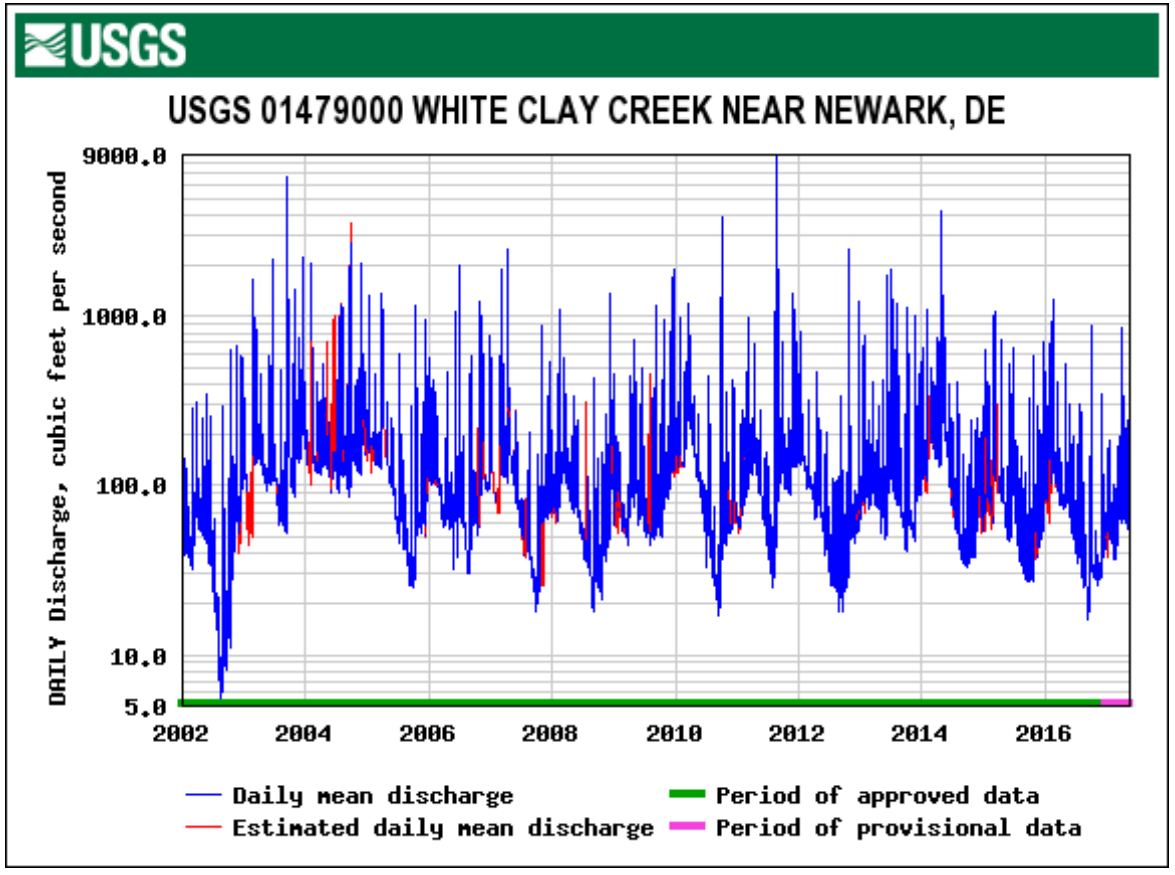
University of Delaware Water Resources Center




Nearly 75% of Delaware's water supply originates in the Brandywine Christina watershed and 2/3 of the watershed forms in the headwaters in Pennsylvania and Maryland.




During fall 2016, the Brandywine Creek and White Clay Creek in northern Delaware recorded the lowest stream flows since the drought of 2002.



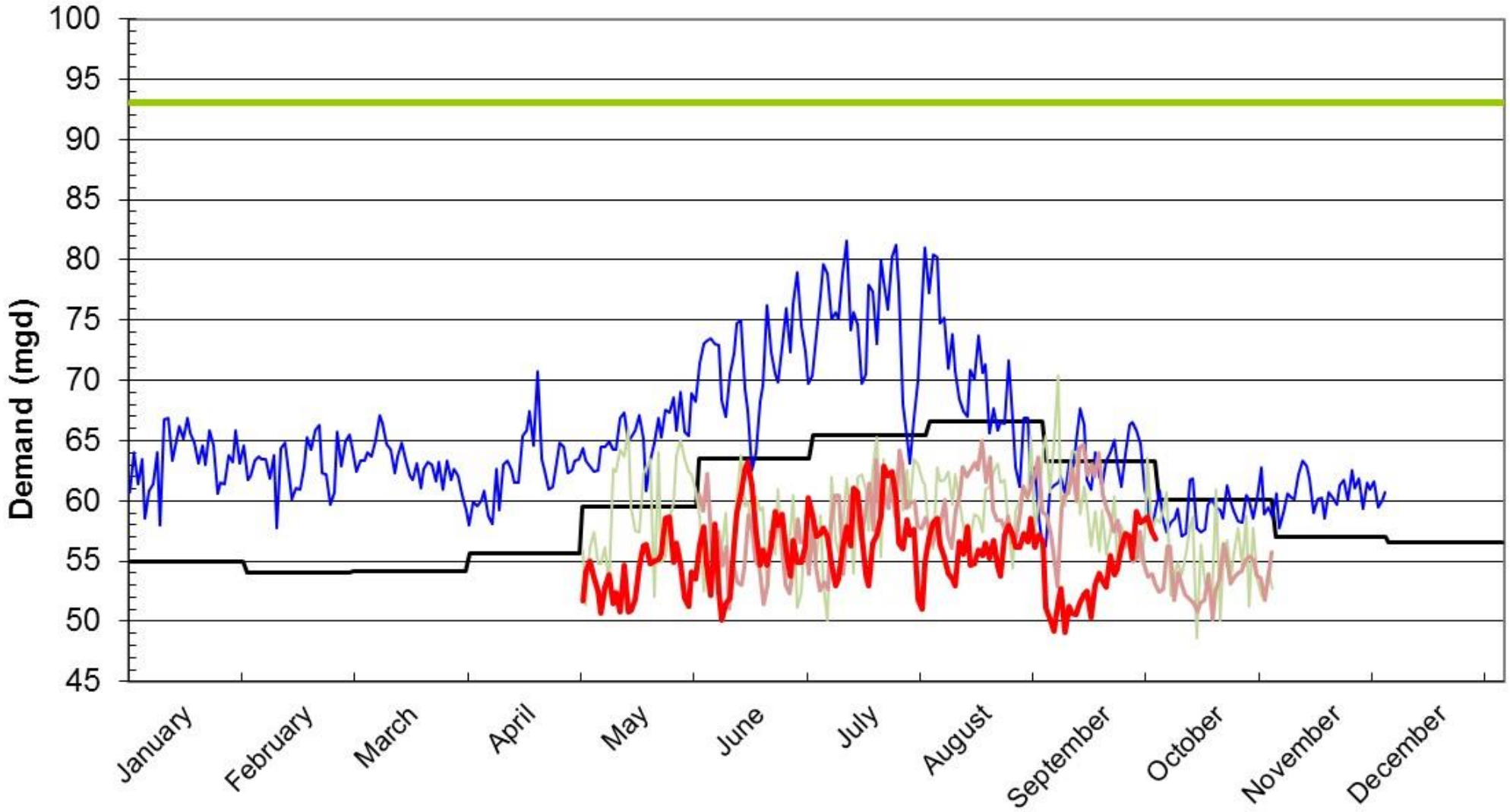
# Northern Delaware Drought Advisory Guidelines

Reported by the Drought Advisory Guidelines Subcommittee (DAGS), which is composed of the Delaware Department of Natural Resources and Environmental Control, Delaware Geological Survey, and University of Delaware Water Resources Agency with input from the water purveyors and representatives from the landscaping industry. These drought operating guidelines are designed to provide guidance to the Delaware Water Supply Coordinating Council (WSCC) and the Governor's Drought Advisory Committee (GDAC). Responsibility for providing technical guidance for a move up to or down from Drought Watch is with the WSCC. Responsibility for providing technical guidance for a move up to or down from Drought Warning or Emergency is with the GDAC. Final declaration of drought advisories rests with the Governor.

| Indicators | Drought Watch Voluntary Conservation | Drought Warning Voluntary Conservation | Drought Emergency Mandatory Restrictions | Status Sept. 28, 2016 |
|---|---|---|---|---|
| **Precipitation** Wilmington Airport 12-month | -6.00" to -8.99" | -9.00" to -11.99" | >-12.00" | -2.87" (deficit increased by 0.48") |
| **Precipitation** Wilmington Airport 6-month | -3.00" to -4.50" | -4.50" to- 6.00" | >-6.00" | -1.90" (deficit increased by 0.49") |
| **Brandywine Creek** (30-day moving avg) | 85 mgd | 70 mgd | 48 mgd | 75.5 mgd (flow increased by 2.9 mgd) |
| **White Clay Creek - Stanton** (30-day moving avg) | 42 mgd | 37 mgd | 31 mgd | 33.1 mgd (flow increased by 1.0 mgd) |
| **White Clay Creek - Newark** (30-day moving avg) | 19 mgd | 16 mgd | 13 mgd | 14.3 mgd (no change) |
| **Well Db24-18** | 14 - 14.99 (fbls) | 15 - 15.99 (fbls) | 16 (fbls) | 13.81 (fbls) (gw level declined by 0.44 ft) |
| **Water Conditions Index** | 4.0-5.0 | 3.0-3.99 | <3.00 | 4.35 (Index increased by .22) |
| **Chlorides** | WCC ≤ 37 mgd for 5 consecutive days at SUEZ Stanton Intake | Cl > 250 ppm for 3 days at Christina River at Newport | Cl > 250 ppm for 3 days at UWD Stanton Intake | Monitoring 512 ppm (Cl decreased by 163 ppm) |
| **Hoopes Reservoir** (City of Wilmington) | -10 ft (68% capacity) | -12 ft (64% capacity) | -15 ft (57% capacity) | -3.7 ft (9/19/2016) |
| **Newark Reservoir** | - 10 ft (70% capacity) | -17 ft (52% capacity) | -27 ft (28% capacity) | -11.0 ft (9/16/2016) |

| Monitored | | | | |
|---|---|---|---|---|
| **Aquifer Storage and Recovery** | Monitor Status | Monitor Status | Monitor Status | SUEZ: .102mg (9/6/2016) AWC: 49 mg (9/19/2016) |
| **Octoraro Reservoir** (Chester Water Authority) | Monitor Status | Monitor Status | Monitor Status | |
| **Marsh Creek Reservoir** | Monitor Status | Monitor Status | Monitor Status | PA DCNR releasing ~7.8 mgd into Brandywine Creek |
| **Chlorides on the Delaware River 9/22/2016** | Monitor Status | Monitor Status | Monitor Status | Normal RM: 76 Current RM: 82 (Commodore Barry Bridge) |
| **DRBC Lower Basin Drought Criteria** | Monitor Status | Monitor Status | Monitor Status | |
| **NYC DRB Reservoirs (DRBC 9/23/2016)** | Monitor Status | Monitor Status | Monitor Status | Storage 180.3 bg or 63 bg above drought watch |

# Public Water Demand: Northern New Castle County

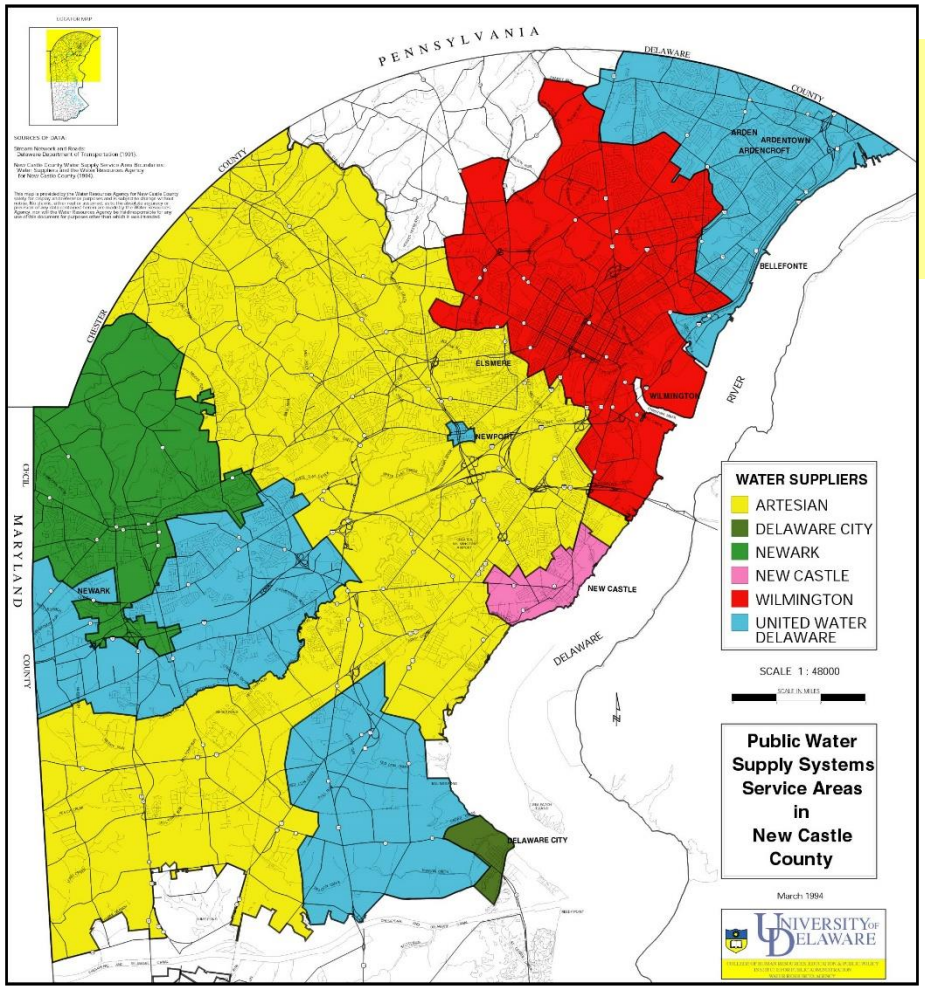



Compiled by the University of Delaware Water Resources Center using data from Artesian Water Co., City of Newark, New Castle Municipal Services Commission, SUEZ Delaware and City of Wilmington

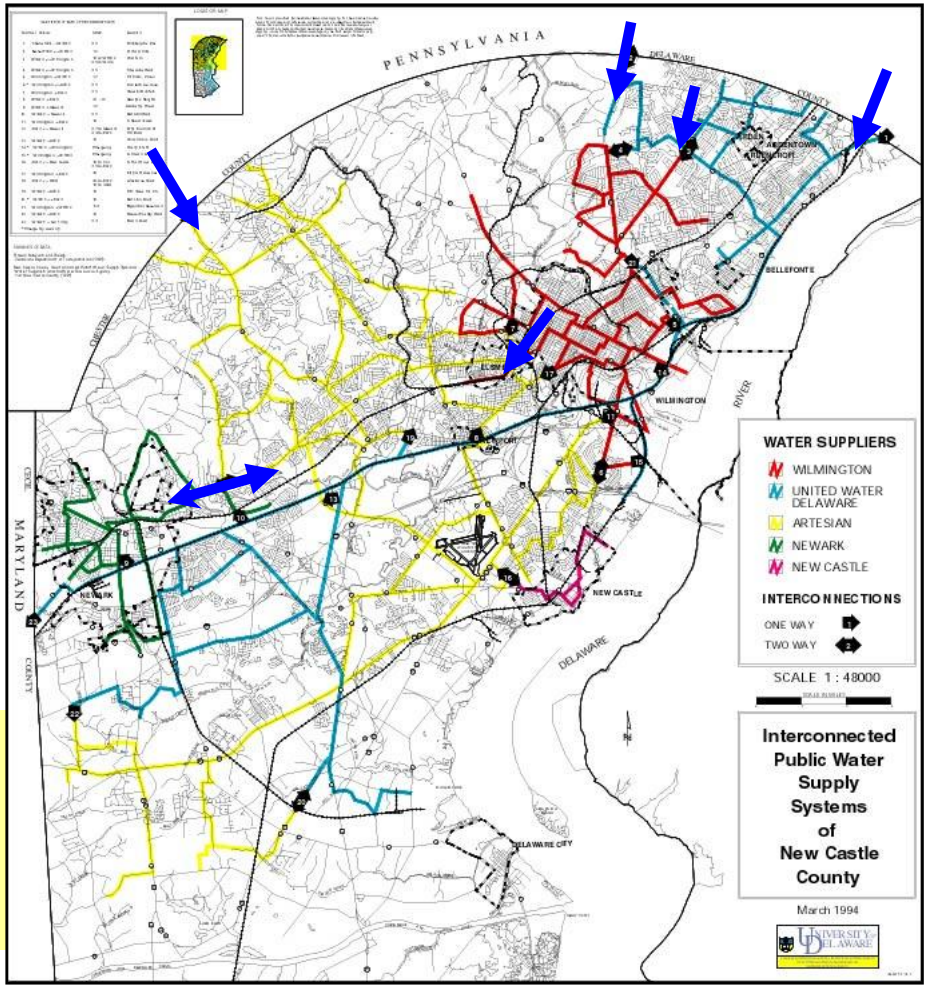
Historic Peak 1997 — Monthly Mean (2006-2010) — 2002 drought — 2015 — 2016 — 2017

# Water supply developed since the drought of 1999 in northern Delaware.

| Sponsor | Project | Capacity (mg) |
|---|---|---|
| Artesian Water Co. | New Wells North of C&D Canal | 405 |
| Artesian Water Co. | Aquifer Storage and Recovery | 130 |
| City of Newark | Newark Reservoir | 317 |
| City of Newark | South Wellfield Iron Treatment Plant | 75 |
| SUEZ Delaware | Modify Tidal Capture Structure Plan | 400 |
| SUEZ Delaware | Aquifer Storage and Recovery | 75 |
| City of Wilmington | Hoopes Reservoir Deep Storage Plan | 500 |
| City of Wilmington | Raise Hoopes Reservoir Water Level by 2 ft | 150 |
| | | **2,052** |

