

**SEVENTH REPORT TO THE GOVERNOR AND THE GENERAL ASSEMBLY**

*Regarding the Progress of the*

**DELAWARE WATER SUPPLY COORDINATING COUNCIL**

(Northern Delaware Drought Operating Plan)

June 24, 2005

*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





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**Introduction**

The Delaware Water Supply Coordinating Council (WSCC) continued to advance toward its goal of developing one billion gallons of additional water supply and storage in northern Delaware since 1999. As of June 2005, purveyors have developed 1,014 million gallons (mg) of the originally projected deficit of 1,020 million gallons to meet the drought of record based on water demands forecast through 2020. Progressing toward this goal, the City of Newark hired a new contractor in October 2004 to resume construction of the 317 mg Newark Reservoir. When the Newark Reservoir is complete in December 2005, total storage added in northern Delaware since 1999 will be 1,331 mg.

Because stream flows reached record low flows during the drought of 2002, the WSCC reevaluated supply and demand projections and concluded that 262 to 450 mg of additional storage could be needed by 2020 to meet peak demands during a drought of record, increasing the projected deficit to as much as 1,470 mg in 2020. Members of the WSCC then nominated projects that each would sponsor and have the potential for groundbreaking and/or completion on a fast track status.

Purveyors have made progress on these projects. Artesian Water Company (AWC) increased its supply through new wells in the Chesapeake City Road area and completed installation of two 20-inch pipelines under the C&D Canal near the Summit Bridge to interconnect water systems on both sides of the canal for assurance of system reliability. The City of Wilmington is planning on raising the water level in Hoopes Reservoir two feet in conjunction with stability improvements to the dam to provide an additional 120 mg of water. The U.S. Army Corps of Engineers determined that the City would not need permits to complete the project. The City has also partnered with United Water Delaware (UWD) and the State to retain a consultant to evaluate the feasibility of modifying the pipeline that supplies water to Hoopes Reservoir and/or increasing the capacities of the pumping stations to provide an additional 36 mg to 510 mg of water to fill Hoopes Reservoir during rainstorms that occur during drought periods. In January 2005, UWD received approval from the Delaware Department of Natural Resources and Environmental Control (DNREC) and the Delaware River Basin Commission (DRBC) to implement a new operating plan for its Tidal Capture Structure that increases supply while protecting the ecology and fishery in the tidal White Clay Creek. The recently approved plan replaces the 7Q10 minimum flow standard with a standard based on minimum flow depth and chloride provisions and provides an additional 400 million gallons of water.

Reduction of drought vulnerability in Delaware has been an important topic of discussion within the state executive and legislative branches. In April 2003, Governor Minner released her water supply initiative, "2020 On Tap: Ensuring Delaware's Fresh Water Supply." The plan builds upon previous efforts to ensure that northern Delaware will be self-sufficient during drought by 2010. In January 2005, UWD implemented conservation water rates. In February 2005, Wilmington City Council approved a resolution adopting conservation water rates. In March 2005, AWC filed an application for certification of water self-sufficiency with the Public Service Commission (PSC). The Commission is considering treating the filing as an interim filing, which would look at AWC self-sufficiency through 2006.

On April 29, 2005 the WSCC approved a new Drought Operating Plan (DOP) for water purveyors in northern Delaware, subject to the Drought Operating Plan Committee's approval by a simple majority of the actions that would be undertaken by United, Wilmington, Newark and New Castle, portions of which were not presented in the draft provided to the WSCC (Artesian opposed conditional approval of the DOP, indicating that WSCC

approval should not occur until all purveyors have submitted their specific drought operating plans). This DOP includes Drought Operating Guidelines (approved by the WSCC in the June 2004 *Sixth Report*) that incorporate a three-phase drought advisory system. The DOP provides specific plans – submitted by the purveyors – to use surface supplies, ground-water supplies, and interconnections in the event of drought. The WSCC also revised its water use recommendations and restrictions for drought watch, drought warning, and drought emergency after an extensive series of very successful development meetings among DNREC and the Delaware Green Industry representatives over the past year.

This report reviews the role of the State Water Coordinator and Water Supply Coordinating Council, summarizes water conditions within the state during 2004 and 2005, and provides updates on activities and projects of WSCC members. Stewart Lovell from DNREC, John Talley and Stefanie Baxter from the Delaware Geological Survey (DGS), and Gerald J. Kauffman and Kevin J. Vonck from the University of Delaware, Institute for Public Administration – Water Resources Agency (UDWRA) authored this report on behalf of the WSCC. This is the seventh report of a series; previous reports are available online at [www.wr.udel.edu](http://www.wr.udel.edu).

### **State Water Coordinator**

In July 2000, Governor Carper signed HB 549, which appointed the UDWRA as the Delaware State Water Coordinator. The mission of the Water Coordinator is to work cooperatively with the water purveyors in northern Delaware to ensure that new water supplies were developed on schedule by the end of 2003. Along with the Water Coordinator, HB 549 appointed the DGS and the Delaware DNREC as a triad of water advisors to the WSCC. By law, the State Water Coordinator appointment expired December 31, 2003, but it has continued into 2005 by resolution of the WSCC.

### **Water Supply Coordinating Council**

HB 549 also appointed the WSCC for a tenure extending until December 31, 2003. The WSCC was directed to 1) develop new water supplies in northern New Castle County to meet peak demands by December 31, 2003 based on the drought of record; and 2) work cooperatively in a public-private effort between government and water purveyors to manage water supplies more efficiently in Delaware. In August 2003, Governor Minner signed HB 203, which reauthorized the WSCC through January 1, 2010, expanded the membership of the WSCC to include statewide representation, and appointed the DGS and UDWRA as voting members. The new mandate of the WSCC is to work cooperatively to achieve water supply self sufficiency in northern New Castle County by 2010 and to develop and publish water supply plans for southern New Castle County, Kent County, and Sussex County. The Secretary of DNREC (or his/her designee) serves as Chair of the WSCC. The Council, by majority vote, may designate additional members. The Council, by majority vote, may also establish subcommittees to deal with specific water supply issues and plans. The following entities (or their designees) are voting members of the expanded WSCC:

- Office of the Governor
- Secretary of the Delaware Department of Natural Resources & Environmental Control (Chair)
- Secretary of the Department of Public Safety
- Secretary of the Delaware Department of Agriculture
- Executive Director of the Public Service Commission
- Director of the Delaware Emergency Management Agency
- Director of the Delaware Geological Survey
- Director of the Delaware Division of Public Health
- Public Advocate
- Executive Director of the Delaware River Basin Commission
- New Castle County Executive
- Artesian Water Company

- City of Newark
- City of Wilmington
- New Castle Municipal Services Commission
- Tidewater Utilities, Inc.
- United Water Delaware
- New Castle County Chamber of Commerce
- Delaware State Chamber of Commerce
- Delaware Nursery and Landscape Association
- Delaware Grounds Management Association
- Delaware State Golf Association
- Delaware Nature Society
- Coalition for Natural Stream Valleys
- New Castle County Civic League
- University of Delaware, Institute for Public Administration - Water Resources Agency
- Kent County
- Sussex County
- Public Water Supply Utility in Sussex County Association of Towns (SCAT)
- Public Water Supply Utility in League of Local Governments, Kent County
- Delaware Rural Water Association
- National Association of Water Companies, Delaware Chapter (not already represented in NCC)
- Local Chamber of Commerce in New Castle County
- Local Chamber of Commerce in Kent County
- Local Chamber of Commerce in Sussex County
- Delaware Farm Bureau
- Center for Inland Bays
- State Fire Marshall

The WSCC met on the following dates:

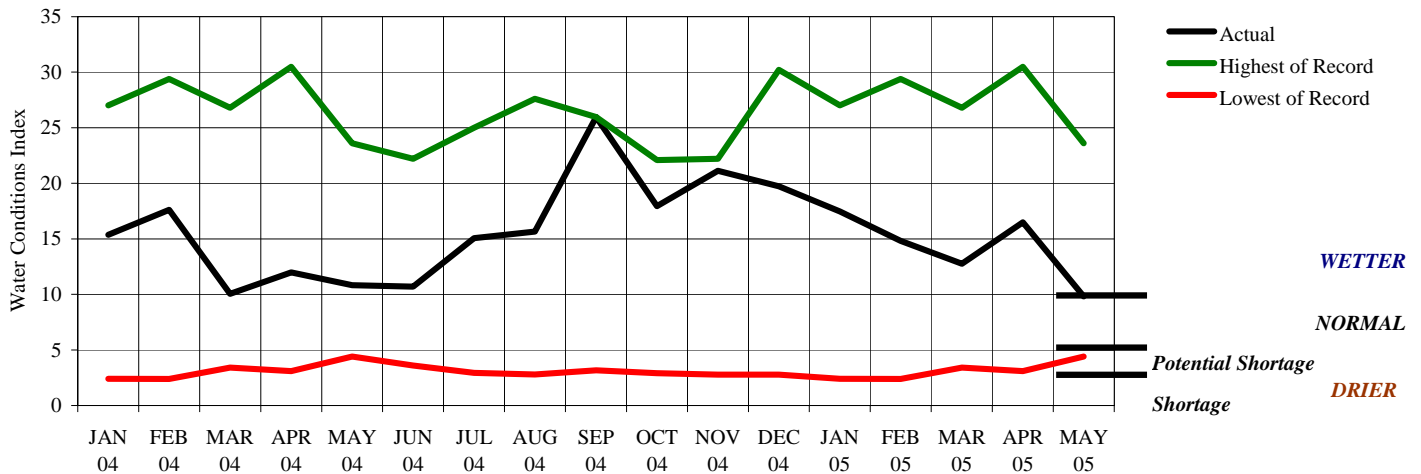
2000	March 3*	Carvel State Office Building, Wilmington, Del.
	March 24*	Carvel State Office Building, Wilmington, Del.
	May 22*	Delaware Geological Survey, Newark, Del.
	July 31	New Castle County Chamber of Commerce, Churchman's Crossing, Del.
	October 4	Artesian Water Company, Churchman's Crossing, Del.
2001	January 10	United Water Delaware, Stanton, Del.
	March 14	Artesian Water Company, Churchman's Crossing, Del.
	June 14	United Water Delaware, Stanton, Del.
	October 4	Artesian Water Company, Churchman's Crossing, Del.
2002	February 5	United Water Delaware, Stanton, Del.
	April 17	Artesian Water Company, Churchman's Crossing, Del.
	July 10	Artesian Water Company, Churchman's Crossing, Del.
	September 11	Artesian Water Company, Churchman's Crossing, Del.
	October 17	Delaware DNREC, New Castle, Del.
	November 21	Artesian Water Company, Churchman's Crossing, Del.
	December 12	Artesian Water Company, Churchman's Crossing, Del.

- 2003 May 22 Artesian Water Company, Churchman's Crossing, Del.
- July 16 Artesian Water Company, Churchman's Crossing, Del.
- October 9 Artesian Water Company, Churchman's Crossing, Del.
- December 11 Artesian Water Company, Churchman's Crossing, Del.
  
- 2004 January 13 University of Delaware Water Resources Agency, Newark, Del.  
*Drought Operating Plan Work Group*
- February 25 University of Delaware Water Resources Agency, Newark, Del.  
*Drought Operating Plan Work Group*
- June 24 Delaware Technical & Community College – Terry Campus, Dover, Del.
- September 30 DNREC Lukens Building, New Castle, Del.
- October 21 University of Delaware Water Resources Agency, Newark, Del.  
*Drought Operating Plan Work Group*
  
- 2005 March 3 University of Delaware Water Resources Agency, Newark, Del.  
*Drought Operating Plan Work Group*
- April 29 DELDOT – Farmington/Felton Room, Dover, Del.

\* The WSCC met under Executive Order 74 (December 30, 1999) before HB 549 was signed in July 2000.

**Delaware Water Conditions Update**

**DGS Water Conditions Index (WCI):** The WCI for New Castle County entered the "normal" range after remaining in the "wetter" range since November 2002. With the exception of a rise in April, the WCI has been steadily declining since December 2004.



**Precipitation:** Precipitation for the 2004 calendar year was above normal in northern Delaware, near normal in central Delaware, and below normal southern Delaware:

<i>Location</i>	<i>Total Precipitation</i>	<i>Normal Precipitation</i>	<i>Difference</i>	<i>2004 % of Normal</i>
Wilmington (Porter Reservoir)	61.85"	45.48"	16.37"	136%
New Castle (NWS)	56.64"	42.81"	13.83"	132%
Dover	44.88"	46.28"	-1.4"	97%
Greenwood	40.17"	45.99"	-5.82"	87%
Lewes	42.11"	46.00"	-3.89"	92%
Georgetown	31.97"	45.34"	-13.37"	71%

Precipitation for the 2005 calendar year (through May) was near normal throughout most of Delaware, except for Wilmington which was above normal:

<i>Location</i>	<i>Total Precipitation</i>	<i>Normal Precipitation</i>	<i>Difference</i>	<i>Jan-May 2005 % of Normal</i>
Wilmington (Porter Reservoir)	21.31"	18.12"	3.19"	118%
New Castle (NWS)	17.97"	17.75"	0.22"	101%
Dover	19.53"	19.14"	0.39"	102%
Greenwood	20.05"	19.53"	0.52"	103%
Lewes	20.84"	19.13"	1.71"	109%
Georgetown	17.59"	19.03"	-1.44"	92%

**Stream Flows:** Monthly stream flows in northern Delaware have been near normal or above normal levels since January 2004. Record high monthly mean flows were recorded on the Red Clay Creek in September and November 2004 and April 2005; the White Clay Creek in November 2004; and the Christina River in July 2004. Monthly mean stream flows in central and southern Delaware have been near normal levels since January 2004.

