Water Supply and Demand in Southern New Castle County through 2050

Draft October 11, 2021

Prepared for:

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1. Introduction

The University of Delaware Water Resources Center (UDWRC) was requested by the New Castle County Department of Land Use to estimate water supply and demand in Southern New Castle County through 2050. To compile these estimates, we utilized data from the Delaware Department of Natural Resources and Environmental Control (DNREC), Delaware Geological Survey (DGS), and our GIS lab. These estimates build on the *Ninth Report to the Governor and General Assembly regarding the Progress of the Delaware Water Supply Coordinating Council, Estimates of Water Supply and Demand in Southern New Castle County through 2030* (DNREC 2006).

2. Population

Population growth with conversion of agricultural land to urban/suburban uses is projected to increase demand for public water supply in southern New Castle County. The Delaware Population Consortium (2020) estimated the population of New Castle County south of the C&D Canal increased from 52,454 in 2010 to 61,882 by 2020 and is projected to increase by 31,200 to 91,002 by 2050 (Table 1 and Figure 1).

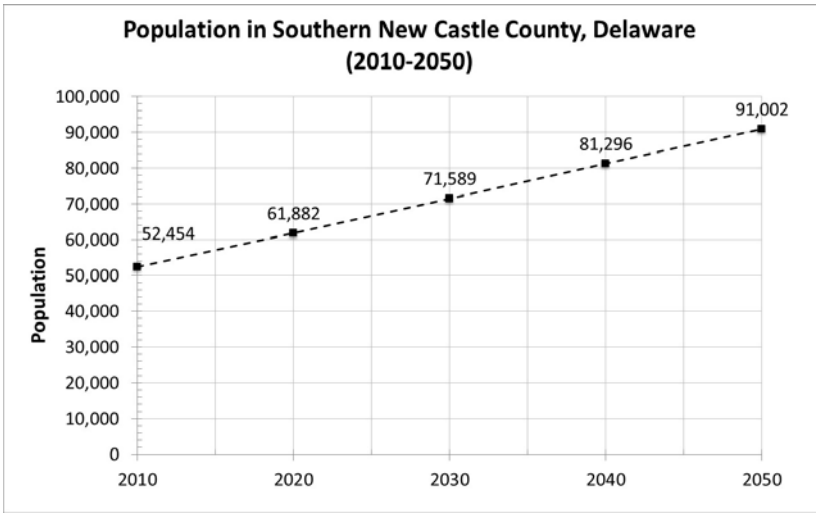

Figure 1. Projected population growth in southern New Castle County (Delaware Population Consortium 2020)

Table 1. Projected population in New Castle County through 2050 (Delaware Population Consortium 2020)

Year	NCC Population		Northern NCC Population		Southern NCC Population	
	Pop.	%	Pop.	%	Pop.	%
2010	538,753	0.0%	486,299	0.0%	52,454	0.0%
2020	558,863	3.7%	496,981	2.2%	61,882	18.0%
2030	566,642	1.4%	495,053	-0.4%	71,589	15.7%
2040	571,198	0.8%	489,902	-1.0%	81,296	13.6%
2050	566,198	-0.9%	475,196	-3.0%	91,002	11.9%

3. Water Providers

A DNREC database indicates over 4,600 individual wells are dispersed throughout southern New Castle County that provide 1.5 mgd of drinking water and over 3,100 individual wells are distributed north of the MOT area (Figure 2).