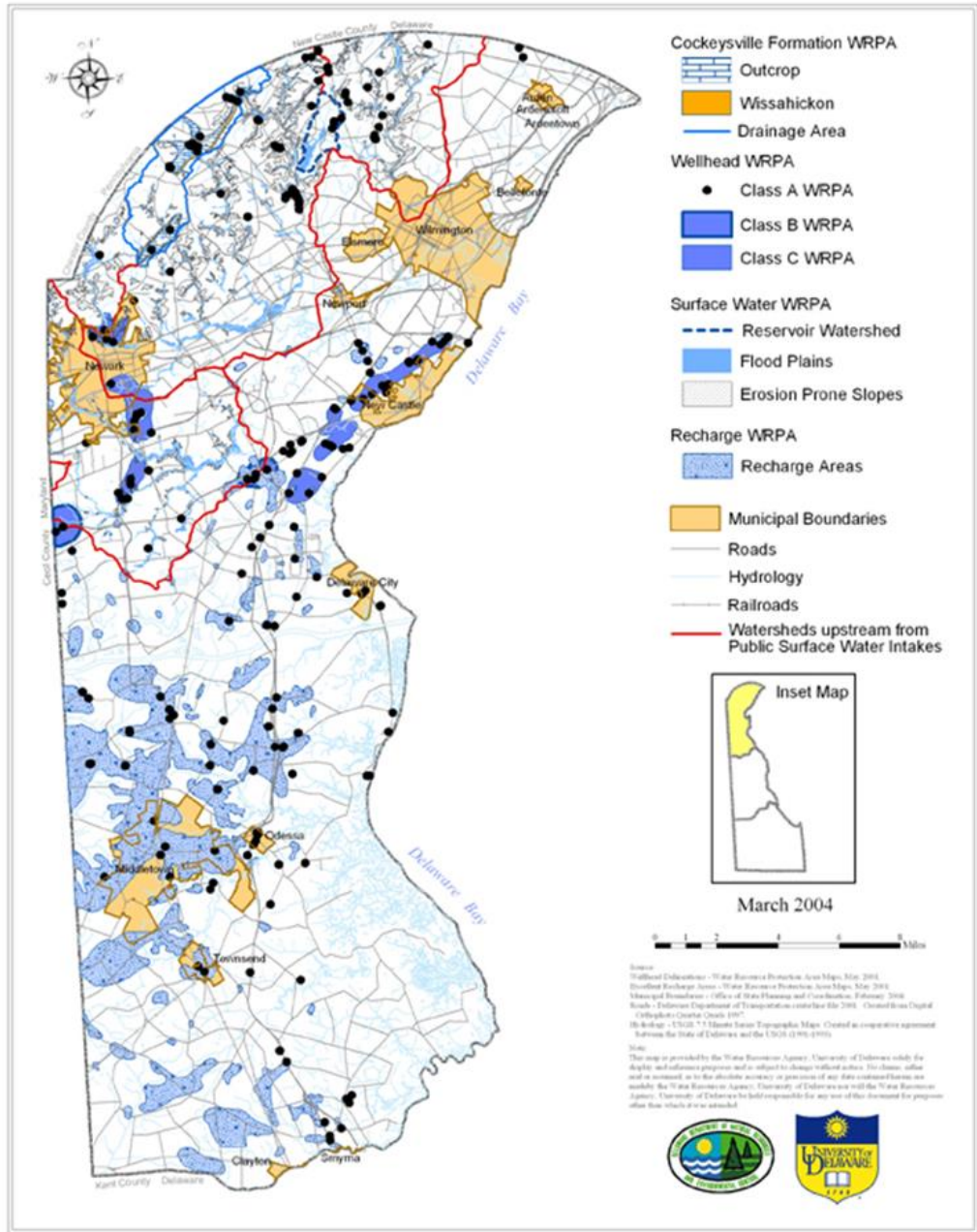



New Castle County
Public Water Supply System Service Areas

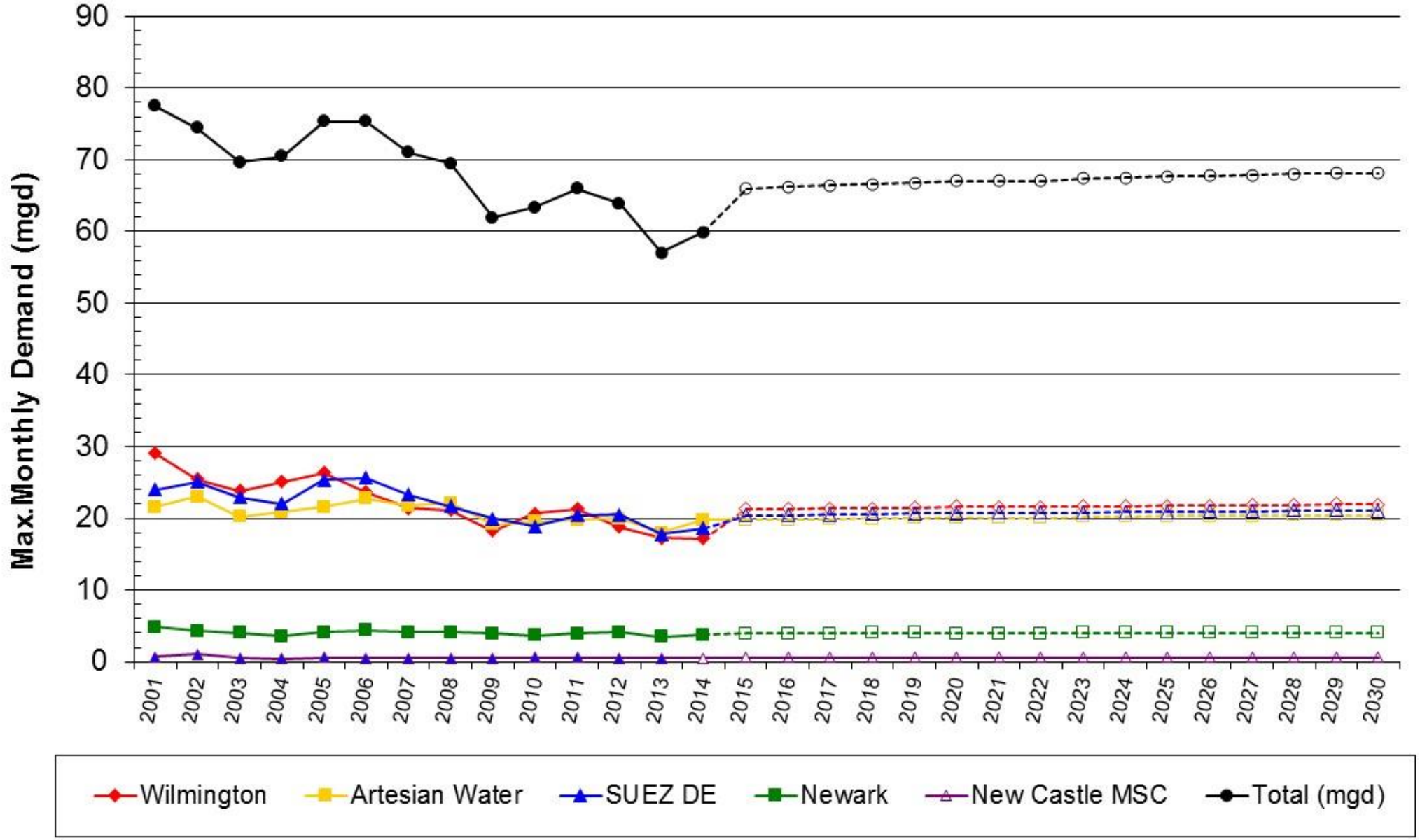



New Castle County
Public Water Supply System Interconnections

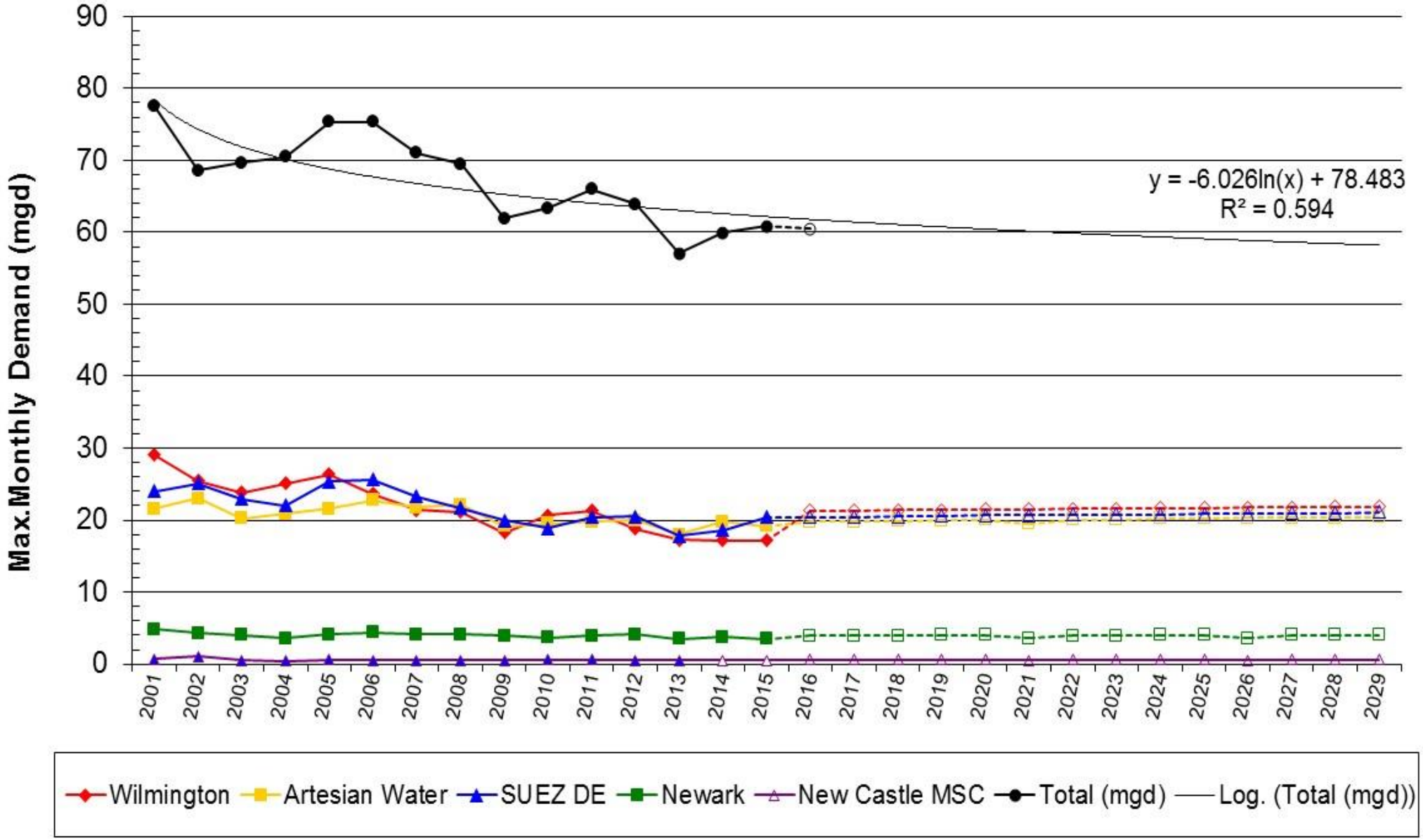
**Figure 5.1. Public water supply wells and surface intake watersheds in New Castle County.**



# Maximum Monthly Water Demand
# Northern New Castle County, Delaware



# Maximum Monthly Water Demand
# Northern New Castle County, Delaware



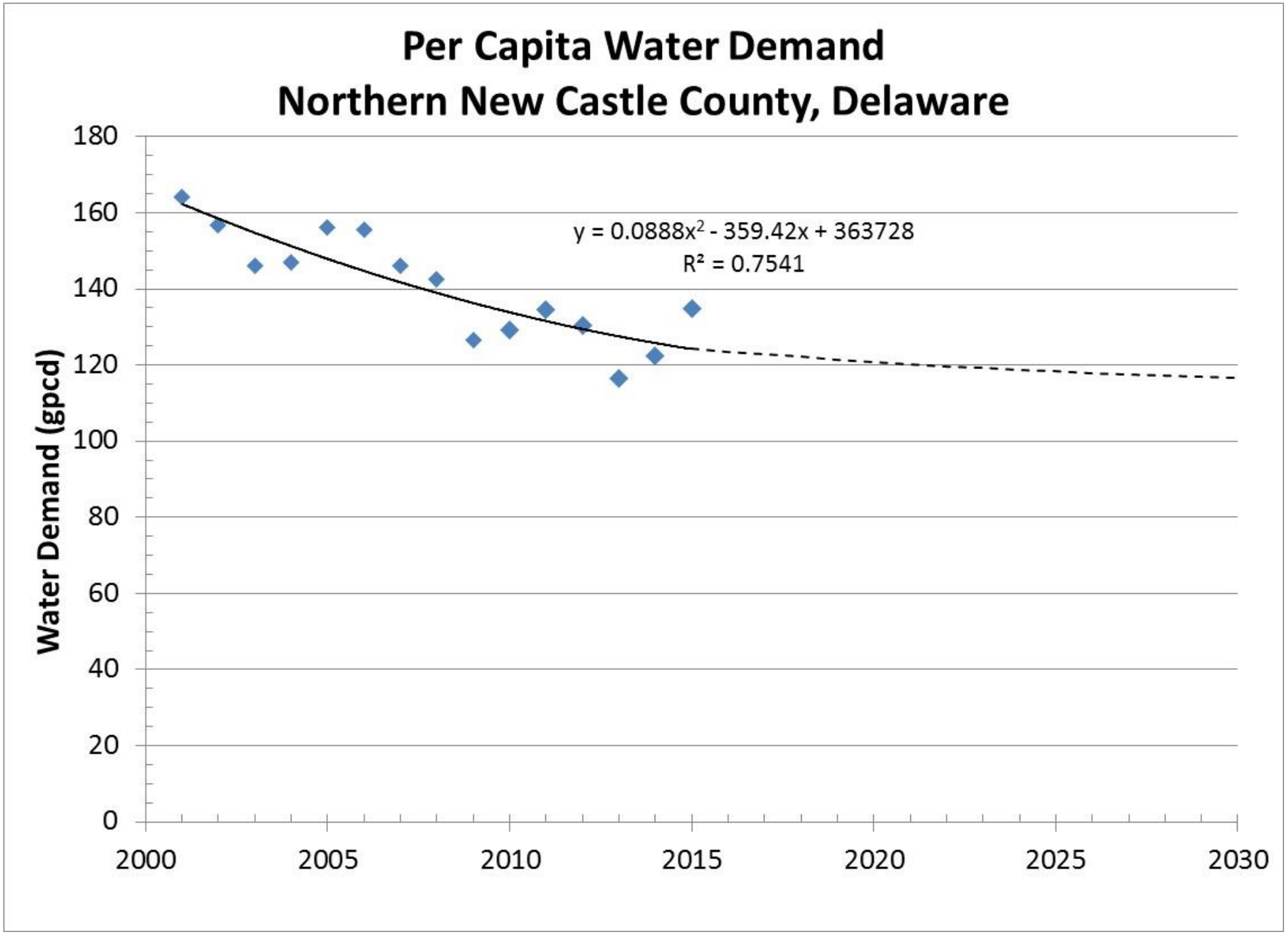

Per Capita Water Demand
Northern New Castle County, Delaware
Water Demand (gpcd)
180
160
140
120
100
80
60
40
20
0
2000
2005
2010
2015
2020
2025
2030
y = 0.0888x² - 359.42x + 363728
R² = 0.7541

**Table 5.** Water supply and demand projections for northern New Castle County through 2030

| Year | Supply (mgd) | Demand (mgd) | Surplus | |
|---|---|---|---|---|
| | | | mgd | mg[1] |
| 2015 | 102.6 | 66.0 | 36.6 | 2,745 |
| 2020 | 103.5 | 67.0 | 36.5 | 2,738 |
| 2030 | 103.5 | 68.1 | 35.4 | 2,655 |

1. Volume calculated assuming a 75-day drought period.

**Table 6.** Water supply and demands (mgd) in Northern New Castle County projected through 2030

| Purveyor | 2015 | | | 2020 | | | 2030 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Supply | Max Monthly Demand | Surplus/ Deficit +/- | Supply | Max Monthly Demand | Surplus/ Deficit +/- | Supply | Max Monthly Demand | Surplus/ Deficit +/- |
| **Wilmington** | **38.3** | **21.3** | **17.0** | **38.3** | **21.6** | **16.7** | **38.3** | **22.0** | **16.3** |
| Brandywine Creek | 15.0 | | | 15.0 | | | 15.0 | | |
| Hoopes Reservoir | 21.3 | | | 21.3 | | | 21.3 | | |
| Raise Hoopes Res. | 2.0 | | | | | | | | |
| **Artesian Water** | **29.0** | **19.8** | **9.2** | **29.0** | **20.1** | **8.9** | **29.0** | **20.4** | **8.6** |
| Groundwater | 24.3 | | | 24.3 | | | 24.3 | | |
| CWA Interconn. | 3.0 | | | 3.0 | | | 3.0 | | |
| ASR | 1.7 | | | 1.7 | | | 1.7 | | |
| **SUEZ Delaware** | **26.8** | **20.4** | **6.4** | **26.8** | **20.7** | **6.1** | **26.8** | **21.1** | **5.7** |
| Stanton WTP | 19.3 | | | 19.3 | | | 19.3 | | |
| Hoopes Contract | 2.7 | | | 2.7 | | | 2.7 | | |
| Christiana WTP | 3.0 | | | 3.0 | | | 3.0 | | |
| ASR | 1.0 | | | 1.0 | | | 1.0 | | |
| CWA Interconn. | 0.8 | | | 0.8 | | | 0.8 | | |
| **Newark** | **6.9** | **3.9** | **3.0** | **7.8** | **4.0** | **3.8** | **7.8** | **4.0** | **3.8** |
| White Clay WTP | 0.0 | | | 0.0 | | | 0.0 | | |
| Newark Reservoir | 4.0 | | | 4.0 | | | 4.0 | | |
| Groundwater | 2.9 | | | 3.8 | | | 3.8 | | |
| **New Castle MSC** | **1.6** | **0.6** | **1.0** | **1.6** | **0.6** | **1.0** | **1.6** | **0.6** | **1.0** |
| **Subtotal** | **102.6** | **66.0** | **36.6** | **103.5** | **67.0** | **36.5** | **103.5** | **68.1** | **35.4** |

Newark Reservoir filling with geomembrane, concrete, and rock liner system (Dec 2005)

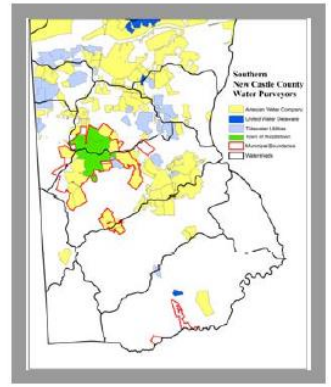
# Southern New Castle County
# Delaware

# NINTH REPORT TO THE GOVERNOR AND THE GENERAL ASSEMBLY

*Regarding the Progress of the*

## DELAWARE WATER SUPPLY COORDINATING COUNCIL

*Estimates of Water Supply and Demand in Southern New Castle County through 2030*




***Final Report***
***June 30, 2006***

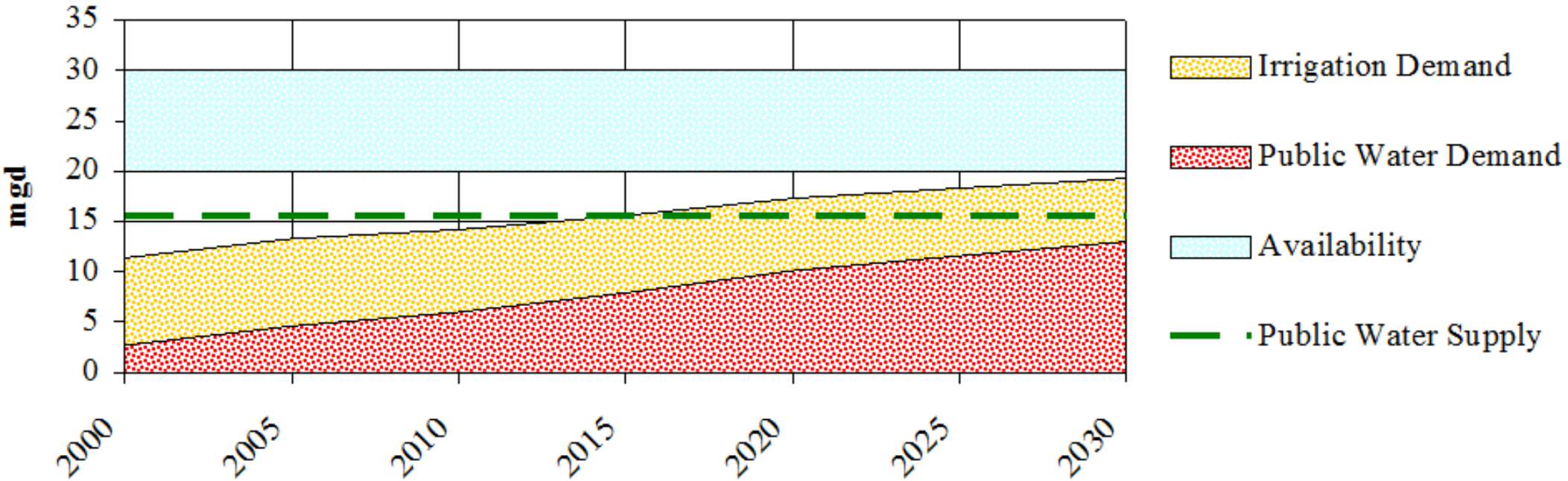
*Prepared by the*

Delaware Department of Natural Resources and Environmental Control

Delaware Geological Survey

University of Delaware, College of Human Services, Education, and Public Policy
Institute for Public Administration – Water Resources Agency