Water Body	Years of Record	2004												2005				
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
Brandywine Creek	56	N	AN	N	N	N	N	AN	AN	AN	AN	AN**	AN	AN	N	N	AN	N
Red Clay Creek	60	N	AN	N	AN	N	AN	AN	AN**	AN*	AN	AN*	AN	AN	N	N	AN*	N
White Clay Creek	63	AN	AN	N	AN	N	AN	AN	AN	AN	AN	AN*	AN	AN	N	AN	AN	N
Christina River	60	N	AN	N	AN	N	AN**	AN*	AN	AN	AN	AN**	N	N	BN	N	AN	N
St. Jones River	45	N	N	BN	AN	N	N	AN	N	N	N	AN	N	N	N	N	AN	AN
Nanticoke River	60	N	N	BN	N	N	N	BN	N	N	N	N	N	N	N	N	AN	AN

\* highest of record; \*\* 2nd highest of record

**Ground-water Levels:** Ground-water levels in northern Delaware have been above normal while ground-water levels in central and southern Delaware have been near normal or below normal since January 2004.

Well (nearest municipality)	Years of Record	2004												2005					
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	
Bc43-01 (Hockessin)	39	AN	AN	N	N	AN**	AN**	AN*	AN	AN	AN*	AN*	AN**	AN	AN	AN	N	AN	N
Db24-10 (Newark)	45	AN	AN	AN	N	N	N	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	N
Hb14-01 (Blackbird)	45	AN	AN	N	N	N	N	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	AN	N
Jd42-03 (Camden)	42	-	N	N	N	N	N	N	N	N	N	N	N	N	N	BN	BN	N	-
Md22-01 (Williamsville)	44	AN	N	BN	BN	N	N	N	N	N	N	N	-	-	BN	N	N	AN*	N
Mc51-01 (Adamsville)	44	AN	N	N	N	N	N	BN	N	BN	BN	BN	N	BN	BN	N	N	N	-
Ng11-01 (Milton)	42	AN*	AN*	N	N	N	N	N	N	N	N	N	N	N	N	N	N	AN	N
Nc45-01 (Bridgeville)	51	N	N	N	N	N	N	N	N	N	N	N	N	N	N	BN	BN	BN	N
Qe44-01 (Trap Pond)	43	N	N	N	BN	N	N	BN	N	N	N	N	N	BN	BN	N	N	N	BN

\* highest of record; \*\* 2nd highest of record

## 2004 Northern Delaware Public Water Demand

<i>Water Purveyor</i>	<i>Peak Daily Demand (mgd)</i>	<i>Date (2004)</i>
City of Wilmington	28.9	August 4
Artesian Water Company	22.3	June 11
United Water Delaware	25.3	July 15
City of Newark	5.8	August 13
New Castle MSC	0.5	June 10

The peak daily demand for northern Delaware (combined purveyors) in 2004 was 75.2 million gallons per day (mgd) on August 4. The peak water transfer through interconnections in 2004 was 5.2 mgd on August 13. The peak daily demand for northern Delaware (combined purveyors) in 2003 was 74.9 million gallons per day (mgd) on June 26, 2003. In comparison, the peak daily demand during the drought of 2002 was 82.7 mgd, recorded on July 10, 2002. The historic peak daily demand of 93.1 mgd was recorded on July 18, 1997. The water utilities have continued submittal of water demand data starting in June 2005.

**Chloride Levels:** During April 2005, the location of the seven-day average of the 250 parts per million (ppm) isochlor (salt line) ranged from river mile 70 to below river mile 54. The normal location of the salt line during April is river mile 61 (about 8 miles south of the Delaware Memorial Bridge). As of May 15, 2005, the salt line was located at river mile 67 (about 2 miles south of the Delaware Memorial Bridge), which is three miles upstream of the normal location for May.

## Supply and Demand Projections through 2020

The December 2, 1999 Water Supply Task Force (WSTF) Report compiled estimates of public water supply and demand in northern New Castle County for drought conditions for the years 2000, 2010, and 2020. The estimates assumed a worst-case historic drought with environmental standards for minimum stream flows (7Q10) in effect along the Brandywine Creek and White Clay Creek. At the time there were minimum flow standards on White Clay Creek at Newark and Stanton and no flow standard on Brandywine Creek. The supply and demand curves forecast a deficit of 17 mgd or 1.020 billion gallon deficit for a 60-day drought period in the year 2020:

<i>Scenario/Year</i>	<i>Supply (mgd)</i>	<i>Demand (mgd)</i>	<i>+/- (mgd)</i>	<i>Volume (mg)*</i>
2000	73.0	86.0	-13.0	-780
2010	73.0	88.0	-15.0	-900
2020	73.0	90.0	-17.0	-1,020

\* based on 60-day drought duration

The WSCC has been working to develop a series of water supply projects to close the 17.0 mgd gap in northern Delaware (north of the C&D Canal). At that time, the water purveyors committed to an "A List" of options that have few environmental constraints, enjoy community support, and could be implemented by the close of 2003. The following table provides the status of these projects:



<i>Sponsor</i>	<i>Project</i>	<i>Targeted capacity Dec. 1999 (mg) / (mgd)</i>	<i>Capacity in service Jun 2005 (mg) / (mgd)</i>	<i>Status of completion</i>
City of Newark	Newark Reservoir	200 / 3	0	75% complete, construction resumed in March 2005 with new contractor, 317 mg reservoir to be operational December 2005
City of Wilmington	Hoopes Reservoir Deep Storage Plan	500 / 8	500 / 8	Complete
Artesian Water Company	New Wells North of C&D Canal	120 / 2	324 / 5	Complete, Chesapeake City Road well online
City of Newark	South Wellfield Iron Treatment Plant	60 / 1	60 / 1	Complete and online, November 2003
Artesian Water Company	Aquifer Storage and Recovery	300 / 5	130 / 2	AWC pumped 130 mg into ASR wells during winter 2004-05
<b>Projected 2020 Deficit:</b>				
<b>1,020 / 17</b>		<b>1,180 / 19</b>	<b>1,014 / 16</b>	

The drought of 2002 replaced the drought of 1965-66 as the drought of record in northern Delaware. Because 2002 streamflows on the Brandywine Creek reached record low flows (thereby reducing safe yields), the WSCC reevaluated supply and demand projections for northern Delaware. The updated chart assumed that all of the projects on the 1999 WSCC "A List" (about 1 billion gallons) would have been implemented by the end of 2004. The WSCC adopted these updated supply and demand projections for northern Delaware on October 17, 2002. These projections are based on a set of conservative assumptions of a future environmental standard (7Q50/7Q10) along the Brandywine Creek by 2020, a 7Q10 along the White Clay Creek at Stanton and Newark, and peak monthly water demands occurring during a drought lasting 75 days. Based on these assumptions, the WSCC concluded that 262 to 450 mg of additional storage could be needed by 2020 to meet peak demands during a drought of record. The WSCC adopted these projections as the water supply necessary to accommodate the peak water demand of the projected population in 2020 without water restrictions, even with a recurrence of conditions similar to the drought of 2002, under these conservative assumptions. The following table summarizes the updated supply/demand projections:

<i>Scenario/Year</i>	<i>Supply (mgd)</i>		<i>Demand (mgd)</i>	<i>+/- (mgd)</i>		<i>Volume (mg)*</i>	
	<i>7Q50</i>	<i>7Q10</i>		<i>7Q50</i>	<i>7Q10</i>	<i>7Q50</i>	<i>7Q10</i>
2003	84.5	82.0	83.3	1.2	-1.3	90	-97
2010	84.5	82.0	86.3	-1.8	-4.3	-135	-322
2020	84.5	82.0	88.0	-3.5	-6.0	-262	-450

\* based on 75-day drought duration

At the November 21 and December 12, 2002 meetings, the WSCC identified a series of additional water supply projects that could be constructed to meet a projected 2020 deficit of 262 to 450 mg, depending on the assumption of minimum stream flow standards (7Q50 or 7Q10) that could be imposed along the Brandywine Creek by 2020. Members of the WSCC then nominated projects that each would sponsor and have the potential for groundbreaking on a fast track status. Each of the sponsors provided a report summarizing the status of their project with a conceptual evaluation of project feasibility and volume (mg/mgd) based on the following criteria:

Engineering: Estimate feasibility from a technical, hydraulic, and/or geologic perspective(s).

Environmental: List the environmental/ecological benefits and constraints.

Regulatory: List federal, state, and local permitting requirements.

Economic: Estimate the capital plus annual operating and maintenance costs.

Community: Determine if the project will have community support.

Timing: Forecast chances for project groundbreaking and/or completion by end of 2003.

The WSCC decided that the following options are most practical for a new "A List" to close the 262 to 450 mg gap between water supply and demand in northern Delaware projected for 2020:

<i>Sponsor</i>	<i>Project</i>	<i>Targeted capacity January 2003 (mg)</i>	<i>Capacity in service June 2005 (mg) / (mgd)</i>	<i>Status</i>
City of Wilmington	Raise Water Level in Hoopes Reservoir by 1 foot to 5 feet	60-375	0 / 0	City plans to raise water level by two to three feet. US Army Corps of Engineers determined that a permit is not needed.
Wilmington, United Water Delaware, DNREC	Increase Hoopes Pump Station Capacity	36-510	0 / 0	DNREC retained consultant in May 2005 to conduct study with supporting funds from DNREC and United Water Delaware.
Artesian Water Company	Aquifer Storage and Recovery	150	0 / 0	Completed preliminary feasibility study at Wilmington Manor Gardens and Artisans Village.
United Water Delaware	Aquifer Storage and Recovery	225	0 / 0	Retained consultant to conduct testing near Delaware City and Smalleys Pond. Smalleys Pond site study completed: not feasible.
United Water Delaware	Modification of Tidal Capture Structure Operating Plan	75 to 500	400 / 5.3*	DRBC docket decision in January 2005 replaced 7Q10 minimum flow standard with a standard based on minimum flow depth and chloride provisions.

\* calculations performed by UWD and reviewed by the State Water Coordinator were based on January 2005 DRBC 7Q10 docket decision.

The next WSCC report will include updated supply and demand estimates that incorporate recently-completed projects.

## Progress and Activities since 1999

### **Artesian Water Company**

- *New Wells*: In December 1999, AWC was granted an increased seasonal allocation of 0.7 mgd for its Old County Road wellfield. In late 2001, AWC placed in service a new 0.2 mgd well at Artisans Village to re-distribute pumpage in order to fully utilize its wellfield allocation. AWC has added two new wells at Middle Run Crossing in the Piedmont with an allocation of 1.0 mgd and has placed wells in service at Chesapeake City Road that provide 3.5 mgd. The total additional capacity provided by these wells is 5.4 mgd. The allocation permit application for the 3.5 mgd at Chesapeake City Road has been submitted to DNREC for review.
- *Aquifer Storage and Recovery*: AWC completed eleven cycles of its Aquifer Storage and Recovery (ASR) testing program at Llangollen at a maximum rate of 2.0 mgd (120 mg over 60 days). Permanent Underground Injection Control (UIC) and water allocation permits were issued for the Llangollen ASR well in 2004. AWC completed the first operational cycle under these permits in November 2004, and currently has 126 mg of water stored for use in summer of 2005. AWC completed ASR testing at the

Wilmington Manor and Artisans Village sites, both in the Coastal Plain. Even though the injected water migrated fairly rapidly at Artisans Village, AWC estimates potential yield of 37.5 mg over 75 days for each site (75 mg total). Pending future need for the supply, AWC has halted further activity.

- *Chesapeake and Delaware Canal Pipeline:* In 2004, AWC completed installation of two 20-inch diameter pipelines under the C&D Canal near the Summit Bridge to interconnect water systems on both sides of the canal for assurance of system reliability.

### City of Newark

- *Newark Reservoir:* Completion of a 317-mg reservoir will make the City nearly self-sufficient. The project is 75 percent complete with the raceway renovated, intake pipeline in place, almost one million cubic yards of soil excavated, and 30 percent of the liner in place. Newark City Council voted to terminate the contract with the initial contractor in January 2004. A new contractor, George and Lynch, was hired by City Council in October 2004 at a cost of \$6 million. City crews performed clean-up and maintenance work during the winter of 2004-05 and construction resumed in March 2005. The new contractor is currently regrading the bottom and side slopes of the reservoir and installing geomembrane and concrete liner. The City estimates that construction will be completed in September 2005, with the reservoir full by December 2005.
- *Newark South Wellfield Iron Treatment Plant:* The City completed construction on the iron, manganese, and organics removal plant at its South Wellfield. The treatment plant was put into service in November 2003. This project increased water supply from the plant by 1.0 mgd.