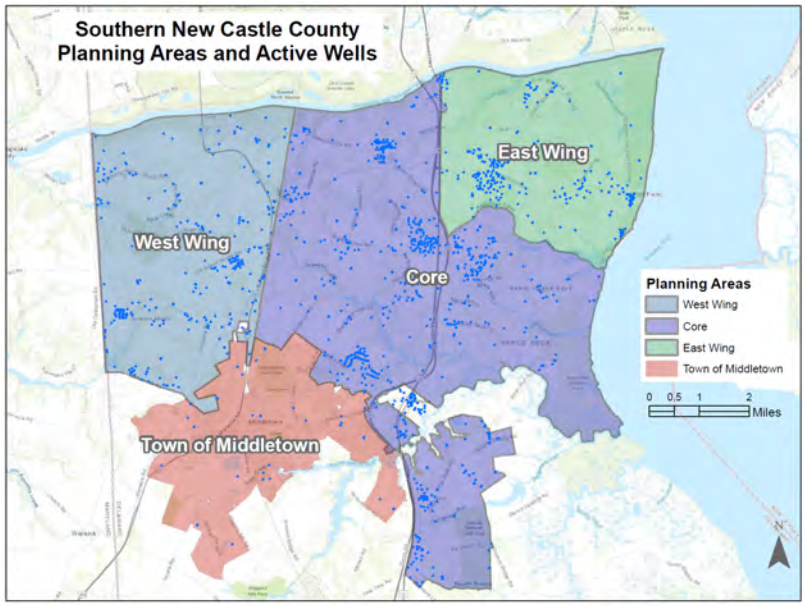

Figure 2. Individual wells in southern New Castle County

Figure 3 delineates the water supply franchise areas of purveyors in southern New Castle County. For a private water utility, and in certain circumstances a municipal water utility, to expand its service territory it must apply for and be granted a Certificate of Public Convenience and Necessity (CPCN) from the Delaware Public Service Commission. According to DNREC, the following water systems provide drinking water in southern New Castle County.

Public Community Wells
- Artesian Water Company (28 wells)
- Artesian Water Company, Delaware Correctional Center (4 wells)
- Tidewater Utilities (24 wells)
- Town of Middletown (4 wells)
- Mount Pleasant Trailer Park (2 wells)

Self-Supplied Non-Community Wells (20 wells)
- Transient: Restaurants, stores, hotels, parks
- Non Transient: Schools, daycare centers, office, factories

Residential Individual Wells (4,600 wells)

Irrigation Water Supplies
- Farms (26 wells)
- Golf courses, nurseries (1 well)