**Figure ES.1. Ground-water availability, currently allocated supply, and peak day public water and irrigation demand in southern New Castle County.**



## Table ES.1. Comparison of water supply and demand in southern New Castle County.

Surplus/deficit calculations are based upon maximum daily supplies in accordance with current DNREC water allocation permits. Water purveyors will apply for additional allocations in the future.

| *Water Purveyor* | *Current Max Daily Allocation (mgd)* | *2005 Peak Day Demand (mgd)* | *2005 Surplus / Deficit (mgd)* | *Current Max Daily Allocation (mgd)* | *2030 Peak Day Demand (mgd)* | *2030 Surplus / Deficit (mgd)* |
|---|---|---|---|---|---|---|
| Artesian Water Company | 8.8 | 1.6 | + 7.2 | 8.8 | 5.0 | + 3.8 |
| AWC: DE Correctional Center | 2.1 | 0.2 | + 1.9 | 2.1 | 0.2 | + 1.9 |
| Tidewater Utilities, Inc. | 2.7 | 1.2 | + 1.5 | 2.7 | 3.7 | - 1.0 |
| Middletown | 1.7 | 1.2 | + 0.5 | 1.7 | 3.7 | - 2.0* |
| Mt. Pleasant and Cantwell | 0.1 | 0.1 | 0.0 | 0.1 | 0.1 | 0.0 |
| Self-Supplied | 0.3 | 0.3 | 0.0 | 0.3 | 0.3 | 0.0 |
| Subtotal Public Water Supply | 15.7 | 4.6 | + 11.1 | 15.7 | 13.0 | + 2.7 |
| Individual Wells | 1.4 | 1.4 | 0.0 | 1.9 | 1.9 | 0.0 |
| Total Potable Water | 17.1 | 6.0 | + 11.1 | 17.6 | 14.9 | + 2.7 |
| Agriculture/Golf Course Irrigation | 10.0 | 8.7 | + 1.3 | 10.0 | 6.3 | + 3.7 |
| Total | 27.1 | 14.7 | +12.4 | 27.6 | 21.2 | + 6.4 |

## Recommendations

Given that long term ground-water availability in southern New Castle County is estimated to be 20 to 30 mgd and the population may increase from 41,000 in 2005 to 96,000 people by 2030, the Delaware Water Supply Coordinating Council recommends the following approach to sustain the most efficient delivery of drinking water without overuse of a limited ground-water resource:

1. **Periodic WSCC Updates**: By December 2010, the WSCC should update these supply and demand estimates in conjunction with the public water purveyors in southern New Castle County and include:

    •Estimates of supply and peak demand in comparison to ground-water availability.

    •A water supply service area map showing distribution mains and interconnections with other water purveyors, water treatment plants and water storage tanks, and boundaries of existing and proposed water supply CPCNs.

**2. Ground-water Availability:** The WSCC should work with the DGS and DNREC to develop comprehensive programs to reevaluate both the long-term and short-term availability and sustainability of ground-water in southern New Castle and northern Kent Counties.

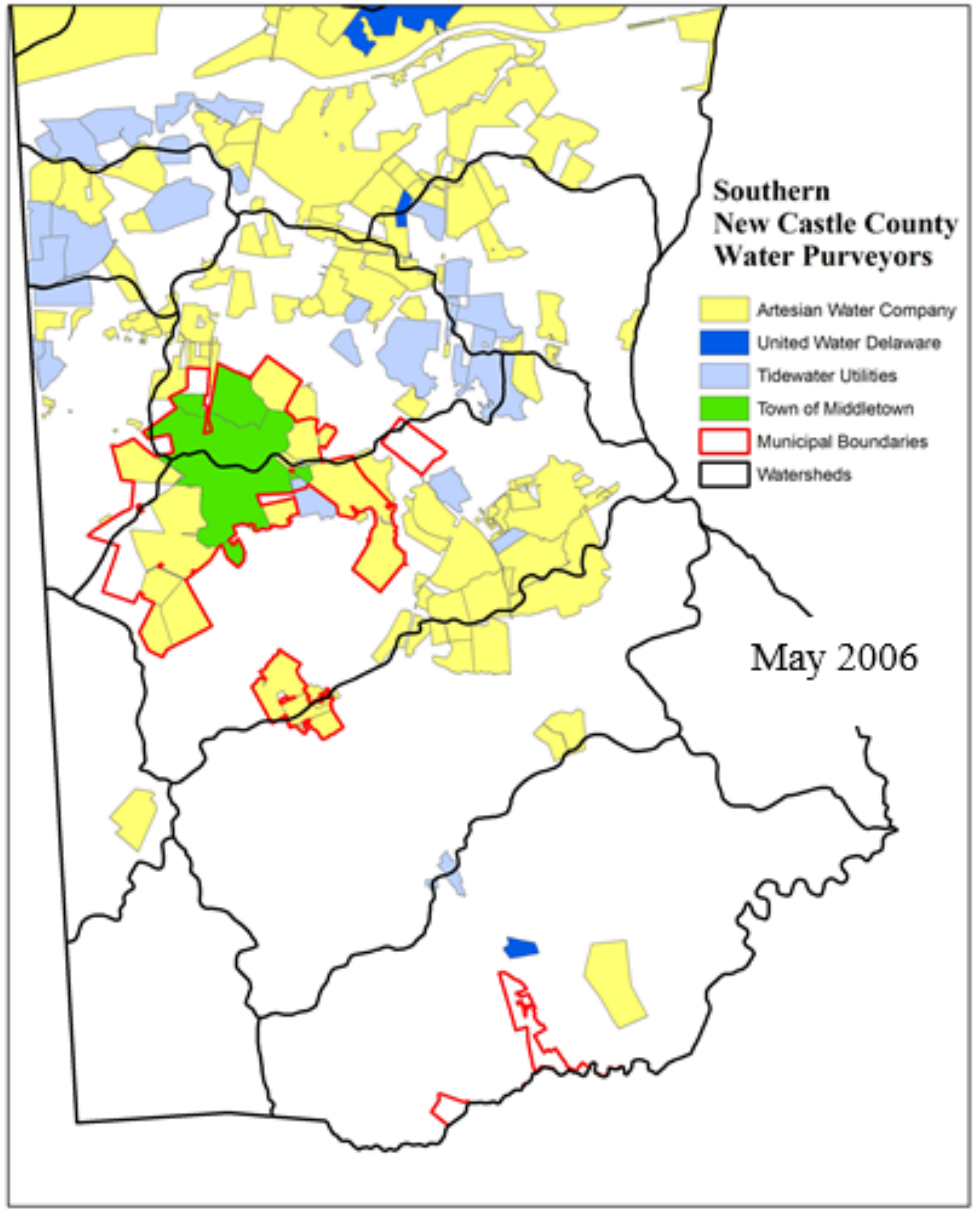
**3. Peak Demands by 2030**: The projections indicate there is sufficient availability (20 to 30 mgd) to meet peak demands in 2030 from public water supply and agriculture/golf course irrigation uses in southern New Castle County provided: 1) DNREC updates the allocated irrigation well data base and 2) continues to monitor public water supply and agricultural wells during the summers to not diminish the capacity of irrigation wells by producers.

**Recommendations (con’t.)**

**4. Treated Wastewater for Irrigation Use**: The utilization of treated wastewater for irrigation, particularly irrigation of golf courses and agriculture, should be further encouraged by DNREC and the local governments in southern New Castle County.

**5. Water Supply CPCNs**: The Water Supply Coordinating Council (WSCC) shall establish a subcommittee to review 26 Del Code Section 203C (Certificates of Public Convenience and Necessity for Water Utilities) to determine if legislative changes are needed to ensure that service territories are granted in a manner that considers water supply planning principles. The subcommittee shall consider water supply planning principles as part of its review, including but not limited to, long-term water supply sustainability and sufficiency; service and infrastructure cost effectiveness; sizing, location and optimization of service areas; and enhanced

**Figure 3.1. Public water supply franchise areas in southern New Castle County.**



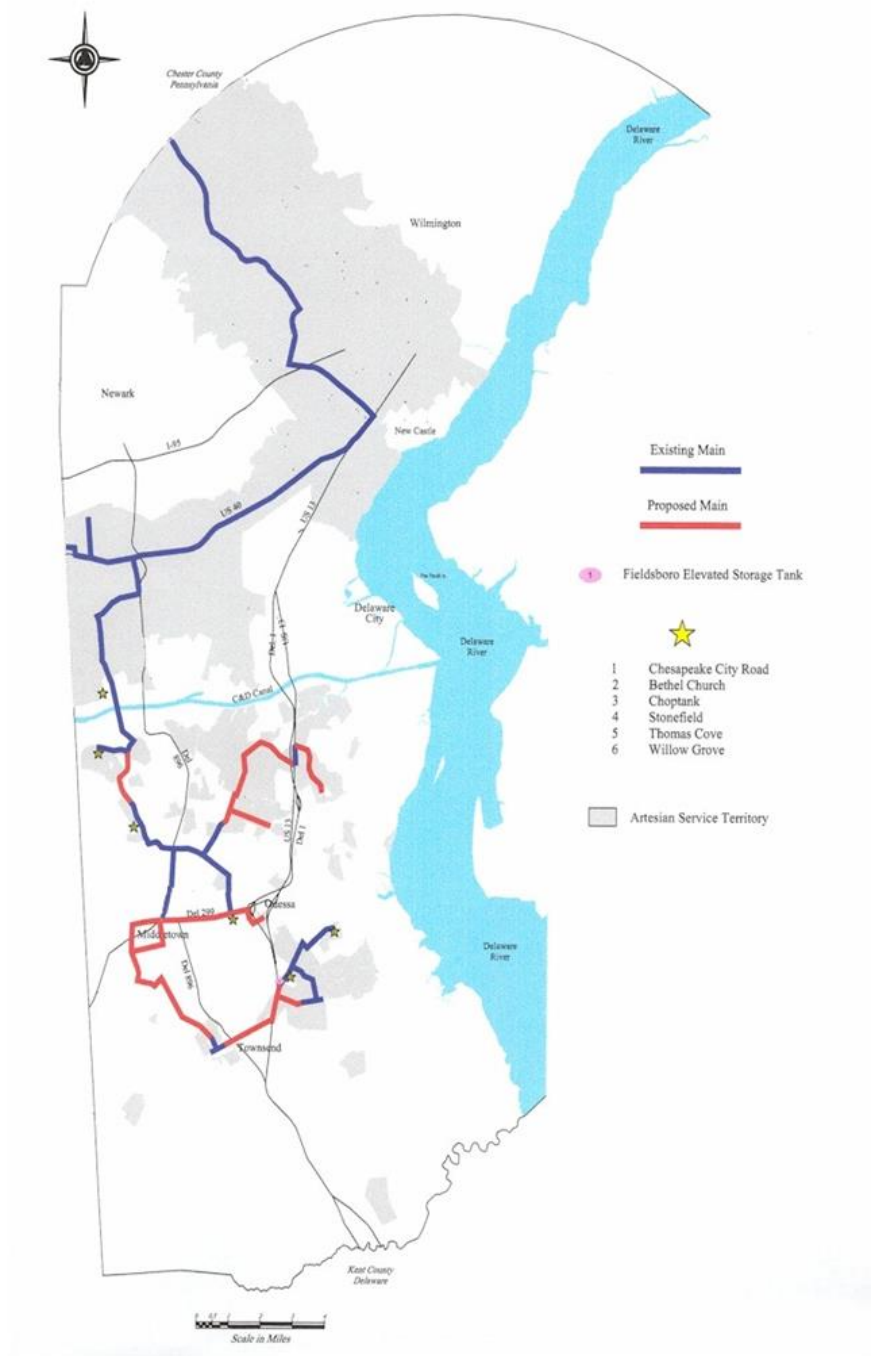
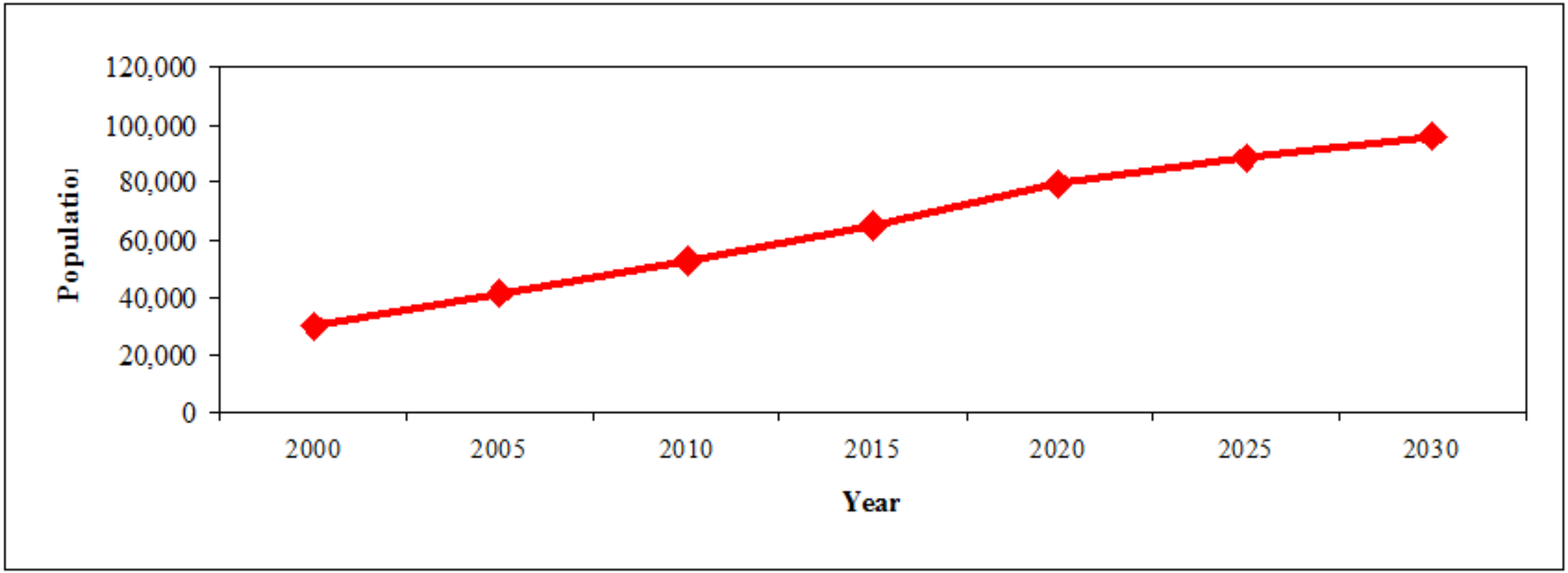



**Figure 2.2. Projected population growth in southern New Castle County.**




Source: Delaware Population Consortium, October 2005

**Figure 2.4. Southern New Castle County Watersheds**

| *ID* | *Watershed* | *Area (sq. mi.)* |
|---|---|---|
| CD | C & D Canal | 31 |
| AS | Augustine Creek / Silver Run | 12 |
| DR | Drawyers Creek | 15 |
| AQ | Appoquinimink River | 32 |
| BB | Blackbird Creek | 32 |
| CS | Cedar Swamp | 8 |
| SM | Smyrna River | 34 |
| CY | Cypress Branch / Chester River | 11 |
| SS | Sassafras River | 8 |
| SB | Sandy Branch / Great Bohemia Creek | 9 |
| BC | Back Creek | 7 |