### City of Wilmington

- *Hoopes Reservoir:* The City is planning on raising the water level in the reservoir two feet in conjunction with stability improvements to the dam to provide an additional 120 mg of water. The U.S. Army Corps of Engineers determined that a permit is not needed.
- *Brandywine Creek to Hoopes Reservoir Pumping Station:* In May 2005, DNREC retained a consultant (Parsons) to evaluate various pumping and infrastructure scenarios to increase the refill capacity for Hoopes Reservoir. Two potential projects associated with this initiative may be a new dedicated pumping station and transmission line for Hoopes, and re-routing of the transmission line from Hoopes to the Porter Filter Plant to allow for gravity flow to Porter and elimination of the Old Mill Pumping Station.
- *Hoopes Reservoir Operating Plan:* The City completed an operating plan for Hoopes Reservoir which was approved by the Secretary of DNREC in 2001 which indicates that the City would release from 3 to 5 mgd (500 mg total) of raw water as requested by other utilities provided the reservoir level was between elevation 220 feet (full) and 210 feet (-10 feet). Below an elevation of 210 feet, the City reserves the right to retain the remaining contents of the reservoir for its internal use. The City also recommended reservoir level indicators for the WSCC to use in the Drought Advisory Guidelines. In May 2005, DNREC retained a consultant (Parsons) to update the operating plan for Hoopes Reservoir.
- *United Water Delaware Contract:* On August 28, 2002, Wilmington City Council approved a contract for the sale of water from Hoopes Reservoir to United Water Delaware (UWD) that authorizes UWD to purchase up to 200 mg of raw water annually from the reservoir. The contract provides water from the top wedge of Hoopes for release to the Red Clay Creek to supplement water at the UWD intake during low stream flow and/or during times when elevated chloride levels are present at the intake. Prior to March of every year, the contract requires UWD to pay an annual “reservation charge” for an estimated volume of water ranging from 50 mg to 200 mg. There is an additional “usage charge” for the actual volume of water released from Hoopes for UWD. In the event UWD requests the City to release more than 200 mg, and the City agrees, UWD shall pay the City an “excess release charge.”

## **New Castle Municipal Services Commission**

- *Wells:* With a supply of 1.7 mgd and a peak demand of 0.5 mgd, the New Castle MSC has excess capacity from its wells and can presently sell water to AWC through interconnections when requested.
- *Interconnection:* New Castle MSC completed construction of a new 1.0 mgd interconnection with AWC at the Riveredge Industrial Park in the summer of 2002.

## **United Water Delaware**

- *Chloride Monitoring:* UWD implemented a Chloride Monitoring Plan that includes three stations along the tidal Christina River and White Clay Creek to provide early warning of elevated chloride levels. This plan is designed to optimize blending of Hoopes releases with water withdrawals from the creek to minimize chloride levels in drinking water supplies during low flows. The plan was implemented during the drought of 2002 and was successful in ensuring compliance with the U.S. EPA chloride standard (250 ppm) in treated water.
- *Aquifer Storage and Recovery:* UWD is evaluating future use of Aquifer Storage and Recovery (ASR) technology (225 mg target based on preliminary estimates) in its River Road service area just north of the C&D Canal. Testing conducted in 2002 deemed that ASR at its Christiana Water Treatment Plant was not feasible.
- *Christiana Water Treatment Plant:* UWD received an operating permit from DNREC for an existing well (0.3 mgd) at the Christiana Treatment Plant to be used for dilution during high chloride events.
- *Interconnections:* UWD signed an agreement with the City of Wilmington in October 2000 for the purchase of 3 mgd of finished water through existing interconnections. The Chatham interconnection was upgraded in 2001 and the Atlas interconnection upgrade was completed in 2002. UWD continues to evaluate the feasibility of additional interconnections with the City of Wilmington.
- *Tidal Capture Structure (TCS) Operating Plan:* UWD worked with DNREC to develop a new operating plan for the TCS that increases water available to UWD while protecting the ecology and fishery in the tidal White Clay Creek. In January 2005, the Delaware River Basin Commission voted to approve the docket to replace the 7Q10 minimum flow standard with a standard based on minimum flow depth and chloride provisions. The revised TCS Operating Plan can provide UWD 5.3 mgd during drought for a total of 400 mg of additional water supply as compared to 2002 actual operation. This number is derived from calculations performed by UWD and reviewed by the State Water Coordinator and were based on the January 2005 DRBC 7Q10 docket decision using 2002 actual operations as the baseline.

## **Interconnected System**

The water purveyors conducted hydraulic testing and modeling to increase the northern Delaware interconnected system capacity to move water during drought or other emergencies. As of December 2003, there were 25 interconnections in place, compared to 23 interconnections in place in 1999. The peak water transfer through interconnections in 2004 was 5.2 mgd on August 13.

## **Conservation Water Rates**

- *HB 118:* Governor Minner signed HB 118, the Water Supply Self-Sufficiency Act, in July of 2003. The law states that each water utility shall implement a water conservation rate structure for services provided to its residential customers in drought sensitive areas. It shall reflect either an inclining block rate structure or a seasonal rate structure.
- AWC continues its conservation water rate structure that has been in place since 1992.

- Newark increased its water rates (effective July 2001) to fund its proposed reservoir and water treatment plant improvements. The City temporarily discontinued its seasonal conservation water rate structure (in place since 1999) when citizens approved the increase in water rates.
- New Castle Municipal Services Commission instituted a conservation water rate structure in 2001.
- In April 2004, UWD filed an application with the Delaware Public Service Commission to adopt water conservation oriented rates. The Public Service Commission (PSC) approved this request in October 2004, and the new rates went into effect in January 2005.
- The City of Wilmington gathered data from the UD Water Resources Agency and other agencies to determine the feasibility of adopting conservation water rates. In February 2005, Wilmington City Council approved a resolution adopting conservation water rates effective in July 2005.

### **Northern New Castle County Ground-water Modeling Study**

The DNREC Division of Water Resources signed a contract on May 23, 2000 with the US Army Corps of Engineers to conduct a study, the results of which would provide estimates of the long-term safe yield of ground-water for supply in northern New Castle County. The ground-water modeling area is in that portion of the Coastal Plain that extends north-south from Wilmington to Middletown, Delaware and east-west from New Jersey across New Castle County into Maryland. The Corps expects to produce model runs by November 2005 and complete the project in February 2006 at the earliest.

### **Governance**

- *SB 370*: In July 2000, Governor Carper signed SB 370, which transferred the jurisdiction for issuing water supply franchise areas, called Certificates of Public Convenience and Necessity (CPCNs), from DNREC to the PSC effective July 1, 2001. On June 5, 2001 the PSC adopted regulations governing the award of CPCNs to public and investor-owned water purveyors statewide.
- *PSC Order No. 6068*: On November 19, 2002, the PSC issued Commission Order No. 6068 which opened an investigation into the water supply available to Artesian Water Company and United Water Delaware: (a) during the drought between March 5 to October 11, 2002, and (b) over the next five years. Pursuant to the order, AWC and UWD were required to submit reports listing available supplies and estimates of peak demand. The reports were filed in January of 2003. The order also directed the PSC staff to issue a report to the PSC Commissioners at the conclusion of its investigation. Subsequently, the PSC contracted with a consulting firm, Parsons, to conduct the investigation. The Parsons report, dated February 2004, concluded that the utilities complied with their responsibilities during the drought of 2002 and have the ability to “provide efficient, sufficient, and adequate” supply for customers within northern New Castle County during future drought conditions.
- *HB 118*: Governor Minner signed HB 118, the Water Supply Self-Sufficiency Act, in July of 2003. The law established a goal of water supply self-sufficiency in northern Delaware by 2010. In March 2005, AWC filed an application for certification of water self-sufficiency with the Public Service Commission (PSC). The Commission is considering treating the filing as an interim filing, which would look at AWC self-sufficiency through 2006.

### **Glenville Reservoir**

The Glenville residential subdivision (in Stanton south of Delaware Route 4) sustained significant flood-related damage during several storms, most recently from the remnants of Tropical Storm Henri in mid-September of 2003. The reservoir proposal was suggested to address two significant problems: 1) Glenville residents' desire that the government purchase their properties to allow them to move out of the flood-prone area; and 2) the need to increase reserve water supplies in northern Delaware. The proposal was evaluated on multiple layers, including engineering, environmental, regulatory, economic, and timing factors, as well as community support. This project is no longer under consideration because of the excessive cost of construction relative to the yield.

## **Bread and Cheese Island Reservoir**

DelDOT, DNREC, the U.S. Army Corps of Engineers, and New Castle Conservation District have taken the lead on this project and are currently discussing options for stormwater management and wetlands mitigation on privately owned land on Bread and Cheese Island near Churchmans Marsh. Further evaluation will determine whether this property is suitable for a reservoir.

## **Drought Operating Guidelines and Plan**

On April 29, 2005 the WSCC conditionally approved a new Drought Operating Plan (DOP) for water purveyors in northern Delaware. This DOP includes Drought Operating Guidelines that incorporate a three-phase drought advisory system (approved in January 2003 by the WSCC). The DOP provides plans – submitted by the purveyors – to utilize surface supplies, ground-water supplies, and interconnections in the event of drought. The Drought Operating Guidelines and Plan are found in Appendices A and B, respectively.

## **Water Use Recommendations and Restrictions for Three-Phase Drought Operating Plan**

Following the drought emergency of 1999, the DNREC Division of Water Resources, UDWRA, and DGS worked with representatives of the Delaware Green Industry to revise rules for water use during droughts. Those rules (approved by the Office of the Governor) were useful in moderating the economic impacts of the mandatory restrictions necessitated by the extreme drought conditions of 2002. That drought of record, prompted further collaborative efforts to refine the rules. On April 29, 2005, the WSCC approved the new language for water use recommendations and restrictions in future droughts. This document, which is incorporated in the three-phase drought operating plan, appears in Appendix C.

## **APPENDIX A**

### ***NORTHERN DELAWARE DROUGHT OPERATING GUIDELINES***

*Prepared and Approved by: Subcommittee of the Delaware Water Supply Coordinating Council*

The Fifth Report to the Governor and General Assembly (January 2003) regarding the progress of the Water Supply Coordinating Council (WSCC) recommended amending the Delaware Drought Operating Plan. Previously, Delaware had a two-phase advisory system of (1) warning and (2) emergency. The WSCC recommended implementation of a three-phase drought advisory system that incorporates goals for water conservation, has the potential to provide earlier notice of drought actions to the public, and aligns Delaware with the drought advisory systems used in adjacent states.

The purpose of the Drought Advisory Guidelines (DAG) is to provide technical guidance to the Governor's Drought Advisory Committee (GDAC) and the Delaware Water Supply Coordinating Council concerning declaration of drought advisories and water use restrictions in northern Delaware (the area of the state north of the Chesapeake and Delaware Canal). It should be noted that the indices within the DAG are guidelines, not triggers. Final declaration of drought advisories rests with the Governor based upon input from the GDAC. The Christina River Basin Drought Management Committee shall be made aware of any amendments to the DAG.

The DAG were summarized in the June 2004 *Sixth Report to the Governor and General Assembly* and approved by a subcommittee comprised of representatives from the following organizations: Artesian Water Company (AWC), City of Newark, City of Wilmington, Delaware Department of Natural Resources and Environmental Control (DNREC), Delaware Geological Survey (DGS), Delaware Nature Society (DNS), Delaware Grounds Management Association (DGMA), United Water Delaware (UWD), and the University of Delaware Water Resources Agency (UDWRA). This document contains two sections: 1) a set of recommended actions that incorporate goals for water conservation in Northern Delaware and 2) a set of indicators from which the WSCC and GDAC may assess “on the ground” conditions. This is a living document subject to revision in response to future changes in supply and demand projections or other factors that impact the effectiveness of the guidelines.

<i>Northern Delaware Drought Advisory Guidelines*</i>			
<i>Advisories</i>	<b>Drought Watch</b>	<b>Drought Warning</b>	<b>Drought Emergency</b>
<b>Status</b>	Potential	Imminent	Emergency
<b>Demand Recommendations / Restrictions</b>	Voluntary	Primarily Voluntary	Mandatory
<b>Northern Del. Demand Conservation Goal</b>	< 80 mgd	< 73 mgd	< 68 mgd
<i>Indicators</i>	<b>Drought Watch</b>	<b>Drought Warning</b>	<b>Drought Emergency</b>
<b>DGS Water Conditions Index</b>	4.0-5.0 (potential shortage)	3.0-3.99 (potential shortage)	<3.00 (shortage)
<b>Precipitation: Running 12-month deficit</b>			
New Castle County (Wilmington) Airport and Wilmington Porter Reservoir	6" to 8.99"	9" to 11.99"	>12.00"
<b>Stream Flows: 30-day moving average</b>			
Brandywine Creek at Wilmington	85 mgd (90% exceedance)	70 mgd (95 % exceedance)	48 mgd (98% to 99% exceedance)
White Clay Creek at Stanton (RCC+WCC)	42 mgd (85% exceedance)	37 mgd (90% exceedance)	31 mgd (95% exceedance)
White Clay Creek at Newark	19 mgd (85% exceedance)	16 mgd (90% exceedance)	13 mgd (95% exceedance)
<b>Chlorides</b>	Stream flows ≤ 37 mgd for 5 consecutive days on WCC at UWD Stanton Intake	Chlorides > 250 ppm for 3 consecutive days at the Christina River at Newport	Chlorides > 250 ppm for 3 consecutive days at the UWD Stanton Intake
<b>Ground-Water Levels</b>			
Shallow DGS Well Db24-10	14 - 14.99 feet (75% exceedance)	15 - 15.99 feet (90% exceedance)	> 16 feet (96% exceedance)
Aquifer Storage and Recovery	Report remaining water volume (mg) to GDAC	Report remaining water volume (mg) to GDAC	Report remaining water volume (mg) to GDAC
<b>Reservoir Levels</b>			
Hoopes Reservoir (City of Wilmington)	- 5 feet (elev. 215 feet) (85% capacity)	- 7 feet (elev. 213 feet) (79% capacity)	- 9 feet (elev. 211 feet) (72% capacity)
Newark Reservoir	- 10 feet (70% capacity)	-17 feet (52% capacity)	- 27 feet (28% capacity)
CWA Conditions (Octoraro Reservoir)	Report water levels to GDAC	Report water levels to GDAC	Report water levels to GDAC
DRBC Conditions (NY City Reservoirs)	Drought Watch	Drought Warning	Drought

\* These drought operating guidelines are not “triggers” for specific advisory levels. Rather, they are designed to provide guidance to the Governor’s Drought Advisory Committee (GDAC) and the Delaware Water Supply Coordinating Council (WSCC). Final declaration of drought advisories rests with the Governor based upon input from the GDAC.



## Drought Advisory Levels

The WSCC recommends three stages of drought advisory in Delaware:

- 1) **Watch:** The potential for drought suggests that voluntary water demand reductions be requested
- 2) **Warning:** An imminent (but not certain) drought recommends increased water demand reductions, primarily on a voluntary basis
- 3) **Emergency:** With declining water conditions, there is no alternative but to declare a State of Emergency with mandatory water use restrictions

Each stage in the Drought Advisory Guidelines correlates to a goal of conserving public and private water supplies in northern Delaware.

- 1) **Watch:** Decrease public water supply use from domestic, commercial, and industrial sectors below 80 million gallons per day (mgd) through voluntary water conservation
- 2) **Warning:** Decrease public water use below 73 mgd through voluntary water conservation
- 3) **Emergency:** Decrease public water use below 68 mgd through mandatory water restrictions (*water use declined below 65 mgd in August 2002 after declaration of Drought Emergency with mandatory water restrictions*)

These goals will be reviewed by the WSCC at its next meeting to consider changes in supply availability, demand estimates and experience during prior periods of requests for voluntary conservation.

## Drought Indicators

This section discusses the technical basis for the drought indicators. These indicators include the DGS Water Conditions Index, Precipitation, Stream Flows, Chlorides, Ground-water Levels, and Reservoir Levels. The WSCC reviewed water conditions during the droughts of the 1960s, 1988, 1995, 1999, and 2002 while constructing the framework.

**DGS Water Conditions Index (WCI):** The DGS WCI for northern Delaware is based on a formula that includes 6-month antecedent precipitation at the New Castle County (Wilmington) Airport and Wilmington Porter Reservoir, ground-water levels in DGS well Db 24-10, streamflows in Brandywine Creek, and population of northern New Castle County. The WSCC recommends that these indicators correspond with the following advisory levels:

- 1) **Watch:** WCI = 4.0-5.0 [*the WCI dipped below 5.0 (the boundary between normal water conditions and potential shortage) in March 2002*]
- 2) **Warning:** WCI = 3.0-3.99 or less [*the WCI dipped below 4.0 in July 2002*]
- 3) **Emergency:** WCI less than 3.00 [*the WCI dipped below 3.0 (the boundary between potential shortage and shortage) in August 2002*]

**Precipitation:** The values were developed by the DGS using previous drought conditions. The WSCC recommends that these indicators correspond with the following advisory levels:

### New Castle County (Wilmington) Airport and Wilmington Porter Reservoir:

- 1) **Watch:** 6" to 8.99" running 12-month deficit
- 2) **Warning:** 9" to 11.99" running 12-month deficit
- 3) **Emergency:** greater than 12.00" running 12-month deficit

**Stream Flows:** This indicator is based on a 30-day moving average of stream flows as determined by the DGS at the following locations. "Exceedance" denotes the percent of time in any given year that the stream flow may exceed that value. The WSCC recommends that these indicators correspond with the following advisory levels:

Brandywine Creek at Wilmington (USGS/DGS Gage 01481500)

- 1) **Watch:** 30-day moving average of 85 mgd (90% exceedance)
- 2) **Warning:** 30-day moving average of 70 mgd (95% exceedance)
- 3) **Emergency:** 30-day moving average of 48 mgd (99% exceedance)

White Clay Creek at Stanton (RCC+WCC) (extrapolated from USGS/DGS Gages 01480015 and 01479000)

- 1) **Watch:** 30-day moving average of 42 mgd (85% exceedance)
- 2) **Warning:** 30-day moving average of 37 mgd (90% exceedance)
- 3) **Emergency:** 30-day moving average of 31 mgd (95% exceedance)

White Clay Creek at Newark (USGS/DGS Gage 01478650)

- 1) **Watch:** 30-day moving average of 19 mgd (85% exceedance)
- 2) **Warning:** 30-day moving average of 16 mgd (90% exceedance)
- 3) **Emergency:** 30-day moving average of 13 mgd (95% exceedance)

**Chlorides:** Raw water from the White Clay Creek at the UWD Stanton intake is monitored for chlorides as part of a plan developed by UWD. Other chloride monitoring stations include downstream of the Tidal Capture Structure on White Clay Creek, the Christina River at Newport, and the Christina River at the Churchmans Boat Ramp. The WSCC recommends that these indicators correspond with the following advisory levels:

- 1) **Watch:** Stream flows on the White Clay Creek at the UWD Stanton Intake are less than or equal to 37 mgd for five consecutive days; this initiates the UWD Chloride Monitoring Plan
- 2) **Warning:** Chlorides exceed 250 parts per million (ppm) for 3 consecutive days at the Tidal Christina River at Newport (*indicator derived from the average of two high tide readings at this location*)
- 3) **Emergency:** Chlorides exceed 250 parts per million (ppm) for 3 consecutive days at the UWD Stanton Intake (*indicator derived from the average of two high tide readings at this location*)

**Ground-Water Levels:** DGS Well Db 24-10 is a shallow ground-water table observation well in the coastal plain in Ogletown, Del. "Exceedance" denotes the percent of time in any given year that the water level may be less than that value. No indicator for deep wells in confined aquifers is currently recommended because of the inability to identify an indicator that would provide meaningful, repeatable information in a timely manner. Deep well pumping rates and draw-down levels will be reviewed and taken into consideration with the overall recommendations of the GDAC. In the event a valid indicator is identified, it will be added to this subsection. The WSCC recommends that ground-water level indicators correspond with the following advisory levels:

DGS Well Db 24-10 (feet below land surface)

- 1) **Watch:** 14 to 14.99 feet (75% exceedance) (*The water level dropped below 14 feet in Oct. 2001*)
- 2) **Warning:** 15 to 15.99 feet (90% exceedance) (*The water level dropped below 15 feet in Nov. 2001*)
- 3) **Emergency:** greater than 16 feet (96% exceedance) (*The water level dropped below 16 feet in Mar. 2002*)

**Aquifer Storage and Recovery:** Starting with Drought Watch, and continuing through all drought advisory levels, purveyors (AWC, UWD) will report remaining water volume (in million gallons) to the GDAC.

**Reservoir Levels:** This indicator denotes reservoir water levels below maximum water elevation and percent capacity remaining. The levels were developed respectively by the City of Wilmington (Hoopes) and the City of Newark. The WSCC recommends that these indicators correspond with the following advisory levels:

Hoopes Reservoir (1,800 mg when full)

- 1) **Watch:** minus 5 feet (elev. 215 feet) (85% usable capacity) (1,530 mg usable remaining)
- 2) **Warning:** minus 7 feet (elev. 213 feet) (79% usable capacity) (1,422 mg usable remaining)
- 3) **Emergency:** minus 9 feet (elev. 211 feet) (72% usable capacity) (1,296 mg usable remaining)

Newark Reservoir (317 mg when full)

- 1) **Watch:** minus 10 feet (70% capacity) (221 mg usable remaining)
- 2) **Warning:** minus 17 feet (52% capacity) (164 mg usable remaining)
- 3) **Emergency:** minus 27 feet (28% capacity) (88 mg usable remaining)

**Chester Water Authority Conditions:** Starting with Drought Watch, and continuing through all drought advisory levels, UDWRA and/or DNREC will report remaining water levels in the Octoraro Reservoir to the Governor's Drought Advisory Committee.

**DRBC Drought Advisory Levels:** This indicator is used because the Governor of Delaware is a Commissioner on the DRBC. It is based on a storage-based rule curve for the New York City-Delaware River Basin reservoirs that controls the basin-wide drought operating status of the Delaware River Basin. The rule curve governs flow targets at Montague, N.J. and Trenton, N.J., as well as diversions to New York City from its three reservoirs in the Delaware River Basin and to New Jersey from the Delaware River. The purpose of the rule curve is to implement phased reductions in flow targets and diversions in order to conserve storage. Section 2.5 of the DRBC Water Code contains detailed information regarding drought operations. Due to the relatively large storage capacity of the New York City reservoirs, dry soil conditions, reduced streamflows and lowered groundwater levels often occur well before the DRBC's drought warning trigger is reached. These related drought conditions are addressed in drought management plans of the four basin states: New York, New Jersey, Pennsylvania, and Delaware.

- 1) **Watch:** Entered when combined storage drops into the Drought Watch zone on the rule curve and remains there for five consecutive days.
- 2) **Warning:** Entered on the day when combined storage drops into the Drought Warning zone.
- 3) **Drought:** Entered when combined storage drops into the Drought zone and remains there for five consecutive days.

## **APPENDIX B**

### ***NORTHERN DELAWARE DROUGHT OPERATING PLAN***

*Prepared and Approved by:* Delaware Water Supply Coordinating Council, April 29, 2005, with Artesian Water Company (AWC) dissenting on the grounds that the WSCC approval was of an incomplete plan and that such approval should not occur until all purveyors have submitted their specific drought operating plans for review. Since the April 29 vote, all of the water purveyors drought operating plans have been updated as detailed below.

The Sixth Report to the Governor and General Assembly Regarding the Progress of the Delaware Water Supply Coordinating Council (WSCC), dated March 26, 2004, and revised June 2004, recommended developing a detailed Drought Operating Plan (DOP) for northern Delaware which incorporates: (a) existing plans for chloride monitoring, Tidal Capture Structure, Hoopes Reservoir and Newark Reservoir operations, and Aquifer Storage and Recovery; (b) existing plans developed by the water utilities; and (c) the operating plans mandated by DNREC and DRBC allocation permits and dockets. The Delaware DOP includes recommendations and protocols for the regional coordination of water withdrawals, interconnections, and use of water storage during a 75-day drought. The goal of the revised DOP is to delineate actions so that northern Delaware can endure a drought of the magnitude of the 2002 drought without mandating water use restrictions.

The DOP will be implemented by the water purveyors based on stream flow exceedance and stream chloride levels which in turn dictate available surface water supply capacity. For instance, when streams are at 99% exceedance – the available water supply capacity is estimated at 105 mgd. This DOP is based on modified version of Scenario “B” which assumes a 7Q10 minimum instream flow standard on the White Clay Creek at Newark, a 7Q10 depth and chloride-based flow standard on the White Clay Creek at Stanton, and no instream flow standard in place along the Brandywine Creek at Wilmington. Scenario “B” was modified in January 2005 when the DRBC approved an application from United Water Delaware (UWD) to replace the 7Q10 minimum flow standard for the White Clay Creek at Stanton with a standard based on minimum flow depth and chloride provisions.

The DOP provides guidance to the Governor’s Drought Advisory Committee (GDAC) on basic operations to be considered for implementation by each water purveyor. Because no two droughts are the same, actual operations and sequencing of events may vary depending on optimal and cost effective options available during varying hydrologic conditions and different stages of drought. For instance, chlorides and streamflows may not correlate to those listed in any one column of the DOP. Therefore, the DOP is flexible and non prescriptive. The following table and subsequent narratives represent reasonable actions to be taken given the specific conditions shown for each level of exceedance.