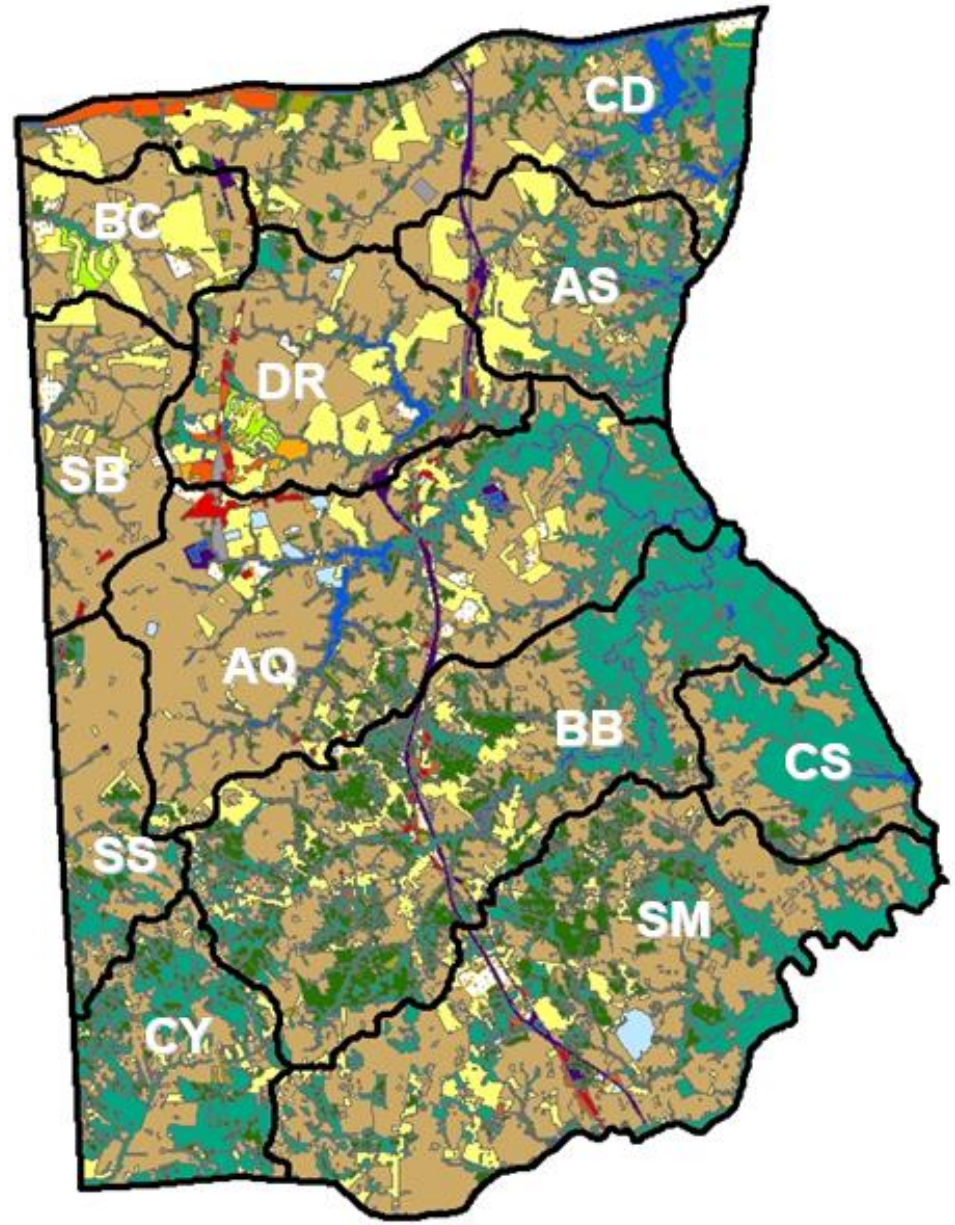


**Figure 4.1. Generalized cross section extending from near Newark to southeastern New Castle County.**

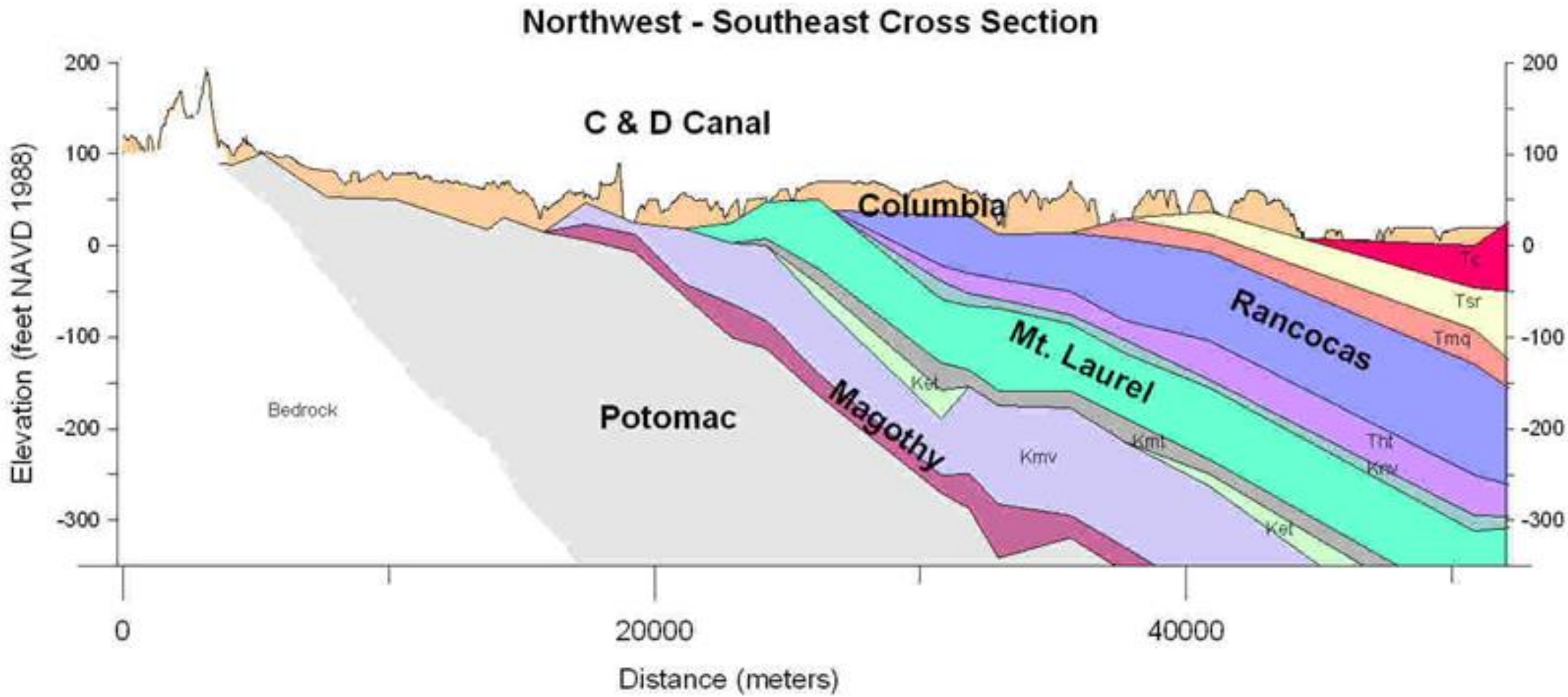
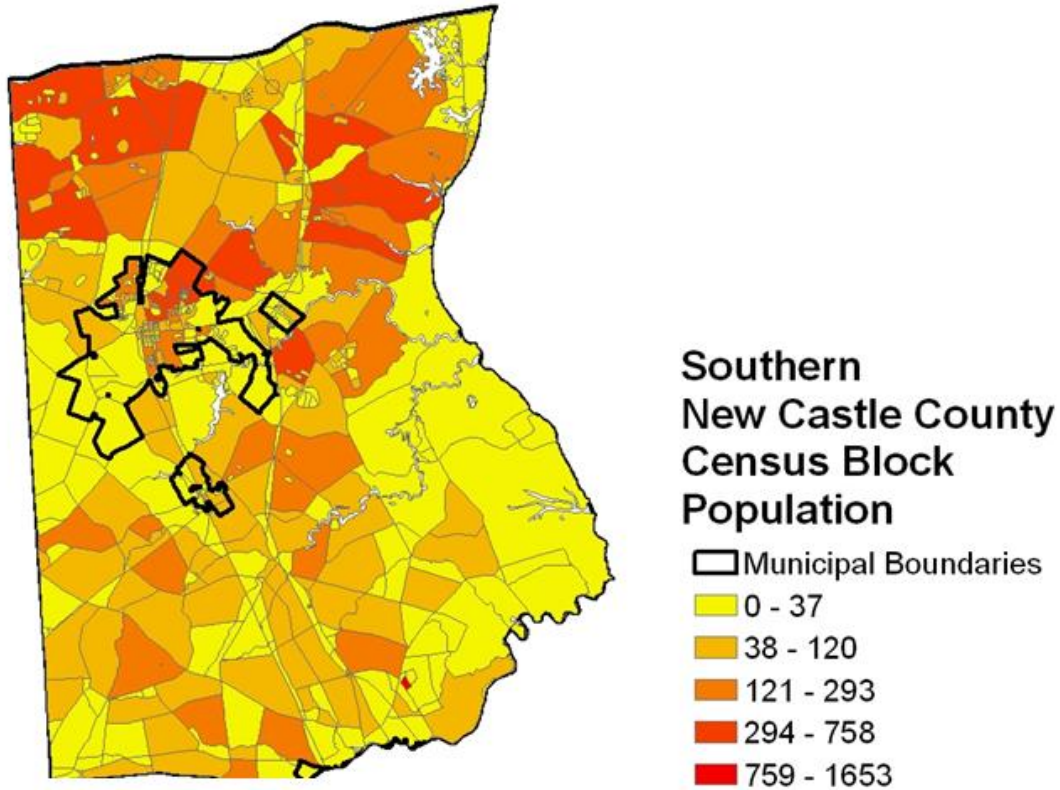


**Figure 6.2. Southern New Castle County Census Block population, 2000.**



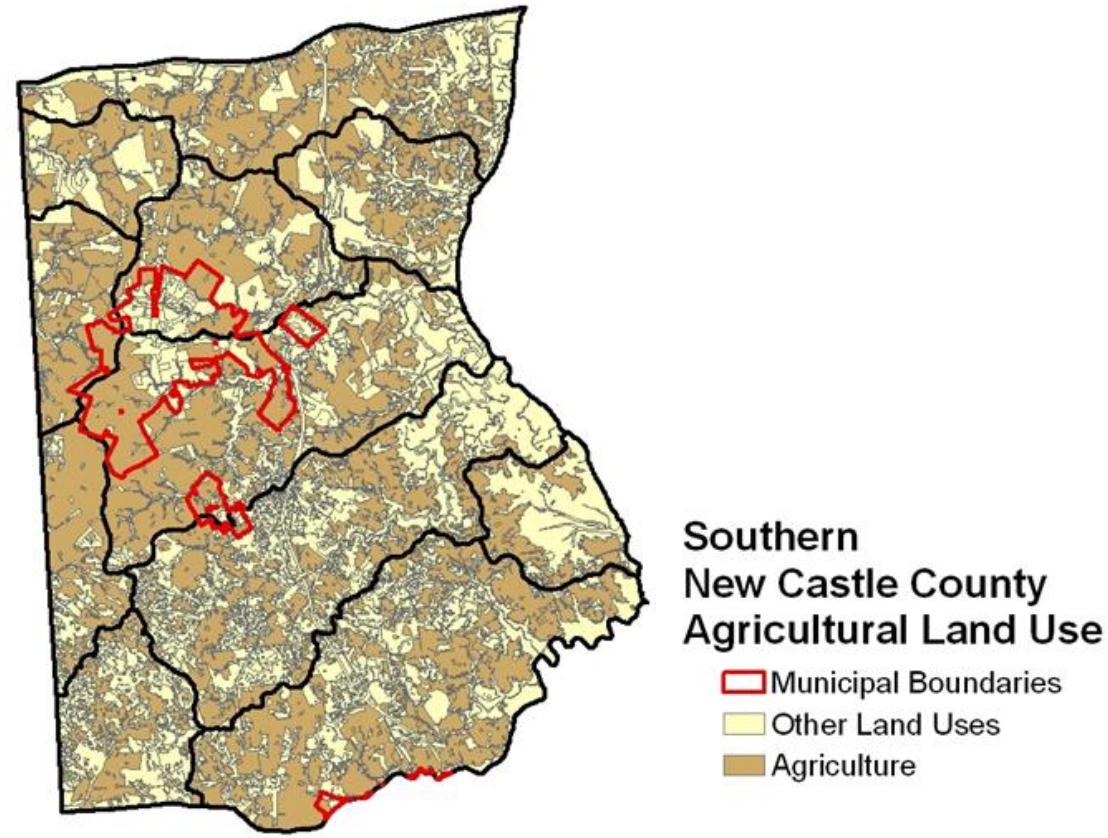
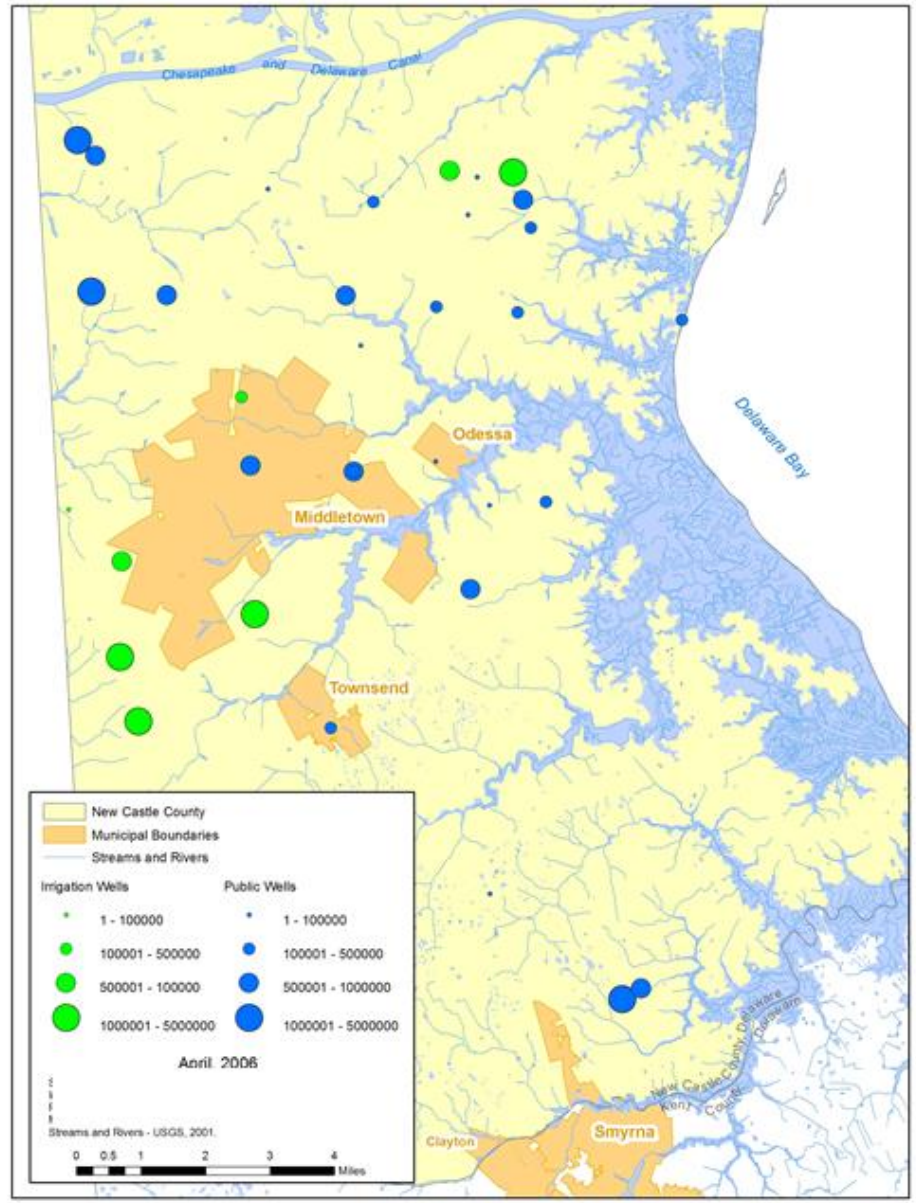



**Table 7.2. Daily water demand in southern New Castle County by local governments, 2000-2030.**

| *Year* | *2000* | *2005* | *2010* | *2015* | *2020* | *2025* | *2030* |
|---|---|---|---|---|---|---|---|
| % Increase Total Population | 0 % | 39 % | 29 % | 22 % | 22 % | 11 % | 8 % |
| Total Population | 29,682 | 41,243 | 53,060 | 65,021 | 79,501 | 88,651 | 95,996 |
| Less population individual wells | 13,830 | 14,176 | 14,530 | 14,893 | 15,266 | 15,647 | 16,039 |
| Less pop. in DE Correctional | 1,653 | 1,653 | 1,653 | 1,653 | 1,653 | 1,653 | 1,653 |
| Population public water supply | 14,199 | 25,414 | 36,877 | 48,475 | 62,582 | 71,351 | 78,304 |
| % Increase public water supply | 0% | 79% | 45% | 31% | 29% | 14% | 10% |
| *Government* | *Peak Demand (mgd)* | | | | | | |
| Unincorporated New Castle Co. | 1.1 | 1.6 | 2.3 | 3.0 | 3.9 | 4.5 | 4.9 |
| Middletown | 1.0 | 1.8 | 2.6 | 3.4 | 4.4 | 5.0 | 5.5 |
| Odessa | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.5 | 0.6 |
| Townsend | 0.2 | 0.4 | 0.5 | 0.7 | 0.9 | 1.0 | 1.1 |
| Self-Supplied Non-Community Wells | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| **Public Peak Daily Water Demand** | **2.7** | **4.3** | **6.0** | **7.8** | **10.0** | **11.3** | **12.4** |
| Individual Wells | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 |
| DE Correctional Facility | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| **Potable Peak Daily Demand** | **3.9** | **5.9** | **7.7** | **9.6** | **11.9** | **13.3** | **14.5** |

**Figure 7.1. Public water supply and irrigation withdrawals in southern New Castle County (gallons per day).**



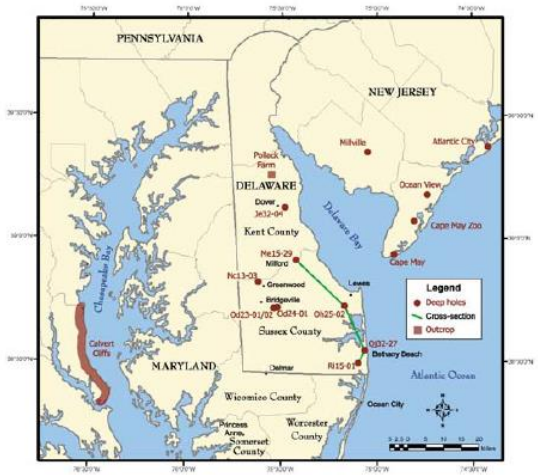
# Kent County and Sussex County Delaware

# TWELFTH REPORT TO THE GOVERNOR AND GENERAL ASSEMBLY

***Regarding the Progress of the***

## DELAWARE WATER SUPPLY COORDINATING COUNCIL

*Estimates of Water Supply & Demand for Kent County and Sussex County through 2030*




June 20, 2014

*Prepared by the*


Delaware Department of Natural Resources and Environmental Control
Division of Water

Delaware Geological Survey

University of Delaware
Institute for Public Administration – Water Resources Agency

**Table 2.2.** Population projections in Kent County and Sussex County, 2010-2030
(Delaware Population Consortium 2012)

| | 2010 (pop.) | 2020 (pop.) | 2030 (pop.) |
|---|---|---|---|
| Kent County | 162,916 | 180,357 | 194,225 |
| Sussex County | 197,870 | 235,574 | 271,018 |
| **Total** | **360,786** | **415,931** | **465,243** |
| | | **2010-2020 (%)** | **2010-2030 (%)** |
| Kent County | | 11% | 19% |
| Sussex County | | 19% | 37% |
| **Total** | | 15% | 29% |

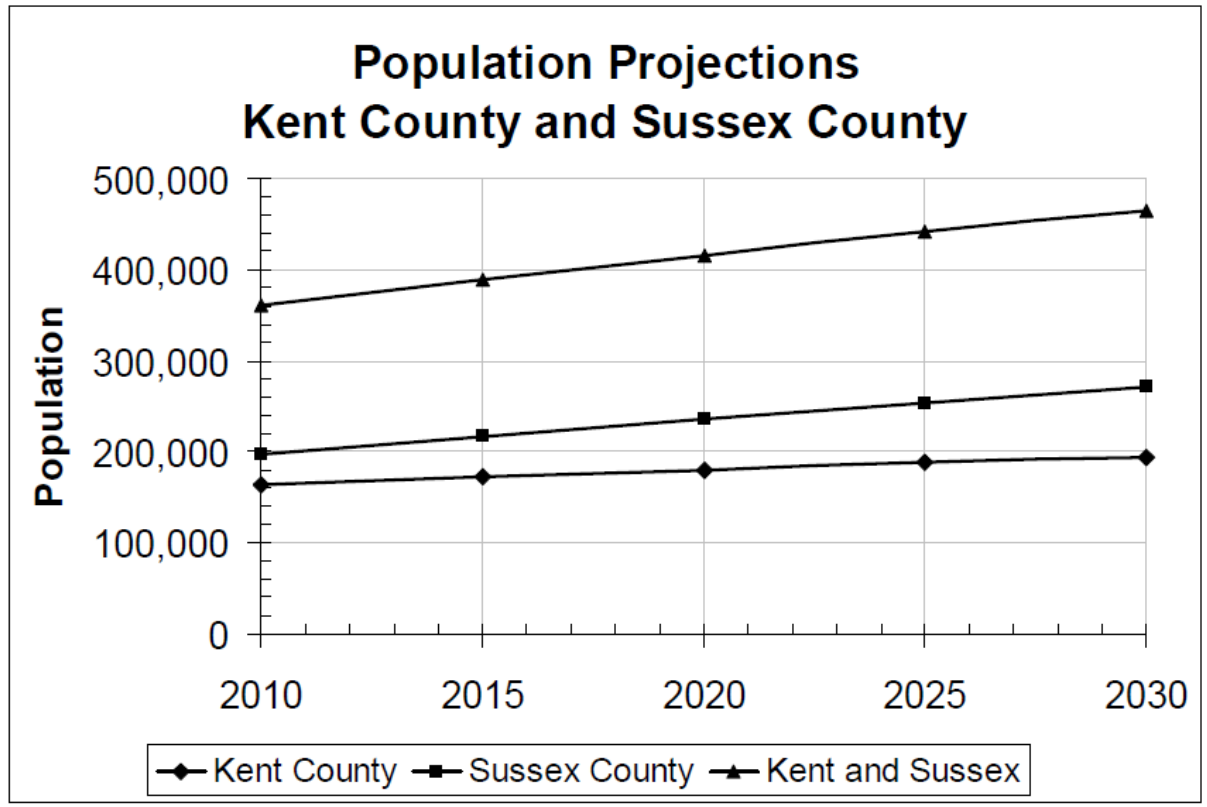
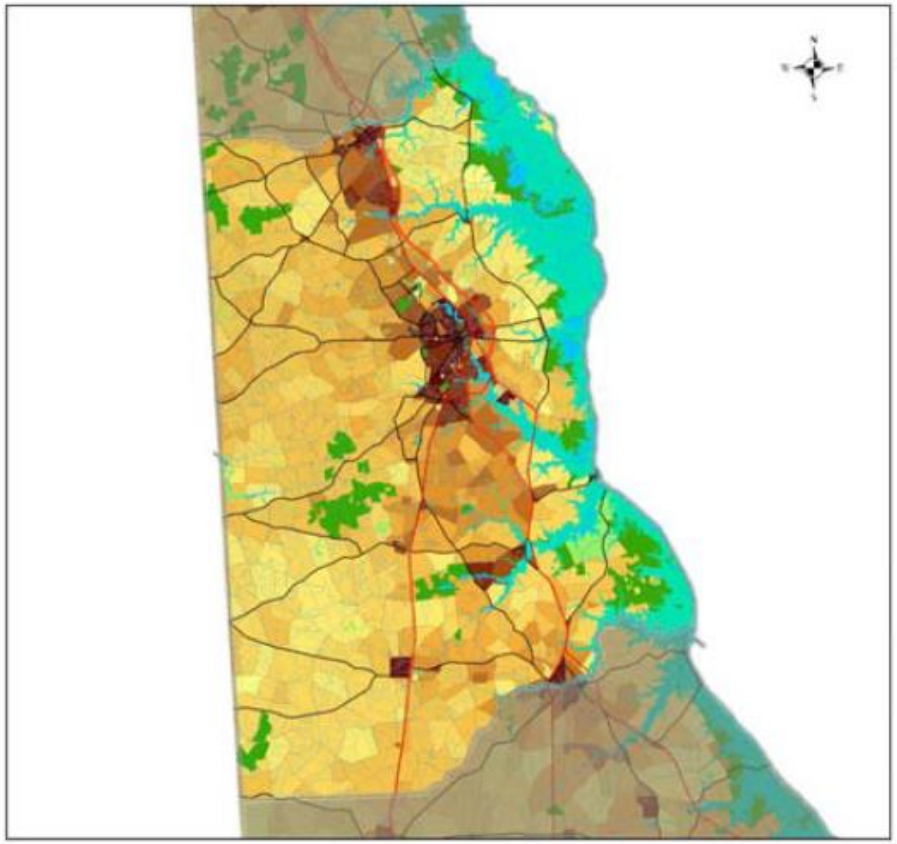



**Figure 2.2.** Population projections in Kent County and Sussex County, 2010-2030



## Kent County Population Density 2030

This map depicts population densities (people per square mile) by Modified Grid census unit.