The following table describes the Drought Operating Plan:

**Northern Delaware Drought Operating Plan**

% of Time Stream Exceeds Listed Flow	80 %	85 %	90 %	95 %	98 %	99 %	Record
					7Q10 flow	1999 drought	2002 drought
<b><i>I. Stream Flow</i></b>	<i>mgd</i>	<i>mgd</i>	<i>mgd</i>	<i>mgd</i>	<i>mgd</i>	<i>mgd</i>	<i>mgd</i>
Brandywine Creek at Wilmington Intake	110	100	85	70	49	40	21
White Clay/Red Clay Creek at Stanton Intake	53	42	37	31	17	10	7
White Clay Creek at Newark Intake	20	19	16	13	7	5	3
Chlorides White Clay Creek at Stanton TCS	< 250	< 250	< 250	< 250	= 250	> 250	> 250
	<i>ppm</i>	<i>ppm</i>	<i>ppm</i>	<i>ppm</i>	<i>ppm</i>	<i>ppm</i>	<i>ppm</i>
<b><i>II. Available Water Supply</i></b>							
<b>Artesian Water Company</b>	31	31	31	31	31	30	30
* Wells	25	25	25	25	25	25	25
* Chester Water Authority interconnection	4	4	4	4	4	3	3
* Aquifer Storage & Recovery wells	2	2	2	2	2	2	2
* New Castle interconnection							
* Wilmington interconnection							
<b>United Water Delaware</b>	34	34	34	34	32	31	31
* White Clay/Red Clay Stanton intake	30	30	30	30	17	10	7
* Inflate Tidal Capture Structure @ WCC	0	0	0	0	10	15	16
* Hoopes Reservoir release to Red Clay Cr.					3	5	7
* Smalleys Pond intake at Christina River	4	4	4	3	1	0	0
* Christiana Well					0.25	0	0
* Chester Water Authority interconnection	1	1	1	1	1	0.8	0.8
* Wilmington interconnection							
* Artesian Water Co. interconnection							
* City of Newark interconnection	-1	-1	-1				
<b>City of Wilmington</b>	35	35	35	35	35	35	30
* Brandywine Creek intakes	35	35	35	35	34	30	10
* Hoopes Reservoir release (1,800 mg)					1	5	20
<b>City of Newark</b>	7	7	7	7	7	7	7
* White Clay Creek intake	3	3	1	0	0	0	0
* Newark Reservoir release (300 mg)	0	0	2	3	3	3	3
* Wells	3	3	3	4	4	4	4
* United Water DE interconnection	1	1	1	0	0	0	0
* Artesian Water Co. interconnection							
<b>New Castle Municipal Services Commission</b>	2	2	2	2	2	2	2
* Wells	2	2	2	2	2	2	2
<b>Available Water Supply (mgd)</b>	109	109	109	109	107	105	100

## **Artesian Water Company Drought Operating Plan**

During periods of low water demand, Artesian regularly completes preventive maintenance in order to minimize the occurrence of unanticipated loss of supply during periods of increased demand. Artesian also rests certain well fields during periods of low demand in order to maximize the available draw down during periods of peak demand. The principle of conjunctive use is applied to Artesian's use of water available under contract with Chester Water Authority, which relies on reservoir storage as its source of supply. Artesian increases its use of water from the interconnection and decreases pumpage from its wells while reservoir storage is adequate to ensure maximum ground-water availability when reservoir storage declines. Under Artesian's contract with Chester Water Authority, Artesian must purchase a minimum of 3 mgd on an annual basis, and can purchase as much as 6 mgd on any single day. Artesian also stores water in its Aquifer Storage & Recovery (ASR) systems during periods of higher reservoir storage and low demand, which is then available to meet peak demands.

### ***Drought Watch***

Upon a declaration of Drought Watch, Artesian will maintain purchases of at least 4.0 mgd through its interconnection with Chester Water Authority. Artesian's pumpage from its wellfields will provide the balance of supply needed to meet demands. Water quantities stored in its ASR systems will be reported to DNREC, DGS, and UDWRA monthly.

### ***Drought Warning***

Upon a declaration of Drought Warning, Artesian will continue to maintain its purchases of at least 4.0 mgd through its interconnection with Chester Water Authority and maintain pumpage from its wellfields at levels necessary to meet customer demand. Water quantities stored in its ASR systems will be reported to DNREC, DGS, and UDWRA weekly.

### ***Drought Emergency***

Upon declaration of Drought Emergency, Artesian will maintain its purchases of at least 4.0 mgd through its interconnection with Chester Water Authority, unless requested by Chester Water Authority to reduce its level of purchases to the same extent Chester Water Authority has requested of all its customers. Based on past experience during drought periods, the largest reduction requested by Chester Water Authority was 20%, still allowing for an expected purchase of at least 3.2 mgd (conservatively rounded to 3 mgd for presentation purposes in the table and consistent with the amount permitted for consideration as a source of supply during drought under the Self-Sufficiency Act of 2003). Artesian will have its peak well capacity and water stored in its ASR available to meet peak demands. In addition, as much as 0.7 mgd has historically been available from the City of New Castle, as necessary. Water quantities stored in its ASR systems will be reported to DNREC, DGS, and UDWRA daily.

## **United Water Delaware Drought Operating Plan**

United Water Delaware (UWD) will perform the majority of its distribution system maintenance during spring and fall months. Also plant maintenance potentially affecting treatment capacity will be planned for the same timeframes. In the first quarter of each year, reservation of water in Hoopes Reservoir will be made with the City of Wilmington. When extended periods of dry weather occur, UWD will report weekly demands as requested by the UD Water Resources Agency. Initial use of the Tidal Capture Structure may begin when stream flows are low enough that additional head is needed at the Stanton intakes. As stream flows continue to decline, TCS operations will be optimized to capture fresh water flows. In addition, the Christiana Water Treatment Plant may be started to provide additional supply. When stream flows on the White Clay Creek at Stanton drop to 37 mgd or below for 5 consecutive days, UWD will initiate its Chloride Monitoring Program and report results to UD Water Resources Agency as requested. As chlorides in the stream increase, UWD will consider supplementing White Clay Creek with purchased raw water from Hoopes Reservoir and will notify the

City of Wilmington of impending or actual request for releases of water from Hoopes. In addition, options for purchasing finished water from existing contracts to reduce demands on UWD's treatment plants will be evaluated.

### ***Drought Watch***

Upon declaration of a Drought Watch, UWD will begin customer communications regarding water conservation tips. It will continue to purchase water from the Chester Water Authority (CWA) according to contract terms. In the event it is desired to reduce demand on the Stanton WTP, the Christiana WTP may be started.

### ***Drought Warning***

Upon declaration of Drought Warning, UWD will increase customer communications regarding water conservation and will increase leak detection and repair activities. During this time, UWD may begin use of its Christiana well to supplement volumes at Smalleys pond. The Christiana well may be used to provide dilution of chlorides. UWD will continue to purchase water from CWA according to contract terms. UWD may also investigate potentially increasing purchased water from CWA or, activating interconnections with the City of Wilmington. In accordance with its chloride-monitoring plan, when chlorides show an upward trend at the Churchmans Road Boat Ramp, UWD will notify the City of Wilmington of an impending request for water releases from Hoopes Reservoir. When chloride levels become naturally unmanageable, UWD will request Hoopes releases from the City of Wilmington in amounts sufficient to dilute high chloride levels at its Stanton WTP intakes.

### ***Drought Emergency***

Upon declaration of Drought Emergency, UWD will continue to perform public outreach and aggressive leak detection and repair activities. UWD will optimize its raw water availability using the TCS. Finished water purchases from other purveyors may be used to decrease raw water demands at Stanton and Christiana.

## **City of Wilmington Drought Operating Plan**

The City of Wilmington will keep Hoopes Reservoir full or as near to full as possible as we enter into a drought period. This will be accomplished by pumping water to Hoopes from Brandywine Creek when flows in the creek are adequate.

### ***Drought Watch***

Upon the issuance of a Drought Watch, the City will inform its customers of the potential drought and advise its customers to conserve water. As flows in the Brandywine decline, the City will maximize withdrawals by utilizing both pumping stations, Wills and Brandywine. So long as flows allow, the Brandywine will supply all the City's drinking water.

### ***Drought Warning***

Upon the issuance of a Drought Warning, the City will inform its customers of the pending drought and advise its customers to curtail non-essential use of water.

When demand exceeds water supply from Brandywine Creek, the City will begin releasing water from Hoopes Reservoir to Porter Reservoir using the Old Mill Pumping Station. These releases will supplement water supplies from Brandywine Creek and will vary depending upon the supply needed to meet demand. During this time it is anticipated that even during a drought, the area will experience limited precipitation events which would increase flows in Brandywine Creek for short periods of time. During these times, pumping from Brandywine Creek will be increased to meet demand. When Brandywine Creek streamflows exceed 50 mgd (during and after storm events), the City will pump water from Brandywine Creek to refill Hoopes Reservoir.

When requested from UWD, releases will be made from Hoopes Reservoir to the Red Clay Creek. These releases will be coordinated with UWD and scheduled around the Christina River tides in order to provide the maximum benefit. These releases will generally not exceed 5 million gallons per day, or an instantaneous release rate of 10 million gallons per day. The City will also attempt to make finished water available to other water suppliers, when requested, in accordance with current agreements.

***Drought Emergency***

Upon declaration of a Drought Emergency, the City will increase withdrawals from Hoopes Reservoir to replace diminished streamflow in the Brandywine Creek. Releases will not exceed 27 mgd. During this time it is anticipated that even during a drought, the area will experience limited precipitation events which would increase flows in Brandywine Creek for short periods of time. During these times, pumping from Brandywine Creek will be increased to meet demand. When Brandywine Creek streamflows exceed 50 mgd (during and after storm events), the City will pump water from Brandywine Creek to refill Hoopes Reservoir.

**City of Newark Drought Operating Plan**

***Drought Watch***

Upon declaration of a Drought Watch, the City will continue to withdraw up to 3 mgd from its intake on White Clay Creek, 3 mgd from its wells, and 1 mgd from an interconnection with United Water Delaware (UWD).

***Drought Warning***

Upon declaration of a Drought Warning, the City will withdraw up to 1 mgd from its intake on White Clay Creek, 2 mgd from the Newark Reservoir, 3 mgd from its wells, and 1 mgd from an interconnection with UWD.

***Drought Emergency***

Upon declaration of a Drought Emergency, the City will cease withdrawals from its intake on White Clay Creek and an interconnection with UWD. The City will withdraw up to 3 mgd from the Newark Reservoir and 4 mgd from its wells.

**New Castle Municipal Services Commission Drought Operating Plan**

New Castle will withdraw 2 mgd from its self-supplied wells. During early stage of drought, New Castle will provide additional water to Artesian Water Company through interconnections. During drought, New Castle will provide up to 1 mgd to AWC through interconnections at School Lane and Riveredge Industrial Park.

**Duration of Droughts in Northern Delaware**

The following table is intended to illustrate the historical nature of droughts in northern Delaware for the period 1963-2002, assuming the most conservative Scenario 3B, (7Q10 minimum instream flows along Brandywine Creek and White Clay Creek in effect). This table is not intended to illustrate the magnitude nor severity of the droughts.



*Duration of Drought in Northern Delaware\**

	<b>1</b>	<b>2</b>	<b>1 - 2 = 3</b>	<b>4</b>	<b>3 - 4 = 5</b>
<b>Drought Year</b>	<b>Start of Drought</b>	<b>End of Drought</b>	<b>Total Duration Days</b>	<b>Hoopes Refill Days</b>	<b>Duration of Drought Days</b>
1963*	18-Jun	6-Nov	141	19	122
1964*	15-Aug	16-Oct	61	10	51
1965*	25-Jul	8-Nov	105	12	93
1966*	3-Jul	14-Sep	73	3	70
1980	3-Sep	24-Oct	51	7	44
1981	19-Aug	15-Sep	27	4	23
1995	26-Jul	16-Sep	52	7	45
1999	5-Jul	15-Sep	72	11	61
2002	30-Jun	10-Oct	103	8	95

UDWRA April 22, 2005

\* Assumes most conservative Scenario 3B, 7Q10 minimum instream flows along Brandywine Creek and White Clay Creek

1. Brandywine Creek at Wilmington flow declines below 7Q10 + withdrawal
2. Brandywine Creek at Wilmington flow increase above 7Q10 + withdrawal
3. Number of days flow below 7Q10 + withdrawal
4. Due to rain, number of days refilling Hoopes Reservoir
5. Duration of drought for water supply planning purposes

## **APPENDIX C**

### ***WATER USE RECOMMENDATIONS AND RESTRICTIONS FOR THREE-PHASE DROUGHT OPERATING PLAN***

*Prepared and Approved by: Delaware Water Supply Coordinating Council, April 29, 2005*

#### **Water Use Recommendations for Drought Watch**

*Lawn and Turf Watering (including residential, commercial, institutional, and government uses)*

- Use of potable water for lawns and turf should be minimized and performed in a conservative manner.

*Landscape Plant Watering (including residential, commercial, institutional, and government uses)*

- Use of potable water for outdoor landscape plants (including groundcover, flowers, shrubs, and trees) should be minimized and performed in a conservative manner.

*Golf Courses and Athletic Fields*

- Use of potable water for turf and landscape plants should be minimized.
- All outdoor watering should be performed by efficient means in a conservative manner.
- A facility-specific drought management plan should be developed or updated in preparation for a drought emergency.
- Recommendation: Where a source of non-potable water exists at the location of use it should be used in lieu of potable water, in a conservative manner.

*Miscellaneous Uses*

- Water should be served in public establishments only at the customer's request.

#### **Water Use Recommendations for Drought Warning**

*Lawn and Turf Watering (including residential, commercial, institutional, and government uses)*

- Use of potable water for "established" lawns and turf should be avoided. Watering of "newly-sodded or seeded" turf should be limited to between the hours of 5 p.m. and 9 a.m. by any efficient means.
- Recommendation: Where a source of non-potable water exists at the location of use it should be used in lieu of potable water in a conservative manner.
- "Established" means planted 1 year or more. "Newly-sodded or seeded" means planted less than 1 year.

*Landscape Plant Watering (including residential, commercial, institutional, and government uses)*

- Use of potable water for "established" landscape plants (including groundcover, flowers, shrubs, and trees), should be avoided.
- Use of potable water for watering of landscape plants should be limited to new plants. New plants should be watered either manually or with soaker hoses.
- Irrigation bags or similar devices are recommended for trees and other individual plants.
- Nursery stock should be watered by any efficient means.
- Recommendation: Where a source of non-potable water exists at the location of use it should be used in lieu of potable water in a conservative manner.
- "Established" means planted 1 year or more. "Newly-sodded or seeded" means planted less than 1 year.

*Golf Courses and Athletic Fields*

- Use of potable water should be limited to between the hours of 5 p.m. and 9 a.m. for tees, greens, and fairways to prevent damage.
- Watering of grass or clay courts and athletic fields should be limited to between the hours of 5 p.m. and 9 a.m.
- Water conservation measures and the use of drought best management practices should be used to reduce water use.
- All facilities' drought management plans shall be finalized, submitted to DNREC, and readied for implementation.

- Recommendation: Where a source of non-potable water exists at the location of use it should be used in lieu of potable water and may be applied to any part of the facility in a conservative manner.

*Miscellaneous Uses*

- Water shall be served in public establishments only at the customer’s request.
- Use of potable water for washing private vehicles is permitted only by the use of a bucket and a hose with a flow-control nozzle.
- The use of potable water for washing paved surfaces is prohibited, except for sanitation.
- Watering required in earthworks projects for erosion and sediment control shall be done under plans approved by the prevailing governmental agency.

NOTICE: Individual water providers have the authority to impose more restrictive limits for demand management purposes.

**Mandatory Water Use Restrictions for Drought Emergency**

*Lawn and Turf Watering (including residential, commercial, institutional, and government uses)*

- The use of potable water for watering of “established” lawns and turf is prohibited.
- The following uses of potable water are permitted, only to the minimum extent necessary to prevent damage:
  - Use of potable water for “newly sodded or seeded” turf areas shall be limited to between the hours of 5 p.m. and 9 a.m. by any efficient means and in a conservative manner.
  - Landscaping work over 10,000 square feet, under contract as of the declaration of drought emergency, may be watered by any efficient means and in a conservative manner.
  - Pesticides may be watered-in within 2 days of application using the recommended rate and only between the hours of 5 p.m. and 9 a.m.
  - Newly-installed irrigation systems may be tested by the contractor up to 10 minutes per zone and a sign on the premises shall be displayed stating testing is occurring.
  - Where a source of non-potable water exists at the location of use it must be used in lieu of potable water in a conservative manner.
  - Diversions from sources of public water supply for non-potable uses may be restricted.
- “Established” means planted for more than 1 year. “Newly-sodded or seeded” means planted less than 1 year and prior to the declaration of Drought Emergency.

*Landscape Plant Watering (including residential, commercial, institutional, and government uses)*

- The use of potable water for watering of “established” landscape plants is prohibited.
- The following uses of potable water are permitted, only to the minimum extent necessary to prevent damage:
  - New landscape plants may only be watered manually or with soaker hoses, and only between the hours of 5 p.m. and 9 a.m. with the user in attendance.
  - Pesticides may be watered-in within 2 days of application using the recommended rate, and only between the hours of 5 p.m. and 9 a.m. Newly-installed irrigation systems may be tested by the contractor up to 10 minutes per zone and a sign on the premises shall be displayed stating testing is occurring.
  - Nursery stock may be watered by any efficient means for only 2 periods per day totaling no more 6 hours, with no more than 10 minutes of syringing of stressed plants between the hours of 12 noon and 3 p.m.
  - Where a source of non-potable water exists at the location of use it must be used in lieu of potable water in a conservative manner.
  - Diversions from sources of public water supply for non-potable uses may be restricted.
- Exceptions:

- Self-supplied public gardens may be watered conservatively by any efficient means and only to prevent damage.
- Irrigation bags or similar devices may be used for trees and other individual plants.
- Commercial watering is permitted beyond one year after planting if required by the applicable contract.
- “Established” means planted for more than 1 year. “Newly-sodded or seeded” means planted less than 1 year and prior to the declaration of Drought Emergency.

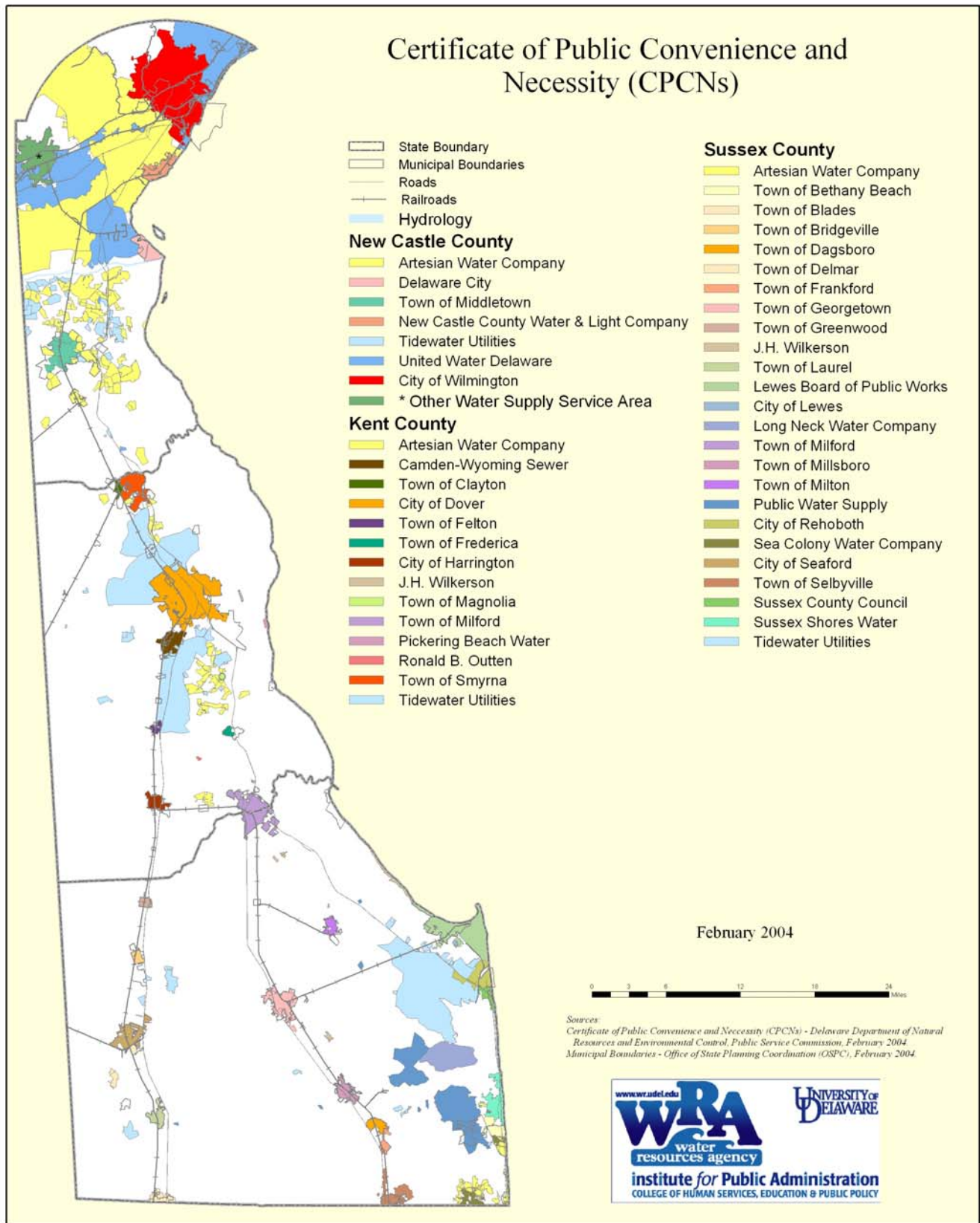
*Golf Courses and Athletic Fields*

- All facilities’ drought management plans as submitted to DNREC shall be implemented.
- Use of potable water is allowed between the hours of 5 p.m. and 9 a.m. and only to prevent damage to tees and greens.
- Watering of grass or clay courts and athletic fields is allowed only between the hours of 5 p.m. and 9 a.m. to maintain playability.
- Where a source of non-potable water exists at the location of use it must be used in lieu of potable water and may be applied to any part of the facility in a conservative manner.
- Diversions from sources of public water supply for non-potable uses may be restricted.
- Exception: Daytime syringing for heat sensitive grasses is permitted to prevent damage

*Miscellaneous Uses*

- Water shall be served in public establishments only at the customer’s request.
- The use of potable water for non-commercial washing of private vehicles is prohibited.
- The use of potable water for washing paved surfaces is prohibited, except for sanitation.
- Opening of hydrants or flushing of water mains is prohibited, except for public protection purposes and shall be performed only by authorized personnel.
- The use of potable water for filling of swimming pools is prohibited except for filling of therapeutic pools or to prevent structural damage to new pools.
- The use of potable water for topping off swimming pools is permitted only to the extent necessary to maintain proper filtration.
- The use of potable water for fountains and ornamental pools is prohibited unless they are supporting fish or plants.
- Watering required in earthworks projects for erosion and sediment control shall be done under plans approved by the prevailing governmental agency.
- Where a source of non-potable water exists at the location of use it must be used, when appropriate, in lieu of potable water in a conservative manner.
- Diversions from sources of public water supply for non-potable uses may be restricted.
- Exception: Use of potable water is allowed for the production of food, fiber, nursery stock, sod, flowers, livestock, and poultry.

NOTICE: Individual water providers have the authority to impose more restrictive limits for demand management purposes.