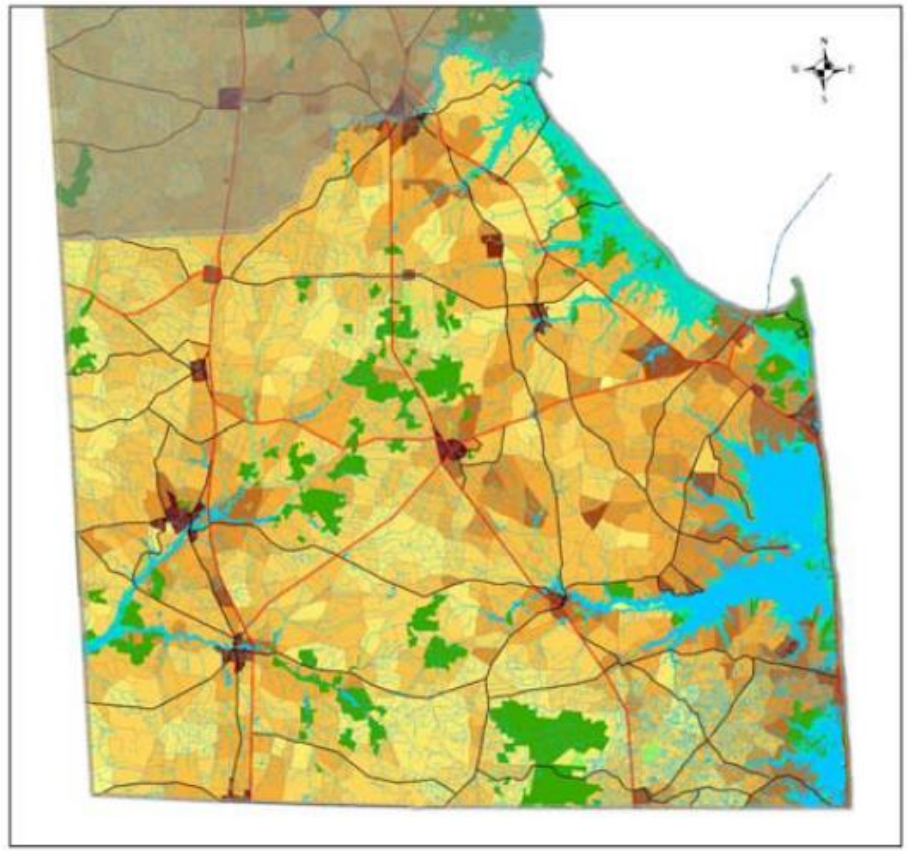
Data are from the Delaware Population Consortium and the U.S. Census Bureau.

**Pop. per Sq. Mi.**

- 0 - 10.00
- 10.01 - 50.00
- 50.01 - 100.0
- 100.1 - 250.0
- 250.1 - 500.0
- 500.1 - 1000
- 1001 - 1500
- 1501 - 2000
- 2001 - 3000
- 3001 - 20000
- Tidal Wetlands
- Non-tidal Wetlands
- Open Water
- Public Land

0 2 4 8 Miles

IPA University of Delaware
Institute for Public Administration



## Sussex County Population Density 2030

This map depicts population densities (people per square mile) by Modified Grid census unit.

Data are from the Delaware Population Consortium and the U.S. Census Bureau.

**Pop. per Sq. Mi.**

- 0 - 10.00
- 10.01 - 50.00
- 50.01 - 100.0
- 100.1 - 250.0
- 250.1 - 500.0
- 500.1 - 1000
- 1001 - 1500
- 1501 - 2000
- 2001 - 3000
- > 3000
- Tidal Wetlands
- Non-tidal Wetlands
- Open Water
- Public Land

0 2 4 8 Miles

IPA University of Delaware
Institute for Public Administration

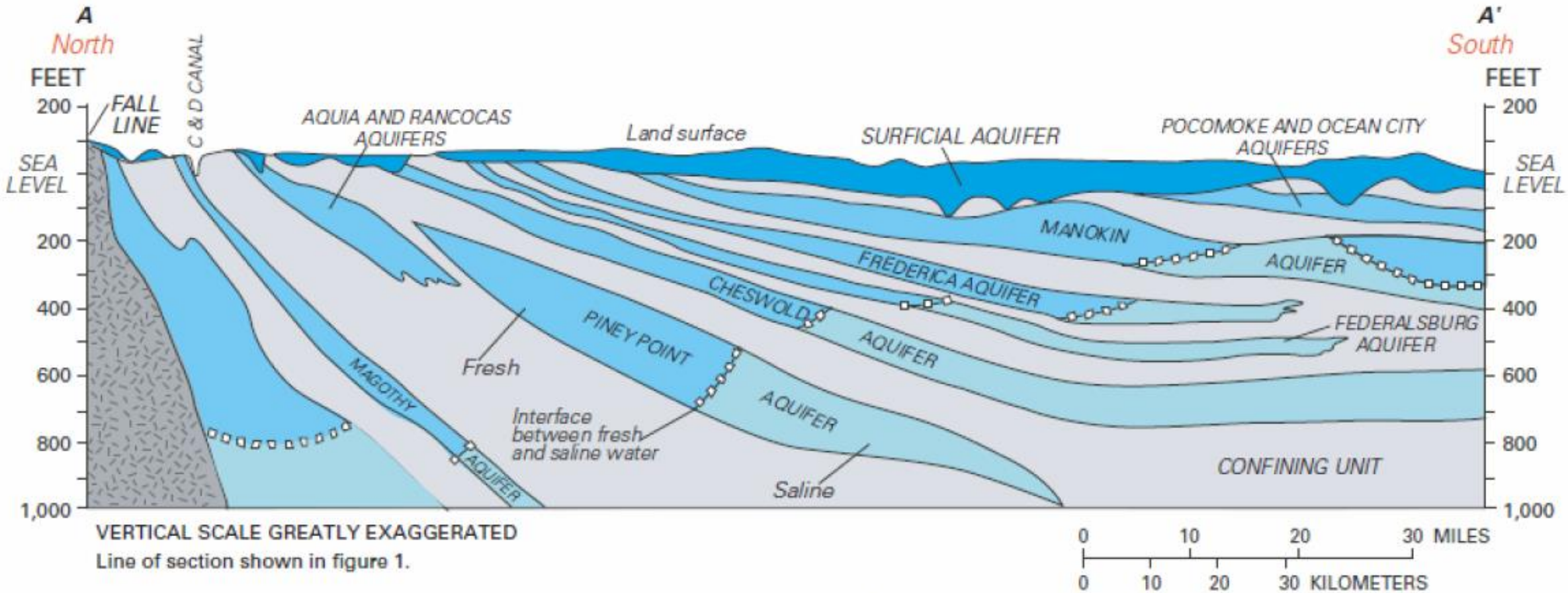



**Figure 4.** Coastal Plain aquifers in Delaware (DGS and USGS)

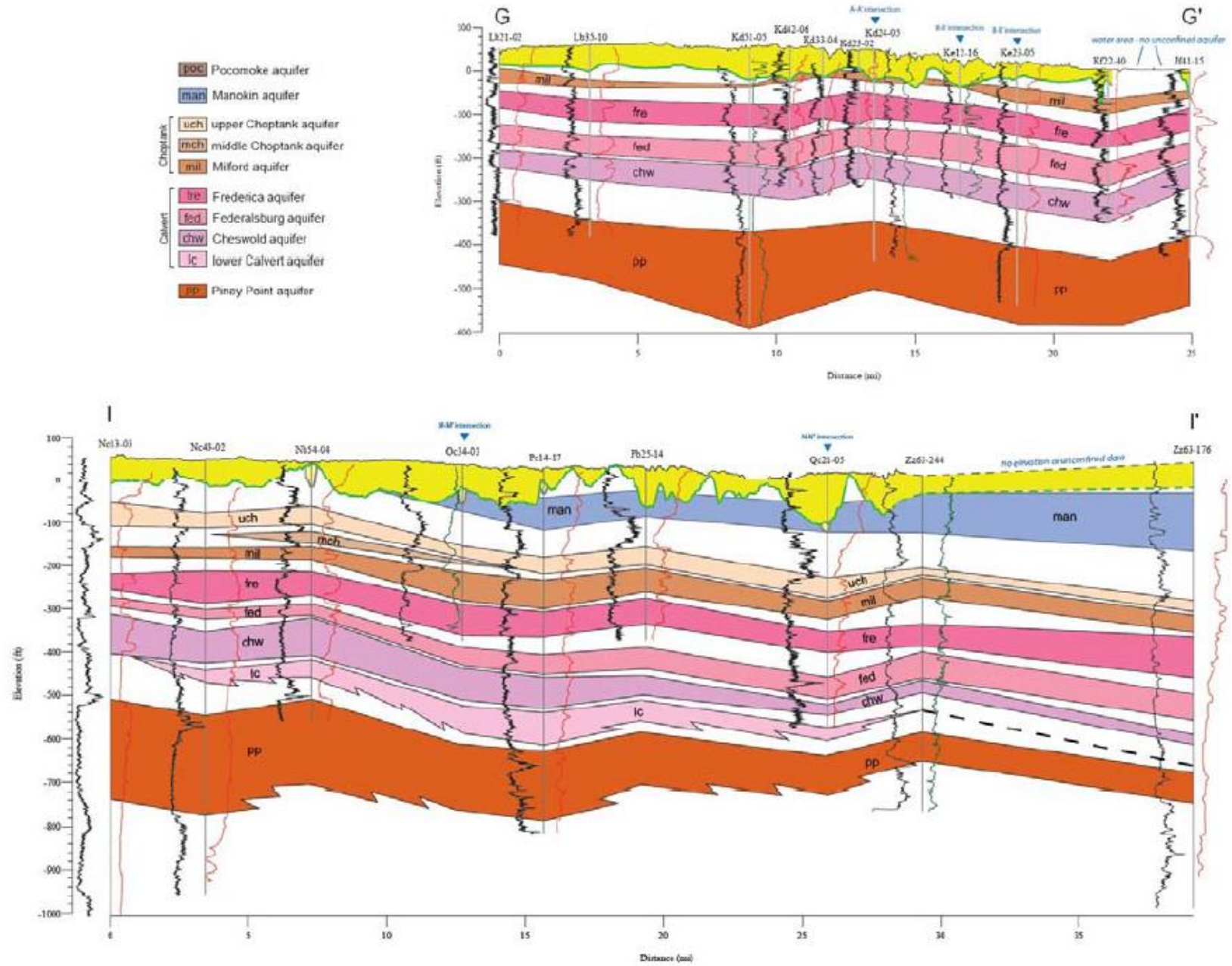



**Figure 3.1.** Typical geologic cross sections from Kent County (G-G') and Sussex County (I-I')

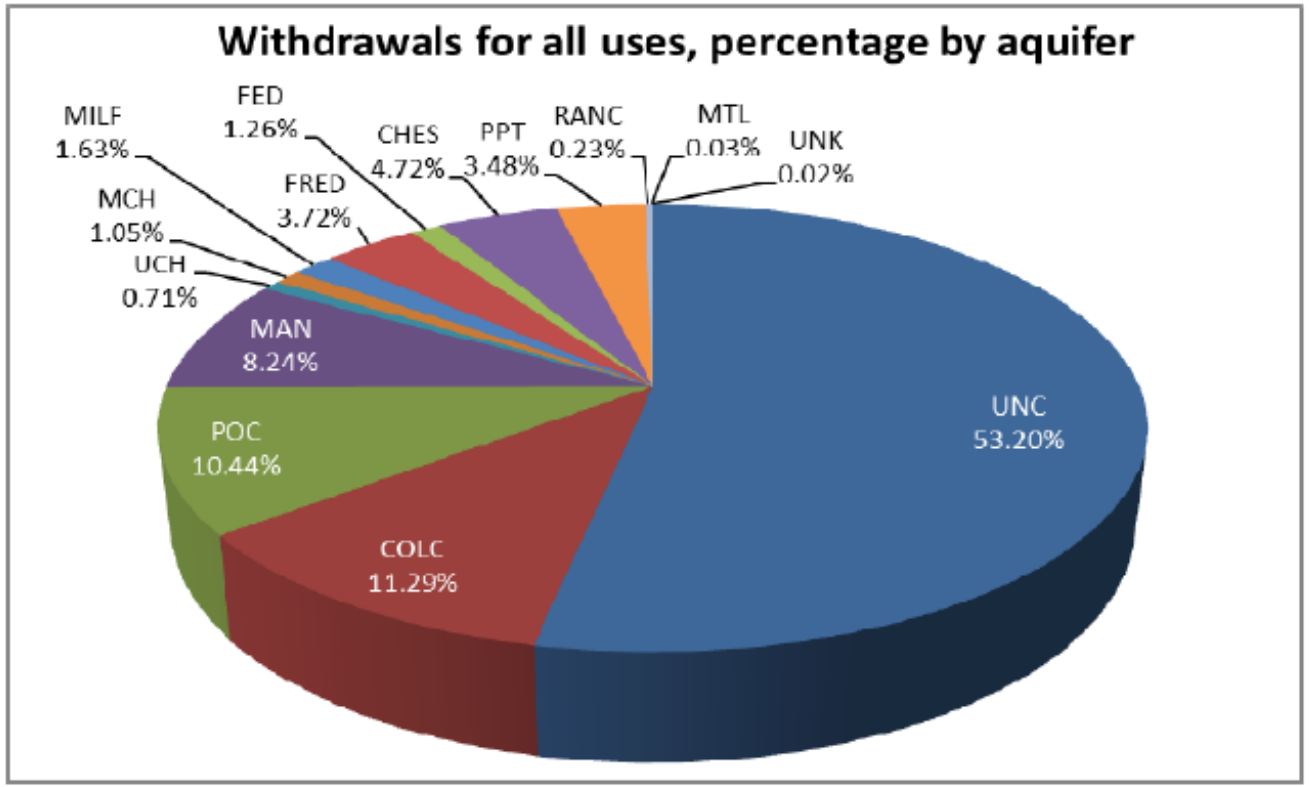



**Figure 3.4.** Groundwater withdrawals by aquifer in Kent and Sussex counties

Mount Laurel (MTL)
Rancocas (RAN)
Piney Point (PPT)
Lower Calvert (LCAL)
Cheswold (CHE)
Federalsburg (FED)
Frederica (FRE)

Milford (MIL)
Middle Choptank (MCH)
Upper Choptank (UCH)
Manokin (MAN)
Pocomoke (POC)
Confined Columbia (COLC)
Unconfined (UNC)

**Nitrogen:** High nitrogen levels above the 10 mg/l drinking water standard are thought to be a possible link to blue baby syndrome. Analysis of N levels in the shallow water table in Kent and Sussex counties indicate:

- 23% of wells in coastal Sussex County had nitrates above the 10 mg/l drinking water standard in 1991.
- One of 30 samples contained nitrite + nitrate above the 10 mg/l EPA drinking water standard in 2002.
- Nitrates were widespread in the surficial aquifer on the Delmarva Peninsula of Del., Md., and Va. in 2004.
- Nitrates were detected in 3 of 4 individual wells, 18% of wells exceeded the drinking water standard in 2008.
- Nitrogen levels have remained constant and did not increase or decrease between 2000 and 2008.

**Volatile Organic Compounds:** VOCs such as chloroform, tetrachloroethene, and methyl tert-butyl ether (MTBE) are suspected cancer-causing compounds detected in low levels but rarely above EPA drinking water standards.

- In 2002, 34 VOCs were detected in at least 1 of 30 wells. No wells exceeded EPA drinking water standards.
- In 2008, VOCs were detected in 75% of 200 shallow domestic wells. Just 2% of wells exceeded EPA standards.
- Just 7 of 31 VOCs had levels greater than 1 ug/l in 2010. All VOCs were below drinking water standards.

**Pesticides:** Low levels of pesticides were detected in Delaware shallow aquifers at detections less than EPA drinking water standards. Pesticides in high amounts above drinking water standards can be toxic to humans.

- Pesticides were detected in at least 1 of 30 samples in 2002, all less than EPA drinking water standards.
- Low levels of herbicides were detected in Delmarva Peninsula shallow aquifers in 2004.
- At least one pesticide was detected in 29 of 30 wells but levels did not exceed drinking water standards in 2010.

**Radionuclides:** Naturally occurring radon and radium are present at low levels in Delaware shallow groundwater that rarely exceed proposed EPA drinking water standards. High radon levels have been linked to lung cancer.

- Radon was detected in 10 wells in 2002. One well exceeded the proposed EPA standard of 300 picocuries/liter.
- Radium and radon were detected in 9 wells in 2010. No samples exceeded proposed EPA standards.