**Figure 1.** Delaware Water Supply Certificate of Public Convenience and Necessity Map.



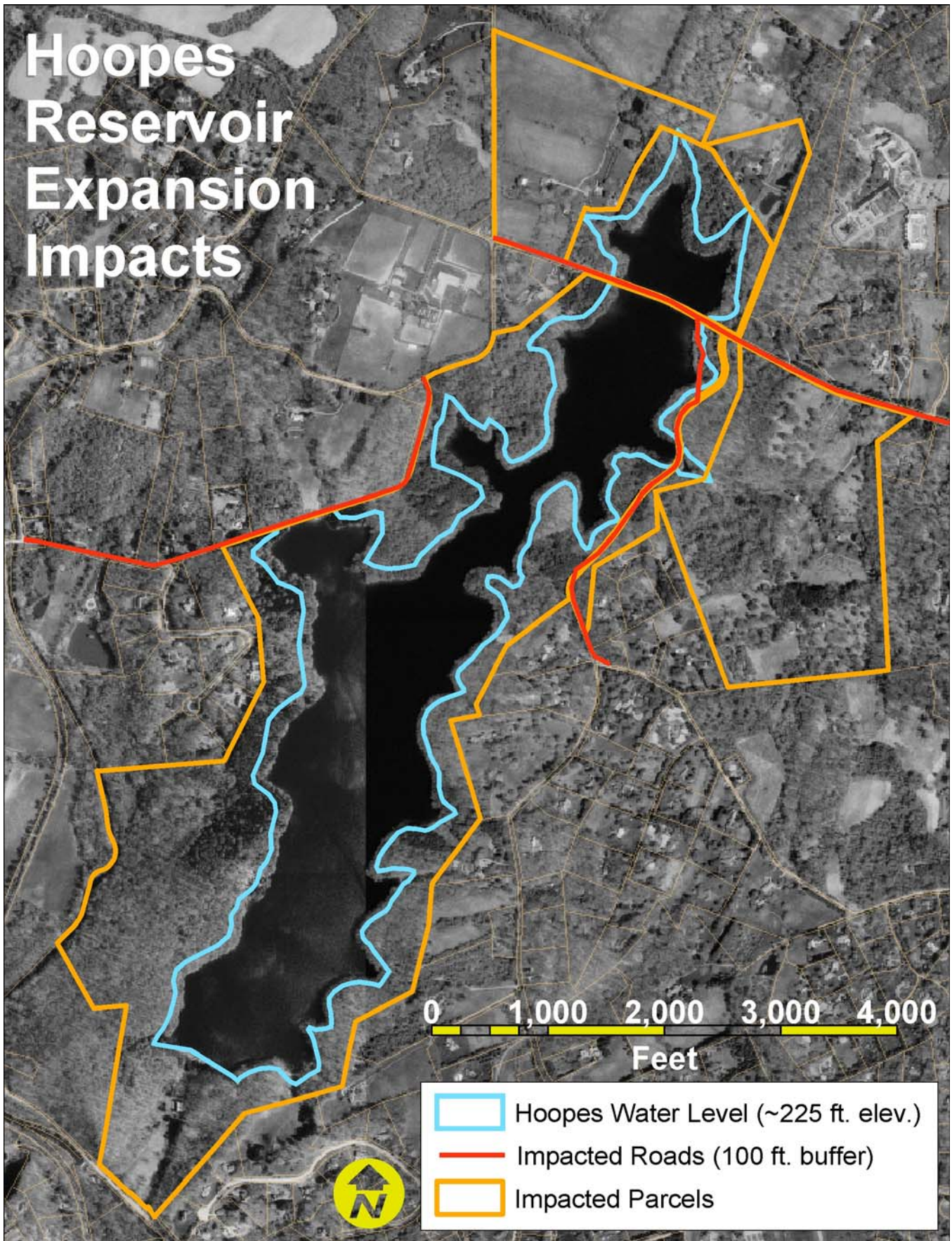


**Figure 2.** Newark Reservoir, view looking south, Fall 2003.



**Figure 3.** Newark Reservoir, view looking north, Spring 2005.





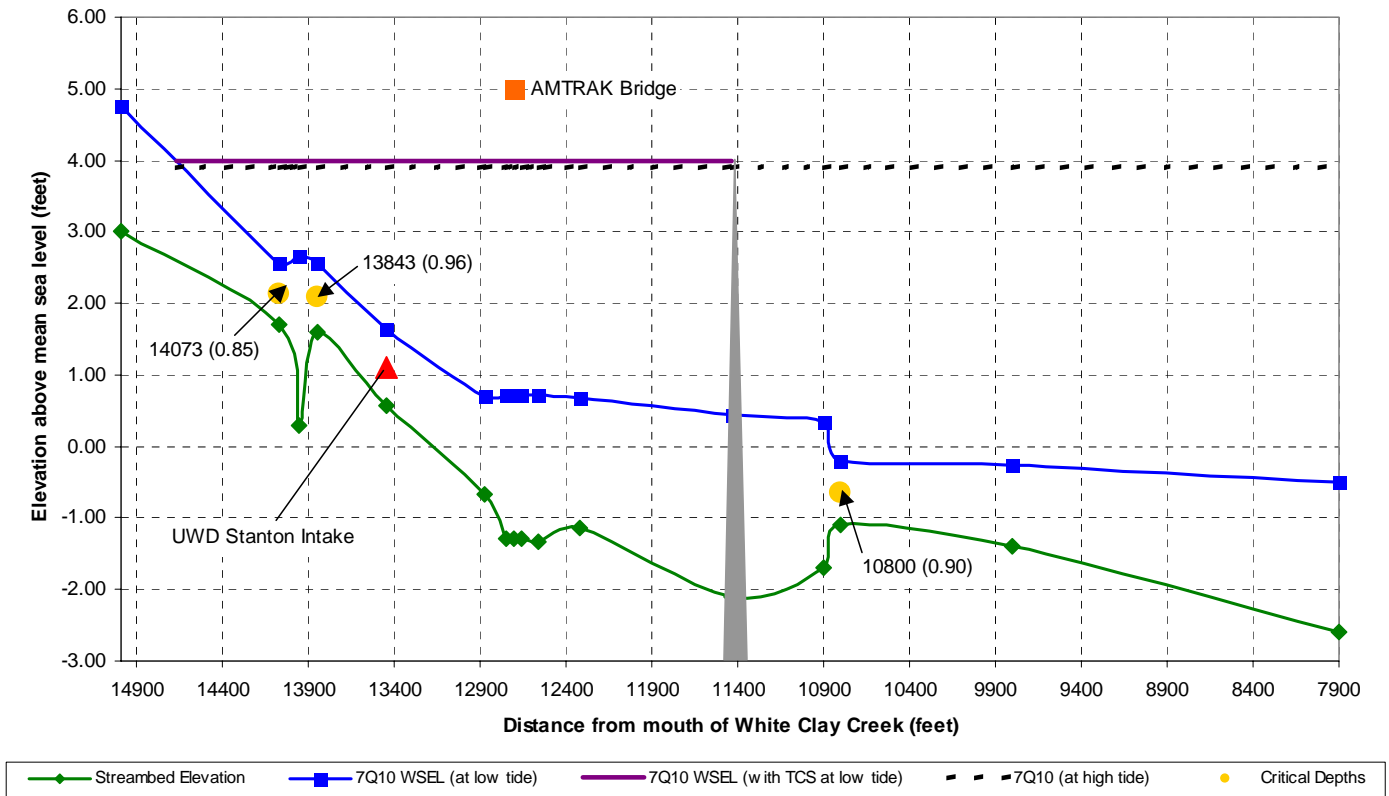
**Figure 4.** Projected Impacts of Hoopes Reservoir Expansion.





**Figure 5.** United Water Delaware Tidal Capture Structure (TCS).

**White Clay Creek at Stanton Stream Profile  
7Q10 Conditions**



**Figure 6.** White Clay Creek at Stanton Stream Profile, 7Q10 Conditions.



**PUBLIC WATER PRODUCTION AND DEMAND REPORT**  
**Northern New Castle County**  
**June-04**

Water Purveyor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	AVG		
	T	W	R	F	S	N	M	T	W	R	F	S	N	M	T	W	R	F	S	N	M	T	W	R	F	S	N	M	T	W			
<b>City of Wilmington</b>	<b>23.6</b>	<b>24.3</b>	<b>22.7</b>	<b>23.7</b>	<b>22.9</b>	<b>23.7</b>	<b>22.3</b>	<b>25.1</b>	<b>26.4</b>	<b>25.3</b>	<b>25.5</b>	<b>21.9</b>	<b>23.2</b>	<b>22.9</b>	<b>21.1</b>	<b>23.8</b>	<b>23.2</b>	<b>22.6</b>	<b>19.9</b>	<b>21.7</b>	<b>23.3</b>	<b>21.5</b>	<b>23.9</b>	<b>22.8</b>	<b>23.1</b>	<b>21.8</b>	<b>23.2</b>	<b>23.2</b>	<b>19.8</b>	<b>22.8</b>	<b>23.0</b>		
Brandywine Filter Plant	7.1	6.8	6.7	7.0	7.2	7.2	7.0	7.2	7.2	7.5	7.8	6.5	7.3	7.0	3.6	6.0	5.7	4.9	3.7	5.9	5.7	5.8	5.8	6.1	6.0	5.8	5.9	5.8	1.1	4.1	6.0		
Porter Filter Plant	16.5	17.5	16.0	16.7	15.7	16.5	15.3	17.9	19.2	17.8	17.7	15.4	15.9	15.9	17.5	17.8	17.5	17.7	16.2	15.8	17.6	15.7	18.1	16.7	17.1	16.0	17.3	17.4	18.7	18.7	17.0		
<b>Artesian Water Co.</b>	<b>20.7</b>	<b>21.6</b>	<b>20.8</b>	<b>21.2</b>	<b>21.3</b>	<b>19.2</b>	<b>21.6</b>	<b>21.0</b>	<b>21.9</b>	<b>22.2</b>	<b>22.3</b>	<b>21.7</b>	<b>21.0</b>	<b>18.6</b>	<b>21.1</b>	<b>21.0</b>	<b>20.0</b>	<b>21.1</b>	<b>21.3</b>	<b>21.2</b>	<b>20.4</b>	<b>19.6</b>	<b>21.2</b>	<b>20.2</b>	<b>21.3</b>	<b>21.2</b>	<b>20.8</b>	<b>21.1</b>	<b>21.6</b>	<b>19.8</b>	<b>20.9</b>		
Wells (North)	15.4	16.5	15.6	15.8	16.2	14.3	16.4	15.9	16.7	17.1	16.8	16.3	16.3	13.7	16.9	16.9	16.0	17.0	17.3	17.1	16.3	15.5	17.1	16.1	17.2	17.2	16.8	17.0	17.6	16.6	16.4		
ASR	0.9	0.9	0.9	0.9	0.9	0.7	0.9	0.8	0.9	0.9	0.9	0.9	0.8	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.9		
CWA (PA) Interconnection	3.1	3.1	3.1	3.1	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.3	3.2	3.2	3.1	3.2	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.1	3.2	3.1	3.2	3.2		
New Castle Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Wilmington Interconnection	1.3	1.2	1.2	1.4	1.1	1.1	1.3	1.2	1.2	1.0	1.4	1.4	0.8	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5		
<b>United Water Delaware</b>	<b>19.9</b>	<b>20.7</b>	<b>21.2</b>	<b>20.7</b>	<b>22.6</b>	<b>21.8</b>	<b>24.9</b>	<b>21.1</b>	<b>21.5</b>	<b>21.5</b>	<b>24.5</b>	<b>18.3</b>	<b>16.9</b>	<b>20.2</b>	<b>21.8</b>	<b>20.8</b>	<b>21.0</b>	<b>19.1</b>	<b>19.1</b>	<b>21.0</b>	<b>20.7</b>	<b>21.6</b>	<b>21.6</b>	<b>21.7</b>	<b>22.0</b>	<b>21.8</b>	<b>22.0</b>	<b>22.1</b>	<b>21.7</b>	<b>21.2</b>			
White Clay Cr./Stanton	15.6	16.5	16.9	16.3	18.3	17.6	20.8	16.6	17.1	17.2	20.0	15.5	15.6	18.9	20.5	19.5	19.7	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8		
-Hoopes Release	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
-Raw Chlorides (ppm)	37	34	34	35	36	29	31	34	36	37	29	31	32	34	23	26	30	27	29	28	32	35	30	42	36	33	35	35	35	35	32.7		
.newport bridge	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
.churchman's	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
.tcs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Christina River WTP	3.3	3.2	3.3	3.4	3.3	3.2	3.1	3.2	3.1	3.0	3.2	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.6	2.9	2.8	2.8	2.9	3.2	3.0	3.2	3.3	2.9	2.2
CWA (PA) Interconnection	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1		
Artesian Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Wilmington Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
<b>City of Newark</b>	<b>3.8</b>	<b>3.2</b>	<b>3.5</b>	<b>4.3</b>	<b>3.1</b>	<b>3.7</b>	<b>3.7</b>	<b>3.4</b>	<b>4.5</b>	<b>3.7</b>	<b>4.0</b>	<b>2.8</b>	<b>2.8</b>	<b>3.4</b>	<b>3.5</b>	<b>3.8</b>	<b>3.7</b>	<b>3.4</b>	<b>3.0</b>	<b>3.6</b>	<b>3.9</b>	<b>3.1</b>	<b>4.5</b>	<b>3.5</b>	<b>3.4</b>	<b>3.3</b>	<b>3.7</b>	<b>3.0</b>	<b>3.3</b>	<b>3.5</b>	<b>3.5</b>		
White Clay Cr. WTP	0.9	1.6	2.1	2.2	0.0	0.0	1.0	1.9	2.3	1.9	0.0	1.2	1.4	1.6	0.0	0.0	0.6	0.0	1.1	1.6	1.9	1.7	0.0	1.8	1.8	0.0	1.2	1.4	1.3	1.8	1.1		
Wells	2.0	1.4	1.4	1.5	2.1	2.1	1.4	1.5	1.4	1.4	2.0	1.4	1.4	1.3	2.0	2.0	2.0	2.2	1.4	2.0	2.0	1.4	2.0	1.3	1.1	1.8	1.1	1.2	1.3	1.2	1.6		
United Interconnection	0.9	0.2	0.0	0.6	1.0	1.6	1.3	0.0	0.8	0.4	2.0	0.2	0.0	0.5	1.5	1.8	1.1	1.2	0.5	0.0	0.0	0.0	2.5	0.4	0.5	1.5	1.4	0.4	0.7	0.5	0.8		
Artesian Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
<b>New Castle MSC</b>	<b>0.3</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>	<b>0.3</b>	<b>0.4</b>	<b>0.4</b>	<b>0.5</b>	<b>0.4</b>	<b>0.3</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>	<b>0.3</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>	<b>0.3</b>	<b>0.3</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>	<b>0.3</b>	<b>0.3</b>	<b>0.4</b>	<b>0.4</b>	<b>0.4</b>	
Wells	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.4	0.4	0.5	0.4	0.3	0.4	0.4	0.4	0.3	0.4	0.4	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.4	0.4	0.4	
Subtotal	68.3	70.2	68.6	70.3	70.3	68.8	72.8	71.0	74.7	73.2	76.7	65.0	64.3	65.5	67.9	69.7	68.3	66.6	63.7	67.8	68.6	66.3	71.6	68.5	69.9	68.7	69.8	69.6	67.2	68.2	69.1		
Delaware Interconnections	-2.2	-1.4	-1.2	-2.0	-2.1	-2.7	-2.6	-1.2	-2.0	-1.4	-3.4	-1.6	-0.8	-1.2	-1.5	-1.8	-1.1	-1.2	-0.5	0.0	0.0	0.0	-2.5	-0.4	-0.5	-1.5	-1.4	-0.4	-0.7	-0.5	-1.3		
<b>TOTAL DEMAND</b>	<b>66.1</b>	<b>68.8</b>	<b>67.4</b>	<b>68.3</b>	<b>68.2</b>	<b>66.1</b>	<b>70.3</b>	<b>69.9</b>	<b>72.7</b>	<b>71.8</b>	<b>73.3</b>	<b>63.5</b>	<b>63.6</b>	<b>64.3</b>	<b>66.4</b>	<b>67.9</b>	<b>67.2</b>	<b>65.4</b>	<b>63.2</b>	<b>67.8</b>	<b>68.6</b>	<b>66.3</b>	<b>69.1</b>	<b>68.1</b>	<b>69.4</b>	<b>67.2</b>	<b>68.4</b>	<b>69.2</b>	<b>66.5</b>	<b>67.7</b>	<b>67.8</b>		

Notes: R = Thursday, N = Sunday; Water demand data provided by the public water purveyors and compiled by the University of Delaware, Institute for Public Administration, Water Resources Agency.