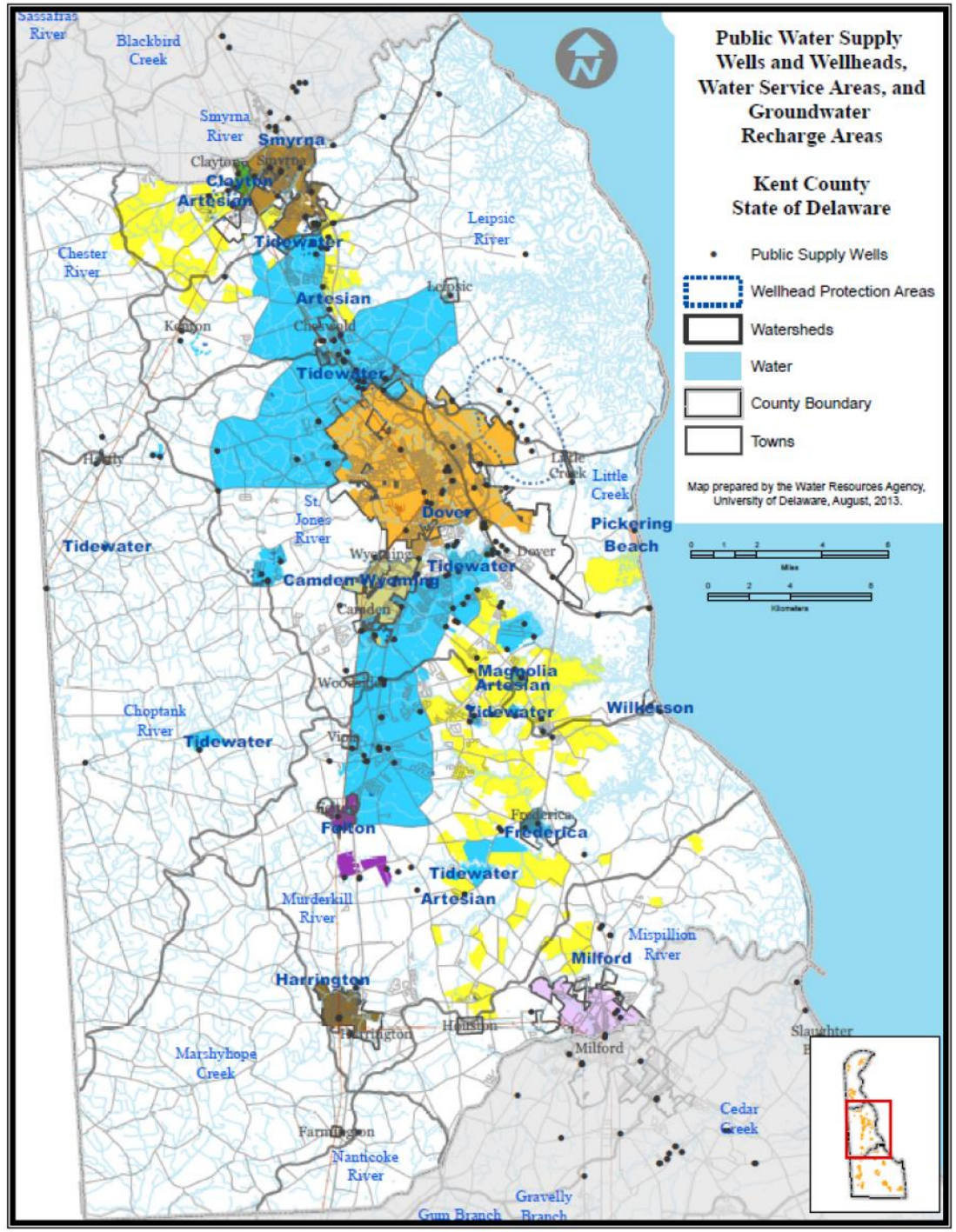
**Public Drinking Water Annual Compliance Report:** Of 486 public water systems, the Delaware Division of Public Health reported 15% of systems recorded a violation mostly due to high nitrate or bacteria levels in 2009.

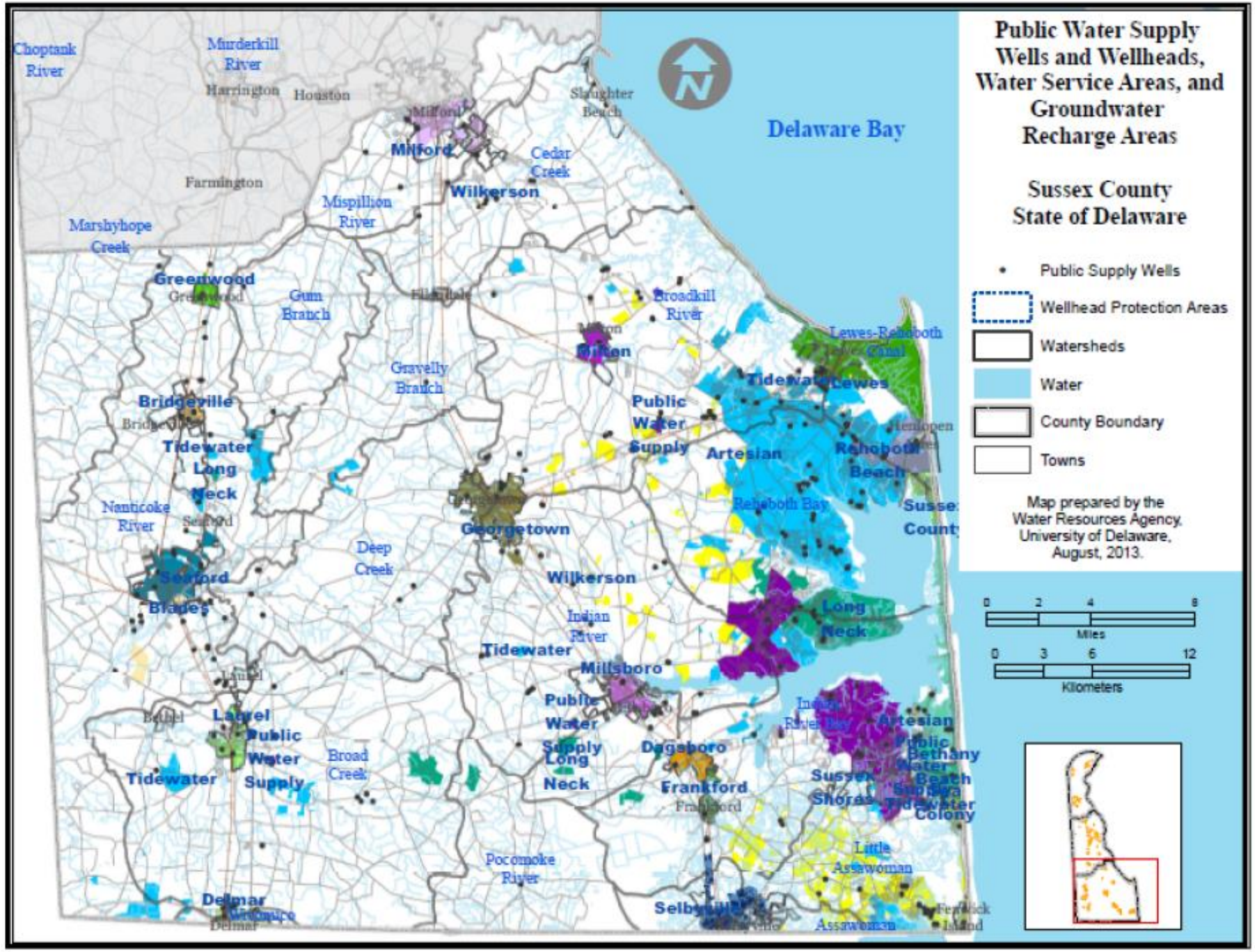
**Emerging Contaminants**: The EPA is considering setting drinking water standards on emerging contaminants such as drugs and personal care chemicals that have been detected in very low levels in surface water and groundwater. In 2008 and 2009, a report for the Delaware Division of Public Health found:

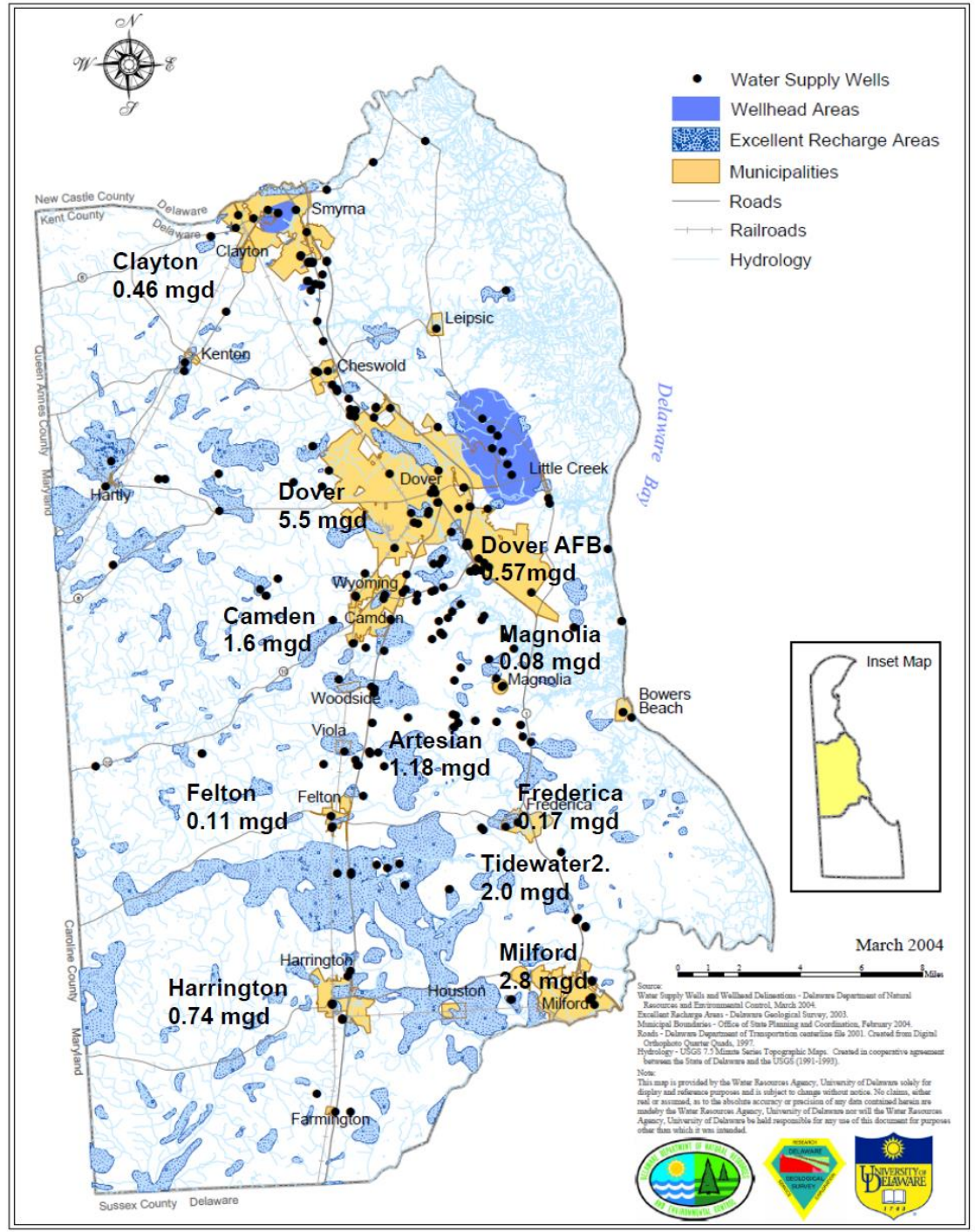
- 17 drugs and personal care chemicals were detected in 55% of public water supply systems.
- At least 17 different drugs were detected in 101 treated and untreated water supplies.
- At least 95 farm wells had detected 14 compounds.

**Source Water Protection:** In accordance with the Delaware Source Water Protection Law of 2001:

- Source water protection ordinances were adopted by 9 governments in Kent County: Smyrna, Cheswold, Dover, Wyoming, Camden, Frederica, Harrington, Milford, and Kent County, and 9 governments in Sussex County: Sussex County, Milford, Lewes, Bridgeville, Georgetown, Seaford, Millsboro, Laurel, and Selbyville.
- Clayton and Milton are currently developing their ordinances.
- Source water assessments at 65 public systems in Kent and Sussex counties indicate untreated water exceeded standards for iron and manganese in 20% of systems, VOCs in 3% of systems, and bacteria in 2% of systems.


Public Water Supply Wells and Wellheads, Water Service Areas, and Groundwater Recharge Areas
Kent County
State of Delaware
Public Supply Wells
Wellhead Protection Areas
Watersheds
Water
County Boundary
Towns
Map prepared by the Water Resources Agency, University of Delaware, August, 2013.
Miles
Kilometers
Sassafras River
Blackbird Creek
Smyrna River
Smyrna
Clayton
Artesian
Tidewater
Chester River
Leipsic River
Leipsic
Kenton
Cheswold
Artesian
Tidewater
Hartly
Little Creek
Little Creek
St. Jones River
Dover
Pickering Beach
Tidewater
Wyoming
Dover
Tidewater
Camden Wyoming
Camden
Magnolia Artesian
Tidewater
Wilkesson
Choptank River
Tidewater
Viola
Felton
Frederica
Frederica
Tidewater
Artesian
Murderkill River
Mispillion River
Milford
Harrington
Harrington
Houston
Milford
Slaughter
Marshyhope Creek
Cedar Creek
Farmington
Nanticoke River
Gravelly Branch
Gum Branch


Public Water Supply Wells and Wellheads, Water Service Areas, and Groundwater Recharge Areas
Sussex County
State of Delaware
Public Supply Wells
Wellhead Protection Areas
Watersheds
Water
County Boundary
Towns
Map prepared by the Water Resources Agency, University of Delaware, August, 2013.
0 2 4 8
Miles
0 3 6 12
Kilometers
Delaware Bay
Choptank River
Murderkill River
Harrington
Houston
Slaughter Beach
Milford
Cedar Creek
Wilkerson
Farmington
Mispillion River
Marshyhope Creek
Greenwood
Gum Branch
Broadkill River
Gravelly Branch
Bridgeville
Tidewater
Long Neck
Nanticoke River
Seaford
Georgetown
Deep Creek
Wilkerson
Indian River
Tidewater
Millsboro
Laurel
Public Water Supply
Broad Creek
Long Neck
Dagsboro
Frankford
Pocomoke River
Delmar
Lewes-Rehoboth Canal
Lewes
Rehoboth Beach
Rehoboth Bay
Artesian
Public Water Supply
Bethany Beach
Sussex Shores
Little Assawoman


Water Supply Wells
Wellhead Areas
Excellent Recharge Areas
Municipalities
Roads
Railroads
Hydrology
New Castle County
Kent County
Delaware
Delaware
Smyrna
Clayton
Clayton
0.46 mgd
Leipsic
Kenton
Cheswold
Queen Annes County
Maryland
Delaware Bay
Little Creek
Dover
Hartly
Dover
5.5 mgd
Dover AFB
0.57mgd
Wyoming
Camden
Camden
1.6 mgd
Magnolia
0.08 mgd
Magnolia
Woodside
Bowers
Beach
Viola
Artesian
1.18 mgd
Felton
0.11 mgd
Felton
Frederica
Frederica
0.17 mgd
Tidewater2.
2.0 mgd
Caroline County
Maryland
Harrington
Milford
2.8 mgd
Harrington
0.74 mgd
Houston
Milford
Farmington
Sussex County
Delaware
Inset Map
March 2004
Miles
Source:
Water Supply Wells and Wellhead Delineations - Delaware Department of Natural Resources and Environmental Control, March 2004.
Excellent Recharge Areas - Delaware Geological Survey, 2003.
Municipal Boundaries - Office of State Planning and Coordination, February 2004.
Roads - Delaware Department of Transportation centerline file 2001. Created from Digital Orthophoto Quarter Quads, 1997.
Hydrology - USGS 7.5 Minute Series Topographic Maps. Created in cooperative agreement between the State of Delaware and the USGS (1991-1993).
Note:
This map is provided by the Water Resources Agency, University of Delaware solely for display and reference purposes and is subject to change without notice. No claims, either real or assumed, as to the absolute accuracy or precision of any data contained herein are made by the Water Resources Agency, University of Delaware nor will the Water Resources Agency, University of Delaware be held responsible for any use of this document for purposes other than which it was intended.

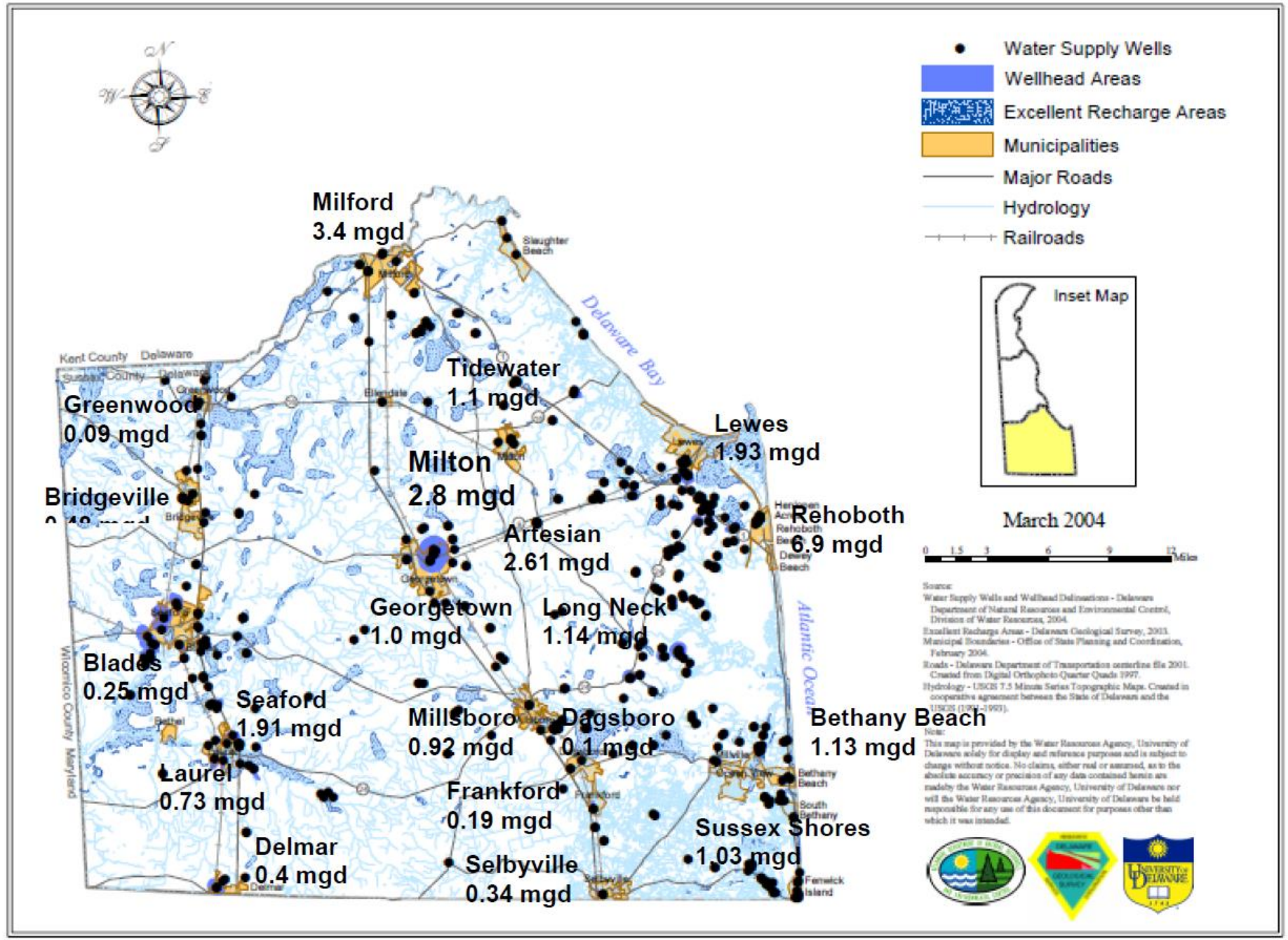

Water Supply Wells
Wellhead Areas
Excellent Recharge Areas
Municipalities
Major Roads
Hydrology
Railroads
Inset Map
Milford
3.4 mgd
Tidewater
1.1 mgd
Greenwood
0.09 mgd
Lewes
1.93 mgd
Milton
2.8 mgd
Bridgeville
Rehoboth
6.9 mgd
Artesian
2.61 mgd
Georgetown
1.0 mgd
Long Neck
1.14 mgd
Blades
0.25 mgd
Seaford
1.91 mgd
Millsboro
0.92 mgd
Dagsboro
0.1 mgd
Bethany Beach
1.13 mgd
Laurel
0.73 mgd
Frankford
0.19 mgd
Sussex Shores
1.03 mgd
Delmar
0.4 mgd
Selbyville
0.34 mgd
Delaware Bay
Atlantic Ocean
Kent County Delaware
Sussex County Delaware
Wicomico County Maryland
March 2004
0 1.5 3 6 9 12 Miles
Source:
Water Supply Wells and Wellhead Delineations - Delaware Department of Natural Resources and Environmental Control, Division of Water Resources, 2004.
Excellent Recharge Areas - Delaware Geological Survey, 2003.
Municipal Boundaries - Office of State Planning and Coordination, February 2004.
Roads - Delaware Department of Transportation centerline file 2001. Created from Digital Orthophoto Quarter Quads 1997.
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**Table 1.** Future potable water demand in Kent County and Sussex County, 2010-2030

| County | 2010 | 2020 | 2030 |
|---|---|---|---|
| **Kent County** | **19.3** | **20.7** | **21.7** |
| Public Water Demand | 15.4 | 16.5 | 17.4 |
| Individual Wells | 3.9 | 4.2 | 4.3 |
| **Sussex County** | **41.7** | **51.3** | **61.3** |
| Public Water Demand | 32.2 | 41.3 | 51.3 |
| Individual Wells | 9.5 | 10.0 | 10.0 |
| **Kent County and Sussex County** | **61.0** | **72.1** | **83.0** |
| Public Water Demand | 47.6 | 58.0 | 68.6 |
| Individual Wells | 13.4 | 14.1 | 14.4 |

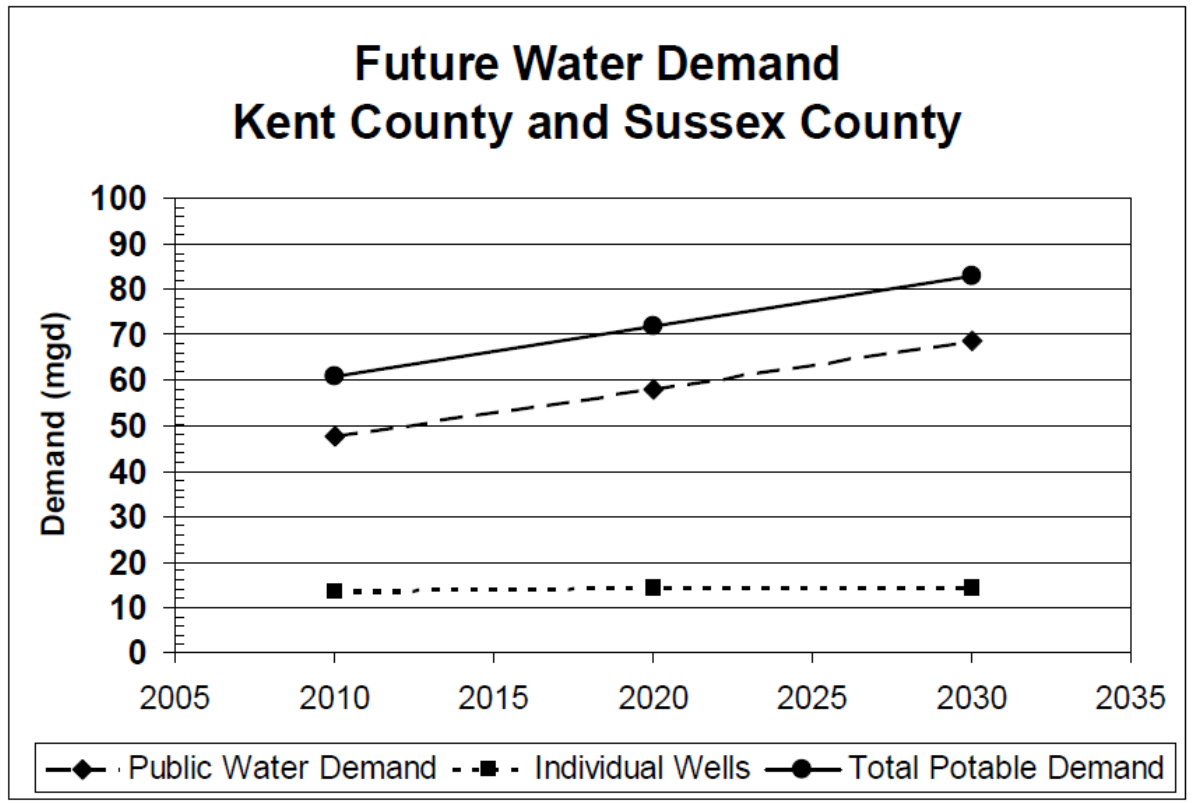
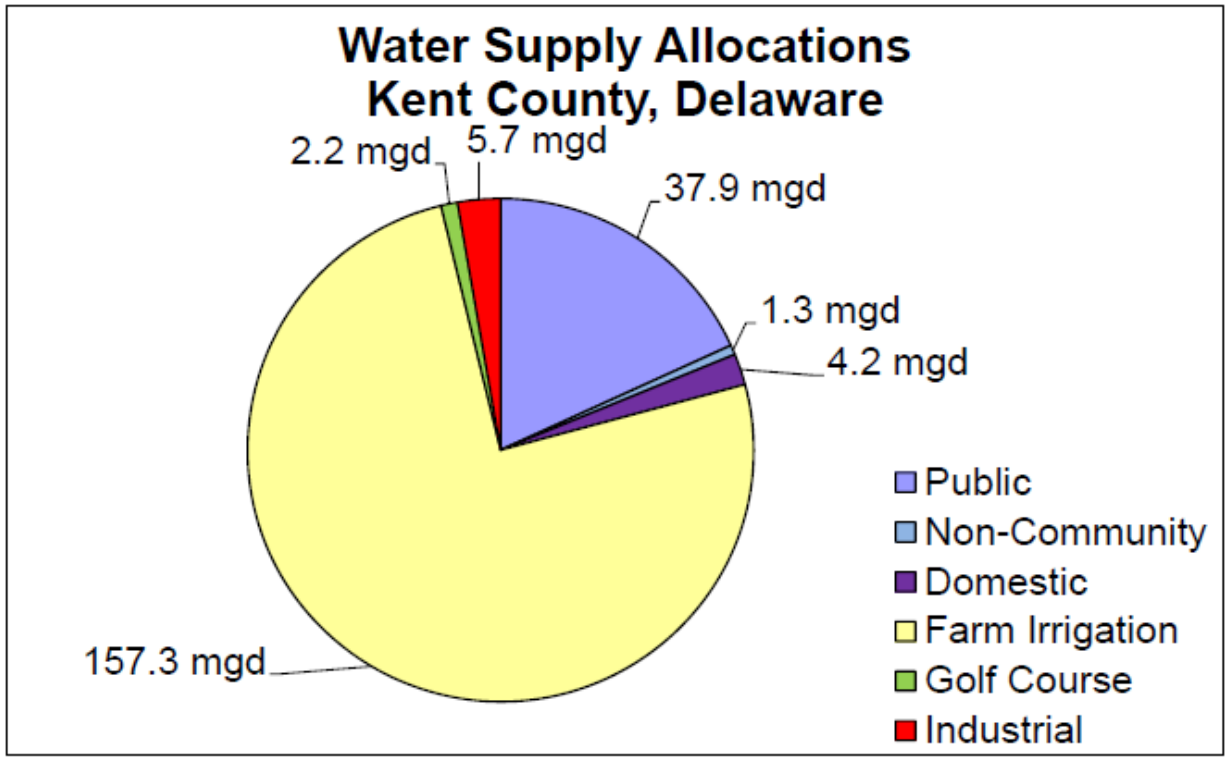



**Figure 6.** Existing and future water demands in Kent and Sussex counties, 2010-2030

**Table 3.2.** Average annual withdrawals for the top 15 public water systems in southern Delaware

| System ID | System | Years | Average Pumping (gal) | Average Pumping (mgd) |
|---|---|---|---|---|
| DE0000571 | Dover Water | 2004-2008 | 1,830,912,200 | 5.016 |
| DE0000616 | Milford Water Department | 2004-2008 | 892,154,684 | 2.444 |
| DE0000723 | Rehoboth Water | 2004-2008 | 540,782,618 | 1.482 |
| DE0000991 | Tidewater Utilities (Rehoboth District) | 2004-2008 | 493,493,635 | 1.352 |
| DE0000602 | Lewes Water | 2004-2008 | 434,809,660 | 1.191 |
| DE0000246 | Seaford Water | 2004-2008 | 424,107,563 | 1.162 |
| DE0000592 | Georgetown Water | 2004-2008 | 299,004,084 | 0.819 |
| DE0000221 | Tidewater Utilities (Bethany Bay) | 2004-2008 | 278,816,464 | 0.764 |
| DE0000124 | Tidewater Utilities (Camden District) | 2004-2008 | 254,066,103 | 0.696 |
| DE0000657 | Smyrna Water | 2005-2008 | 243,811,000 | 0.668 |
| DE00A0323 | Artesian Water Co. (South Bethany) | 2004-2008 | 205,408,380 | 0.563 |
| DE0000625 | Long Neck Water | 2004-2008 | 202,452,480 | 0.555 |
| DE0000833 | Perdue (Georgetown) | 2004-2008 | 196,947,060 | 0.540 |


Water Supply Allocations
Kent County, Delaware
2.2 mgd
5.7 mgd
37.9 mgd
1.3 mgd
4.2 mgd
157.3 mgd
Public
Non-Community
Domestic
Farm Irrigation
Golf Course
Industrial

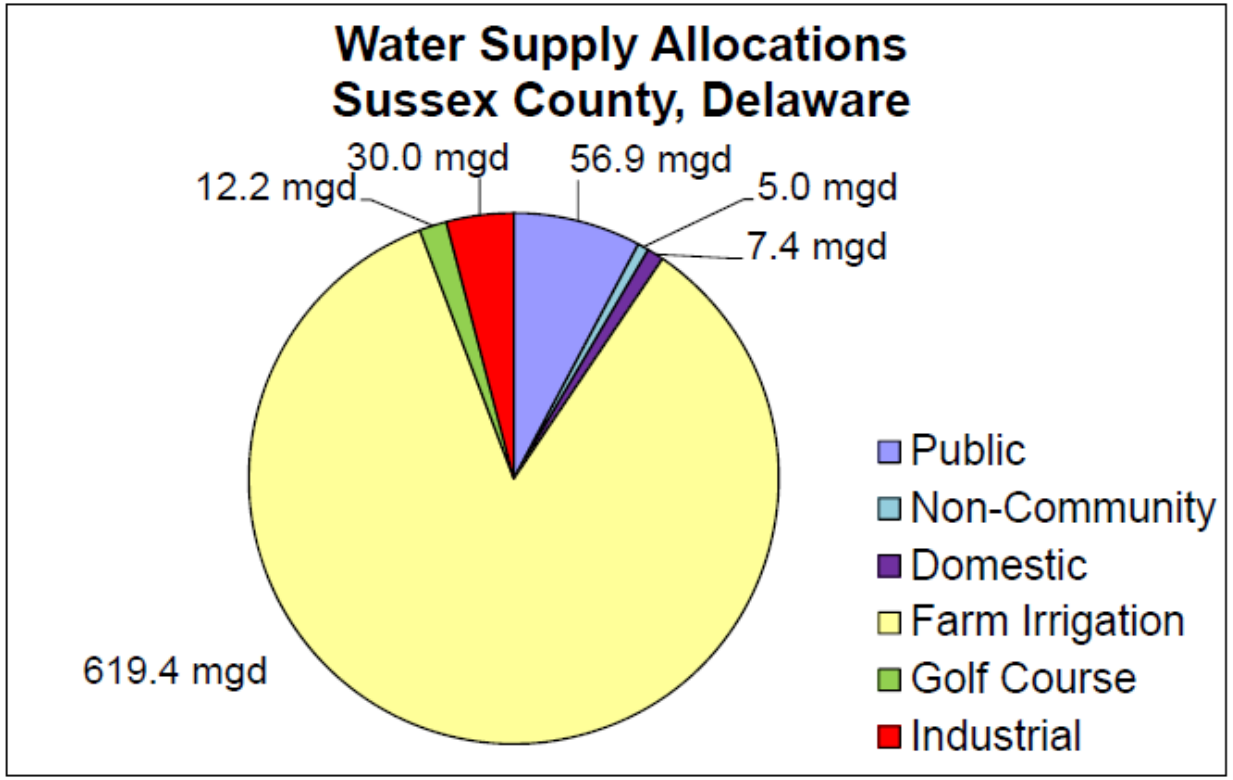

Water Supply Allocations
Sussex County, Delaware
12.2 mgd
30.0 mgd
56.9 mgd
5.0 mgd
7.4 mgd
619.4 mgd
Public
Non-Community
Domestic
Farm Irrigation
Golf Course
Industrial

**Table 6.1.** Peak day water demand in Kent County and Sussex County, Delaware

| County | Use | Peak Day Demand (mgd) |
|---|---|---|
| **Kent County** | Public Water | 14.3 |
| | Non-community | 0.6 |
| | Domestic Well | 4.2 |
| | Farm Irrigation | 18.9 |
| | Golf Course | 2.2 |
| | Industrial | 1.3 |
| | | |
| **Sussex County** | Public Water | 30.5 |
| | Non-community | 1.2 |
| | Domestic Well | 7.4 |
| | Farm Irrigation | 71.7 |
| | Golf Course | 12.2 |
| | Industrial | 5.6 |
| | | |
| **Total** | Public Water | 44.8 |
| | Non-community | 1.8 |
| | Domestic Well | 11.6 |
| | Farm Irrigation | 90.8 |
| | Golf Course | 14.4 |
| | Industrial | 6.9 |