**Figure 7. Northern New Castle County Public Water Production Demand Report, June 2004.**

**PUBLIC WATER PRODUCTION AND DEMAND REPORT**  
**Northern New Castle County**  
**July-04**

Water Purveyor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	AVG	
	R	F	S	N	M	T	W	R	F	S	N	M	T	W	R	F	S	N	M	T	W	R	F	S	N	M	T	W	R	F	S		
<b>City of Wilmington</b>	23.7	23.9	24.5	23.4	22.6	26.4	26.8	18.8	24.4	23.1	23.3	21.8	19.1	26.0	23.5	25.2	22.3	21.9	22.6	23.6	24.1	24.0	24.9	20.6	23.8	23.9	24.1	23.1	23.3	23.3	22.7	23.4	
Brandywine Filter Plant	5.6	5.8	5.9	5.8	5.0	6.8	5.6	1.2	5.3	5.2	5.9	3.9	0.0	6.2	6.8	6.4	6.0	5.7	5.9	6.0	6.0	5.6	5.7	6.1	6.2	6.2	6.4	4.5	5.0	5.8	5.5	5.4	
Porter Filter Plant	18.1	18.1	18.6	17.6	17.6	19.6	21.2	17.6	19.1	17.9	17.4	17.9	19.1	19.8	16.7	18.8	16.3	16.2	16.7	17.6	18.1	18.4	19.2	14.5	17.6	17.7	17.7	18.6	18.3	17.5	17.2	18.0	
<b>Artesian Water Co.</b>	18.5	21.8	21.1	20.2	18.9	21.0	21.1	19.6	19.9	18.9	21.2	19.0	16.8	19.8	19.9	20.2	18.3	19.1	20.4	18.4	18.4	19.2	19.8	19.6	18.6	18.3	19.3	15.8	17.3	18.2	21.1	19.3	
Wells (North)	14.4	18.0	17.0	16.1	14.9	16.9	17.1	15.7	15.9	14.8	17.2	15.1	12.4	15.8	15.9	16.2	14.2	15.0	16.2	14.3	14.3	15.1	15.7	15.5	14.4	14.1	15.4	12.7	13.9	14.6	16.0	15.3	
ASR	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.7	1.2	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.7	0.0	0.2	0.4	0.9	0.8
CWA (PA) Interconnection	3.2	2.9	3.2	3.2	3.1	3.2	3.1	3.0	3.1	3.2	3.1	3.2	3.2	3.2	3.1	3.1	3.2	3.2	3.3	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.2	3.1	3.2	3.2	3.1	3.2	
New Castle Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Wilmington Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
<b>United Water Delaware</b>	23.2	22.6	22.8	22.0	22.1	22.8	22.9	22.6	22.6	21.6	22.2	21.6	21.9	21.3	25.3	22.4	20.9	21.1	21.0	20.3	22.6	21.5	21.8	21.1	20.9	22.6	21.8	22.3	22.1	20.9	22.0	22.0	
White Clay Cr./Stanton	18.7	18.1	18.3	17.4	17.6	18.3	18.4	18.1	18.1	17.1	17.7	17.1	17.4	16.8	20.5	17.6	16.1	16.3	16.2	15.5	17.8	16.7	17.0	16.3	16.1	17.8	17.0	17.5	17.6	16.4	17.5	17.4	
- Hoopes Release	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
- Raw Chlorides (ppm)	35	33	36	36	35	40	40	34	31	34	37	25	23	23	30	32	38	25	26	28	37	31	38	35	36	32	32	19	29	32	37	32.2	
.newport bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
.churchman's	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
.tcs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
Christina River WTP	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	
CWA (PA) Interconnection	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.0	1.0	1.0	1.1	
Artesian Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Wilmington Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
<b>City of Newark</b>	3.5	3.5	3.6	3.5	3.6	3.4	2.5	5.0	3.8	3.3	3.7	2.5	4.7	2.1	4.5	2.5	3.8	2.4	2.7	3.4	5.0	3.6	3.3	3.3	3.4	3.3	3.3	3.0	1.9	4.2	4.8	3.5	
White Clay Cr. WTP	1.8	1.9	1.7	1.9	1.7	1.7	0.0	1.5	0.7	2.1	1.7	0.5	0.4	0.3	0.0	1.5	1.8	1.0	0.0	1.7	1.7	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
Wells	1.2	1.1	1.1	1.1	1.1	1.1	1.8	1.8	1.2	1.2	1.2	1.1	1.8	1.1	1.8	1.0	1.0	1.0	1.0	1.7	2.2	2.1	1.8	1.8	1.9	1.8	1.8	0.0	0.4	1.9	2.4	1.4	
United Interconnection	0.5	0.5	0.8	0.5	0.8	0.6	0.7	1.7	1.9	0.0	0.8	0.9	2.5	0.7	2.7	0.0	1.0	0.4	1.7	0.0	1.1	0.3	0.3	0.3	0.3	0.3	0.3	1.8	0.3	1.1	1.2	0.8	
Artesian Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
<b>New Castle MSC</b>	0.5	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
Wells	0.5	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	
Subtotal	69.4	72.3	72.4	69.5	67.6	74.1	73.8	66.5	71.2	67.3	70.8	65.3	62.9	69.6	73.6	70.7	65.7	64.9	67.1	66.1	70.6	68.6	70.2	65.0	67.1	68.5	68.9	64.6	65.0	71.0	68.6		
Delaware Interconnections	-0.5	-0.5	-0.8	-0.5	-0.8	-0.6	-0.7	-1.7	-1.9	0.0	-0.8	-0.9	-2.5	-0.7	-2.7	0.0	-1.0	-0.4	-1.7	0.0	-1.1	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-1.8	-0.3	-1.1	-1.2	-0.8	
<b>TOTAL DEMAND</b>	68.9	71.8	71.6	69.0	66.8	73.5	73.1	64.8	69.3	67.3	70.0	64.4	60.4	68.9	70.9	70.7	64.7	64.5	65.4	66.1	69.5	68.3	69.9	64.7	66.8	68.2	68.6	62.8	64.7	65.9	69.8	67.8	

Notes: R = Thursday, N = Sunday; Water demand data provided by the public water purveyors and compiled by the University of Delaware, Institute for Public Administration, Water Resources Agency.

**Figure 8.** Northern New Castle County Public Water Production Demand Report, July 2004.

**PUBLIC WATER PRODUCTION AND DEMAND REPORT**  
**Northern New Castle County**  
**August-04**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	AVG
	N	M	T	W	R	F	S	N	M	T	W	R	F	S	N	M	T	W	R	F	S	N	M	T	W	R	F	S	N	M	T	
<b>Water Purveyor</b>																																
<b>City of Wilmington</b>	22.1	25.2	23.0	23.9	23.8	25.6	23.8	22.4	25.2	26.5	26.8	25.6	27.1	22.5	23.6	25.0	25.1	24.9	25.1	24.7	24.5	24.8	24.3	25.4	26.9	26.8	24.5	26.3	25.4	25.9	25.0	25.1
Hoopes Reservoir Water Level (ft)	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88.0
Hoopes Release to Wilmington (mgd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Brandywine Filter Plant	4.4	3.6	5.7	7.3	7.4	6.9	6.8	6.8	7.9	7.4	8.5	8.0	6.4	4.4	4.7	5.3	6.1	7.2	7.6	7.2	7.1	6.9	6.9	7.2	7.3	7.8	6.2	7.1	7.0	7.0	7.4	6.7
Porter Filter Plant	17.7	21.6	17.3	21.6	16.4	18.7	17.0	15.6	17.3	19.1	18.3	17.6	20.7	18.1	18.9	19.7	19.0	17.7	17.5	17.5	17.4	17.9	17.4	18.2	19.6	19.0	18.3	19.2	18.4	18.9	17.6	18.4
<b>Artesian Water Co.</b>	18.7	21.1	18.7	19.7	19.7	16.6	16.8	16.9	17.1	19.1	18.9	19.2	17.9	16.6	16.0	17.7	17.5	17.9	19.2	18.1	18.0	18.0	17.9	17.8	18.4	18.2	18.3	18.0	19.1	18.6	18.2	18.2
Wells (North)	14.6	17.4	15.1	15.7	15.6	13.4	13.6	13.7	13.8	15.7	13.7	14.0	12.6	12.1	12.5	13.3	13.1	13.5	14.7	13.6	13.8	13.7	13.7	13.6	14.1	14.1	14.6	14.2	14.6	14.6	13.8	14.1
ASR	0.9	0.5	0.4	0.9	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
CWA (PA) Interconnection	3.2	3.2	3.2	3.1	3.2	3.2	3.2	3.2	3.3	3.2	3.2	3.2	3.1	3.3	3.3	3.2	3.2	3.3	3.2	3.3	3.1	3.2	3.2	3.2	3.2	3.3	3.3	3.2	3.2	3.2	3.2	
New Castle Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Wilmington Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.0	2.0	2.2	1.2	0.2	1.2	1.1	1.3	1.2	1.1	1.1	1.1	1.0	1.0	1.1	0.8	0.4	0.6	1.3	0.8	1.2	0.8
<b>United Water Delaware</b>	22.3	22.6	23.0	22.8	22.4	21.4	21.3	20.9	20.3	21.2	23.2	22.0	22.4	22.6	22.5	21.0	20.8	20.8	21.4	21.7	21.3	22.4	20.1	19.8	20.1	20.7	20.6	19.1	20.8	20.0	19.8	21.3
White Clay Cr/Starton	18.8	19.1	19.5	19.3	18.9	17.9	17.8	17.4	16.8	17.7	19.7	18.5	18.9	19.1	19.0	17.5	17.3	17.3	17.9	18.2	17.8	18.9	16.6	16.3	16.6	17.2	17.1	15.6	17.3	16.5	16.3	17.8
- Hoopes Release (mgd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
- Intake Chlorides (ppm)	29	28	30	29	28	33	30	34	61	32	34	31	26	31	33	33	34	33	32	36	34	30	31	31	35	36	46	42	36	35	27	34
- Plant Effluent Chlorides (ppm)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
newport bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
churchman's	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
its	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Christina River WTP	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
CWA (PA) Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Artesian Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wilmington Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>City of Newark</b>	2.2	4.6	4.2	3.9	4.1	3.4	3.2	2.9	4.1	3.2	3.4	2.1	5.8	2.5	2.5	4.0	3.2	3.6	3.5	3.6	3.3	2.2	3.8	3.1	3.8	3.4	4.3	3.4	5.1	4.5	3.8	3.6
White Clay Cr. WTP	0.3	1.2	2.4	1.6	0.6	1.3	2.0	1.7	2.3	2.0	2.3	0.0	1.7	0.0	0.0	1.7	1.6	2.0	1.9	2.0	1.7	0.7	1.0	1.7	2.1	2.0	2.2	1.7	1.9	1.4	1.1	1.5
Wells	1.2	1.8	1.8	1.8	1.8	1.2	1.2	1.2	1.8	1.2	1.1	1.1	1.1	1.1	1.1	1.6	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.7	1.3	1.8	1.3	1.9	1.3
United Interconnection	0.7	1.6	0.0	0.5	1.7	0.9	0.0	0.0	0.0	0.0	0.0	1.0	3.0	1.4	1.4	0.7	0.5	0.5	0.5	0.5	0.5	0.4	1.7	0.4	0.7	0.4	0.4	0.4	1.4	1.8	0.8	0.8
Artesian Interconnection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>New Castle MSC</b>	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Wells	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
<b>Subtotal</b>	65.7	73.9	69.3	75.7	70.4	67.4	65.5	63.4	67.0	70.3	72.7	69.3	73.6	64.6	65.0	68.1	67.0	67.6	69.6	68.5	67.5	67.8	66.5	66.5	69.6	69.5	68.1	67.2	70.8	69.4	67.2	68.5
Delaware Interconnections	-0.7	-1.6	0.0	-0.5	-1.7	-0.9	0.0	0.0	0.0	-0.2	-2.0	-3.0	-5.2	-2.6	-1.6	-1.9	-1.7	-1.6	-1.8	-1.7	-1.6	-1.5	-2.7	-1.4	-1.8	-1.2	-0.8	-1.0	-2.7	-2.6	-2.0	-1.5
<b>TOTAL DEMAND</b>	65.0	72.3	69.3	75.2	68.7	66.5	63.4	67.0	70.1	70.7	66.3	68.4	62.0	63.4	66.2	65.3	66.0	67.8	66.8	65.9	66.3	63.8	65.1	67.8	68.3	67.3	66.2	68.1	66.8	65.2	67.0	

Notes: R = Thursday, N = Sunday; Water demand data provided by the public water purveyors and compiled by the University of Delaware, Institute for Public Administration, Water Resources Agency.

**Figure 9. Northern New Castle County Public Water Production Demand Report, August 2004.**