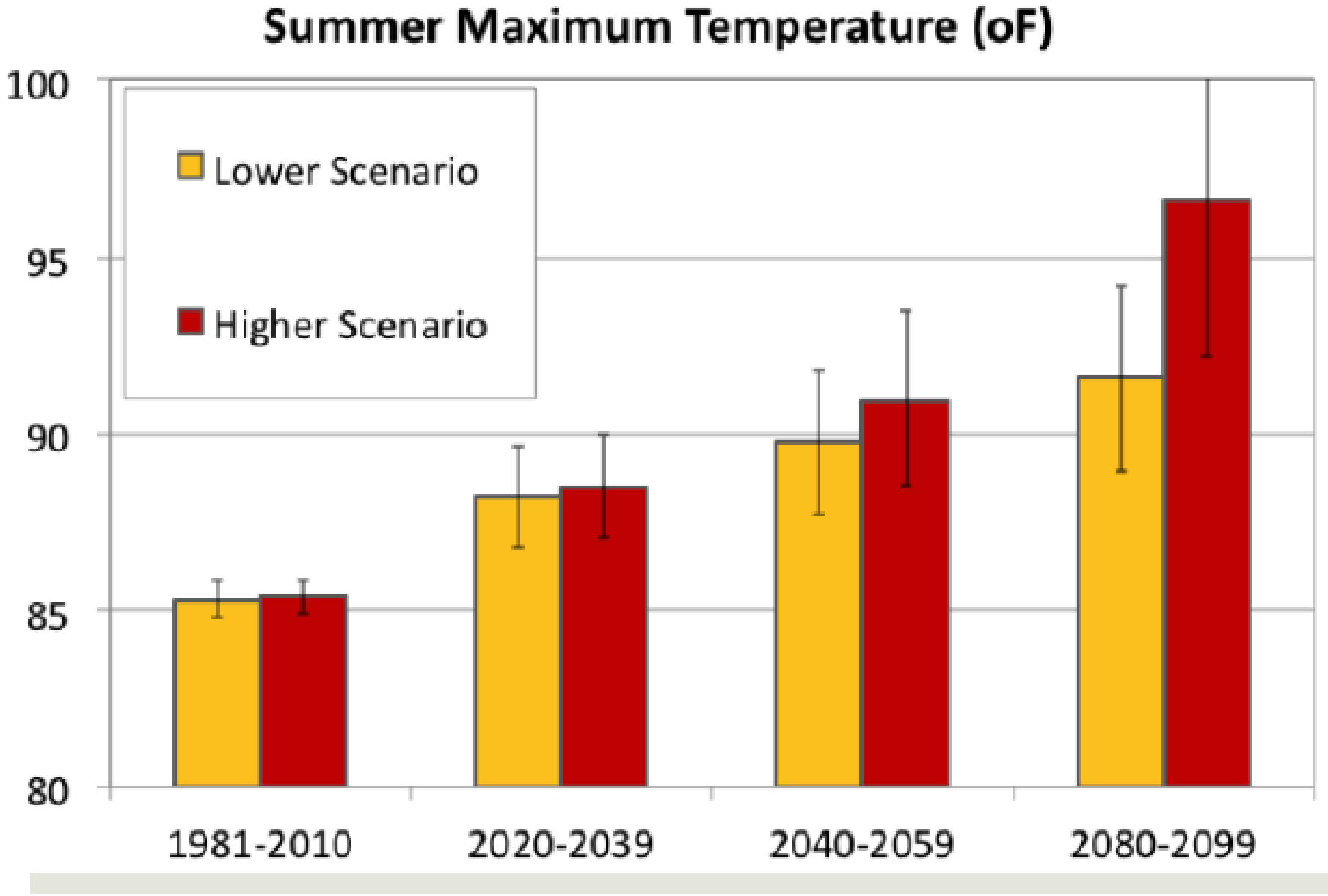



**Figure 6.4.** Change in summer maximum temperature in Delaware (DNREC 2014)

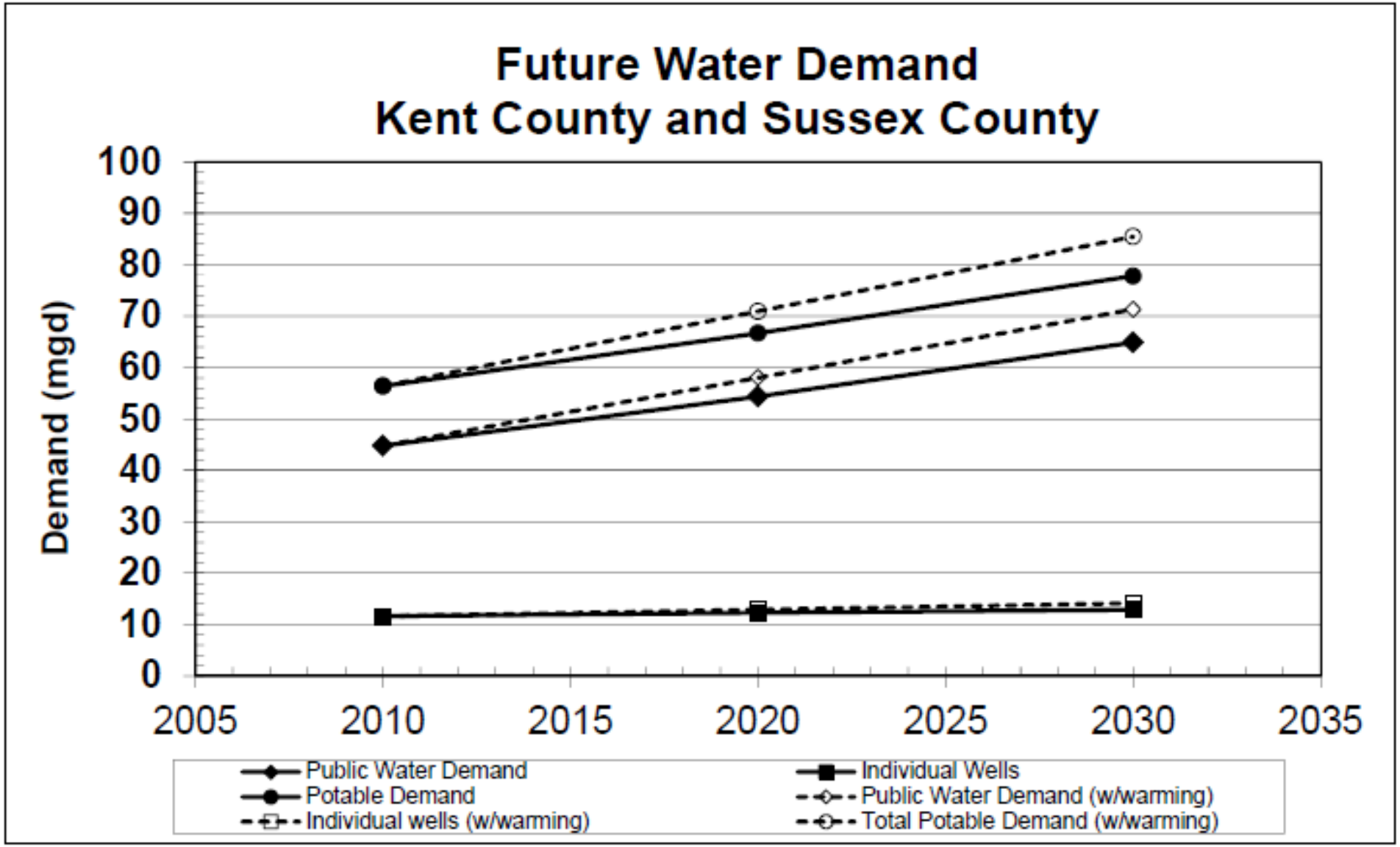
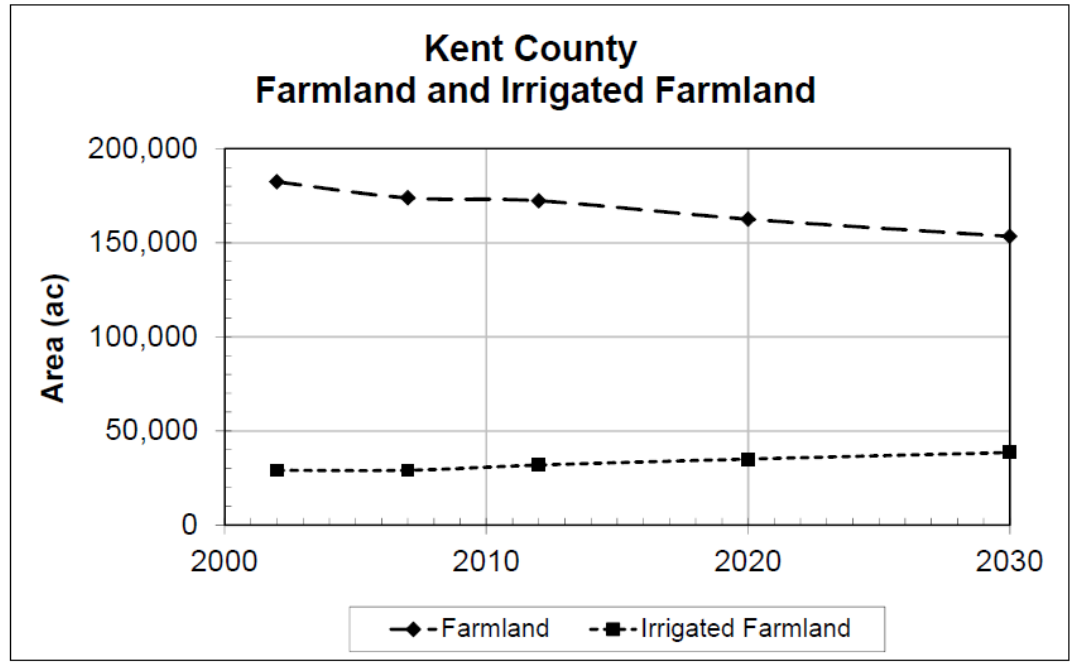



**Figure 6.5.** Future water demands with climate change in Kent and Sussex counties from 2010-2030



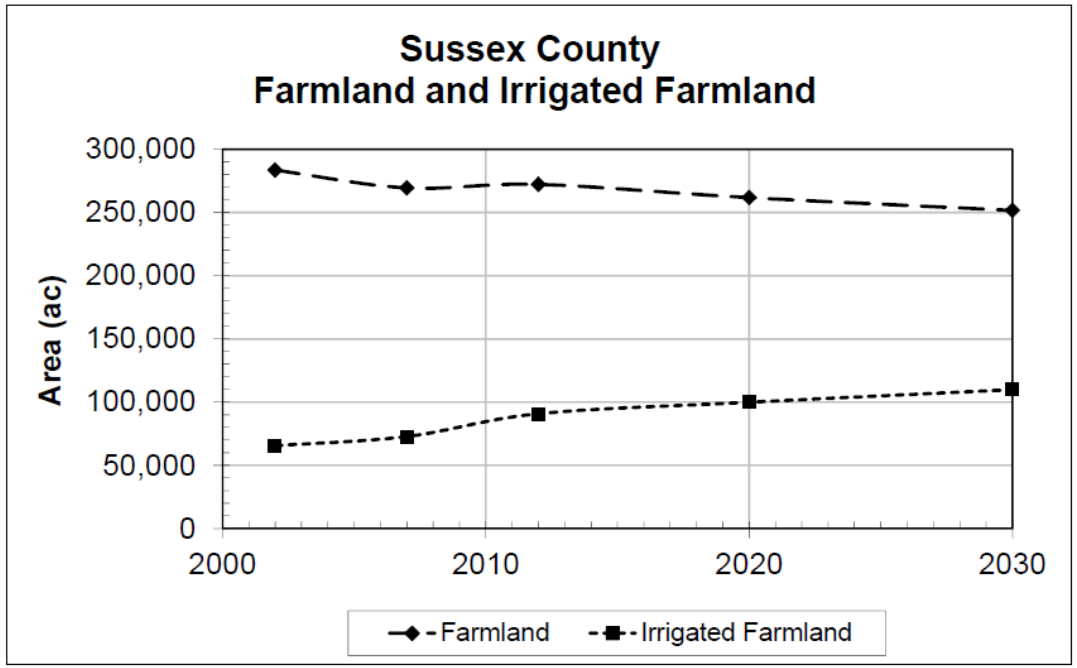
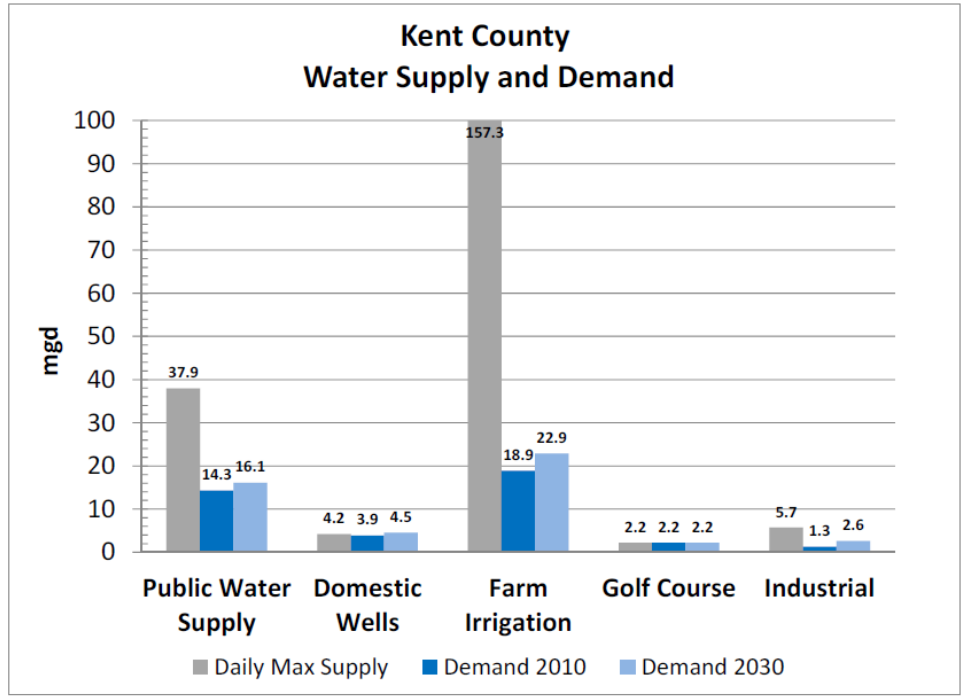
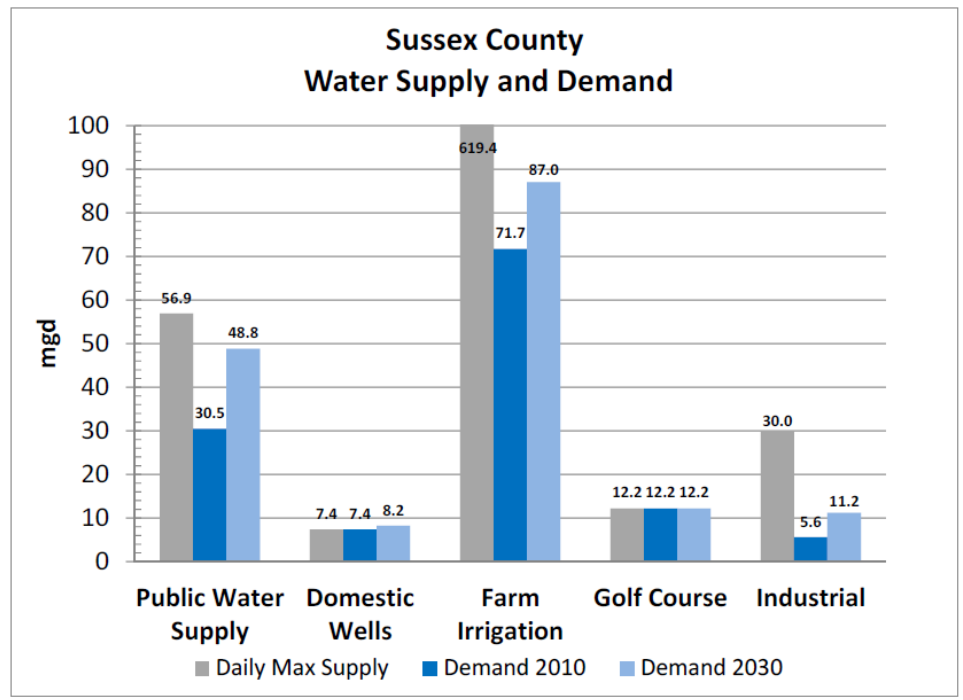




**Figure 6.6.** Farmland and irrigated farmland in Kent County and Sussex County (USDA 2004, 2009, 2014)

**Table 7.1.** Summary of water supply and demand in Kent County and Sussex County

| Water Use | Daily Maximum Allocation (mgd) | 2010 Peak Day Demand (mgd) | 2010 Surplus/ Deficit (mgd) | 2030 Peak Day Demand (mgd) | 2030 Surplus/ Deficit (mgd) |
|---|---|---|---|---|---|
| **Kent County** | | | | | |
| Public Water Supply | 37.9 | 14.3 | 23.6 | 16.1 | 21.8 |
| Non-Community | 1.3 | 0.5 | 0.8 | 0.6 | 0.7 |
| Domestic Wells | 4.2 | 3.9 | 0.3 | 4.5 | -0.3 |
| Farm Irrigation | 157.3 | 18.9 | 138.4 | 22.9 | 134.4 |
| Golf Course | 2.2 | 2.2 | 0 | 2.2 | 0 |
| Industrial | 5.7 | 1.3 | 4.4 | 2.6 | 3.1 |
| **Sussex County** | | | | | |
| Public Water Supply | 56.9 | 30.5 | 26.4 | 48.8 | 8.1 |
| Non-Community | 5 | 1.5 | 3.5 | 2.4 | 2.6 |
| Domestic Wells | 7.4 | 7.4 | 0 | 8.2 | -0.8 |
| Farm Irrigation | 619.4 | 71.7 | 547.7 | 87.0 | 532.4 |
| Golf Course | 12.2 | 12.2 | 0 | 12.2 | 0 |
| Industrial | 30.0 | 5.6 | 24.4 | 11.2 | 18.8 |


Kent County
Water Supply and Demand
mgd
100
90
80
70
60
50
40
30
20
10
0
37.9
14.3
16.1
4.2
3.9
4.5
157.3
18.9
22.9
2.2
2.2
2.2
5.7
1.3
2.6
Public Water Supply
Domestic Wells
Farm Irrigation
Golf Course
Industrial
Daily Max Supply
Demand 2010
Demand 2030


Sussex County
Water Supply and Demand
mgd
100
90
80
70
60
50
40
30
20
10
0
56.9
30.5
48.8
7.4
7.4
8.2
619.4
71.7
87.0
12.2
12.2
12.2
30.0
5.6
11.2
Public Water Supply
Domestic Wells
Farm Irrigation
Golf Course
Industrial
Daily Max Supply
Demand 2010
Demand 2030

**Recommendations**

**1. Drought Operating Guidelines:** The Water Supply Coordinating Council should appoint a committee composed of the Delaware DNREC Division of Water, Delaware Department of Agriculture, University of Delaware Water Resources Agency, public water utilities, and green industry to assist the Delaware Geological Survey to develop drought operating guidelines for Kent County and Sussex County based on streamflow, groundwater, precipitation, soil moisture, irrigation.

**2. Interconnected Water System:** The Water Supply Coordinating Council should work with the public water suppliers to encourage construction and mapping of interconnections between public water systems in Kent County and Sussex County.

**3. Hazardous Substance Cleanup:** To focus on strategic cleanup of volatile organic contaminants (VOCs), pesticides, and emerging contaminants and improve groundwater quality in wellhead areas, the Water Supply Coordinating Council should appoint a member to participate in the Hazardous Substance Cleanup Act (HSCA) committee organized by the DNREC Div.on of Waste and Hazardous Substances and Department of Agriculture nutrient management and pesticide committees.

**4. Groundwater Monitoring**: The State of Delaware should continue to fund and expand groundwater monitoring programs operated by the Delaware Geological Survey, Delaware DNREC, and Delaware Department of Agriculture for both water quantity and water quality. The key for monitoring water quantity is construction of new monitoring infrastructure and maintenance of existing monitoring infrastructure to meet changing water demand patterns. Two critical components to incorporate in water quality monitoring are having: (1) data collection and evaluation systems in place to recognize and respond to water quality threats and trends, and (2) a mechanism for state and local agencies to coordinate and prioritize data.

**5. Climate Change:** The Delaware DNREC should enhance infrastructure for monitoring along the seacoast to detect salt water intrusion from coastal storm flooding or related to rising sea levels.

**6. Groundwater Availability:** The DGS has developed a scope of work and budget needed to generate data needed by modern planning tools that better estimate groundwater availability for growing areas of Kent and eastern Sussex Counties. These plans follow the goals and objectives of the Southern New Castle-Northern Kent Counties project that is now nearing successful completion. Groundwater monitoring infrastructure is designed with a 20 to 30 year lifespan and will evaluate adequacy of water availability by aquifer, threats of saltwater intrusion, and other large-scale potable water quality concerns.

**7. Water Availability:** Key information related to DNREC regulations, policies, and permit conditions that should be addressed in future water availability reports include:

- Permit limits on drawdown by well and wellfield
- Special rules applied to areas that have experienced depletion, such as Dover area aquifers
- Summary of regulations, policies, and details of special cases for groundwater management zones.

**8. Water Supply/Demand Projections**: The Water Supply Coordinating Council should update water supply and demand projections for Kent County and Sussex County at five-year intervals beginning in 2022 to utilize population data from the 2020 U.S. Census.

**9. Peak Summer Demands:** Public water utilities in coastal communities should examine peak daily demand patterns, plan to develop new water supplies, and construct interconnections with adjacent water systems to anticipate high peaking factors due to the influx of summer visitors to the beach communities.

**10. Water Use Database:** The DNREC Division of Water should continue modernization of the state water use database and consolidation of datasets, with attention to issues identified in the recently completed Delaware Geological Survey Kent-Sussex Aquifer and Groundwater Study. This USGS Water Census initiative should be utilized to provide financial resources through grants to State water resource agencies to improve the availability and quality of water use data that they collect.

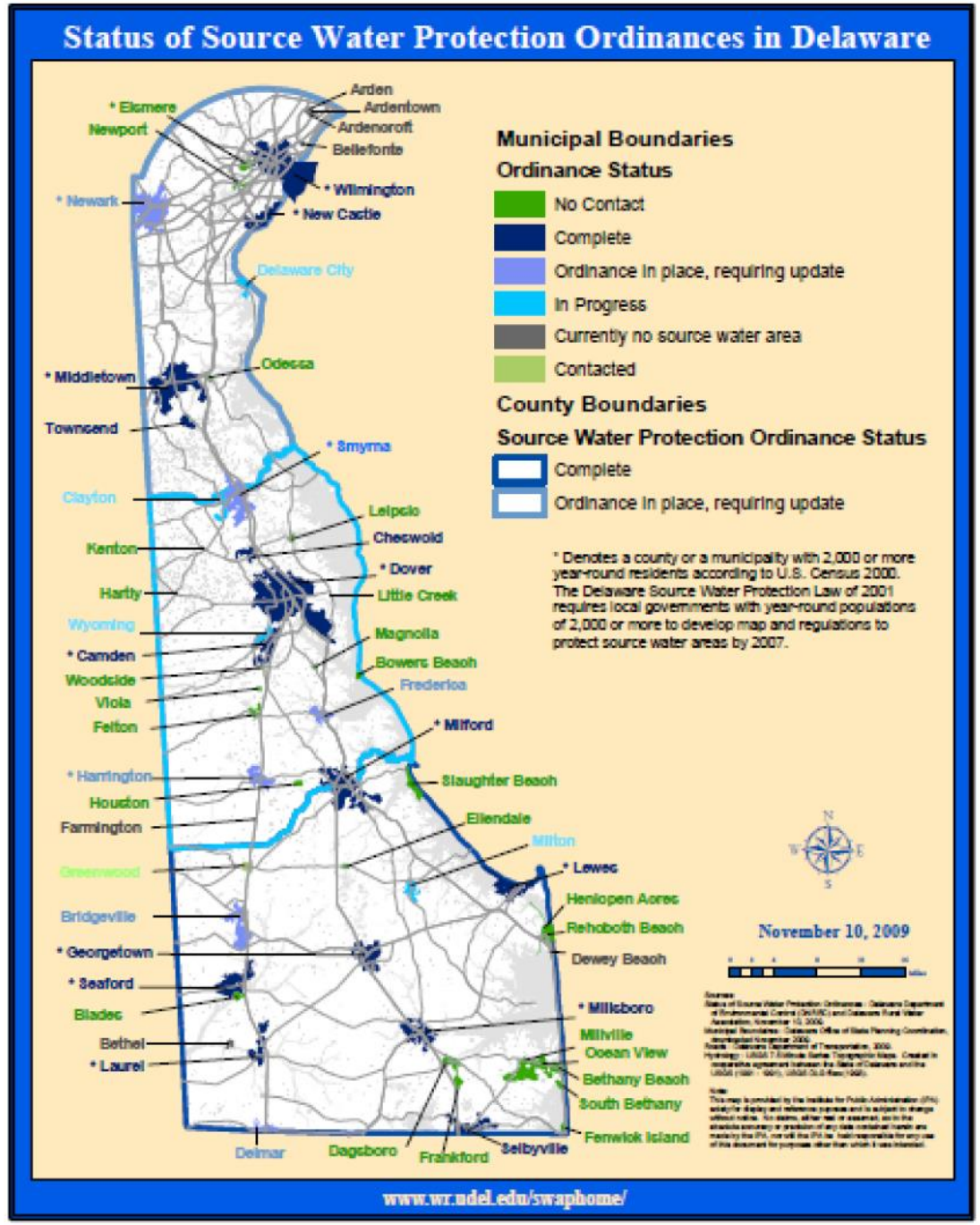



**Figure 4.1.** Status of source water protection ordinances in Delaware