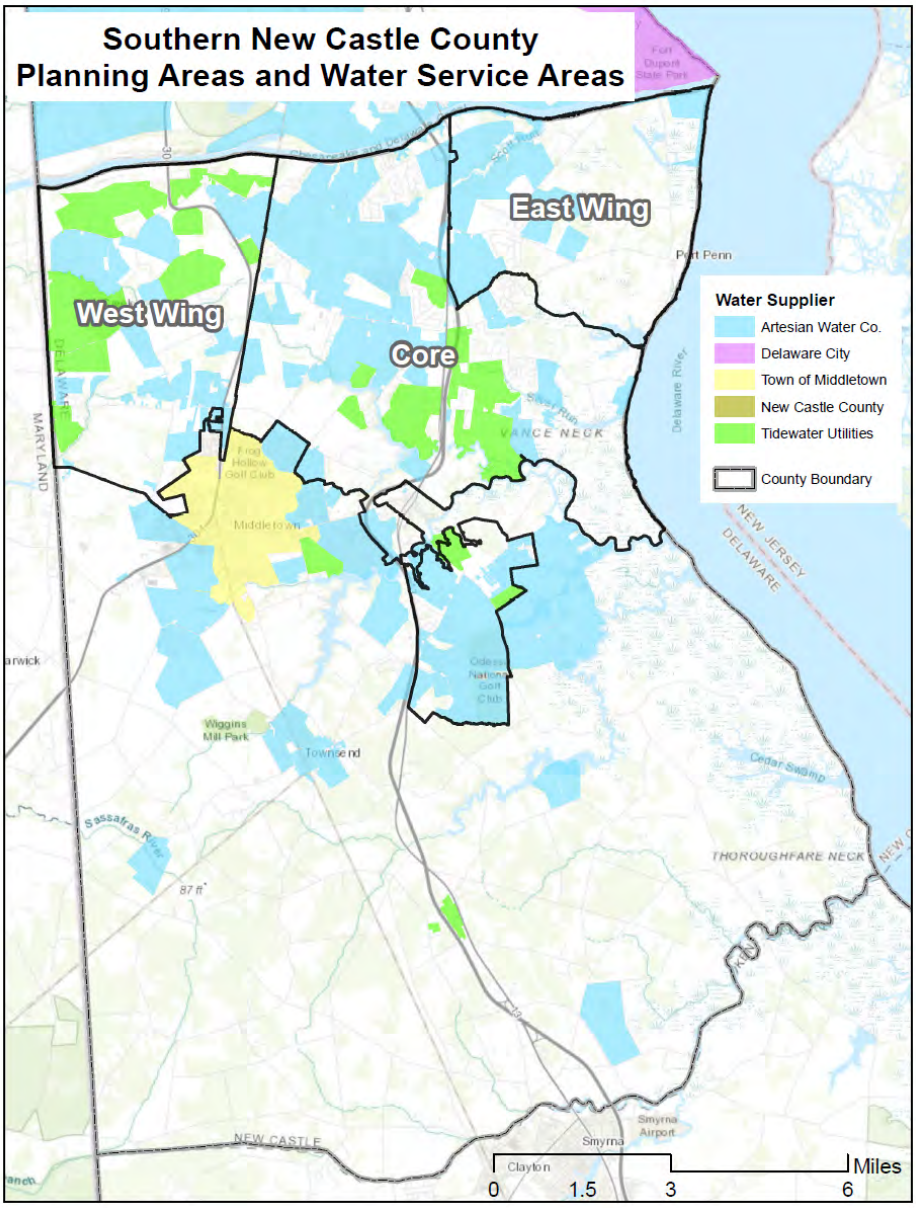

Figure 3. Public water supply franchise areas in southern New Castle County (UDWRC 2020)

4. Groundwater Availability

Groundwater drawn from aquifers is the sole source of drinking water in Southern New Castle County. As depicted in a cross-section developed by the Delaware Geological Survey, the aquifers yield this water within a southeasterly dipping and thickening wedge of unconsolidated sediments of the Atlantic Coastal Plain (Figure 4). Ground-water in the shallow Columbia formation is drawn for irrigation and is also the source of stream flow in the watersheds (Figure 5). Deeper aquifers in the Rancocas, Mt. Laurel, Magothy, and Potomac formations are tapped by potable drinking water wells by the water purveyors. Groundwater availability in the shallow aquifers may be impacted by impaired water quality from rural sources or septic systems (high nitrogen) or salt water intrusion along Delaware Bay.

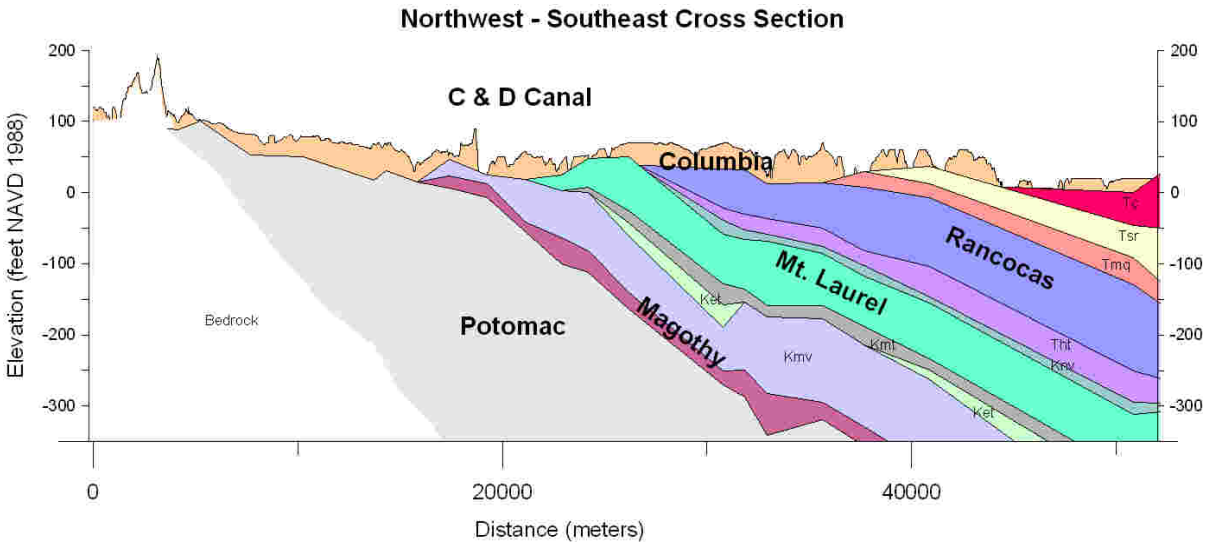

Figure 4. Cross section extending from near Newark to southeastern New Castle County (DGS)

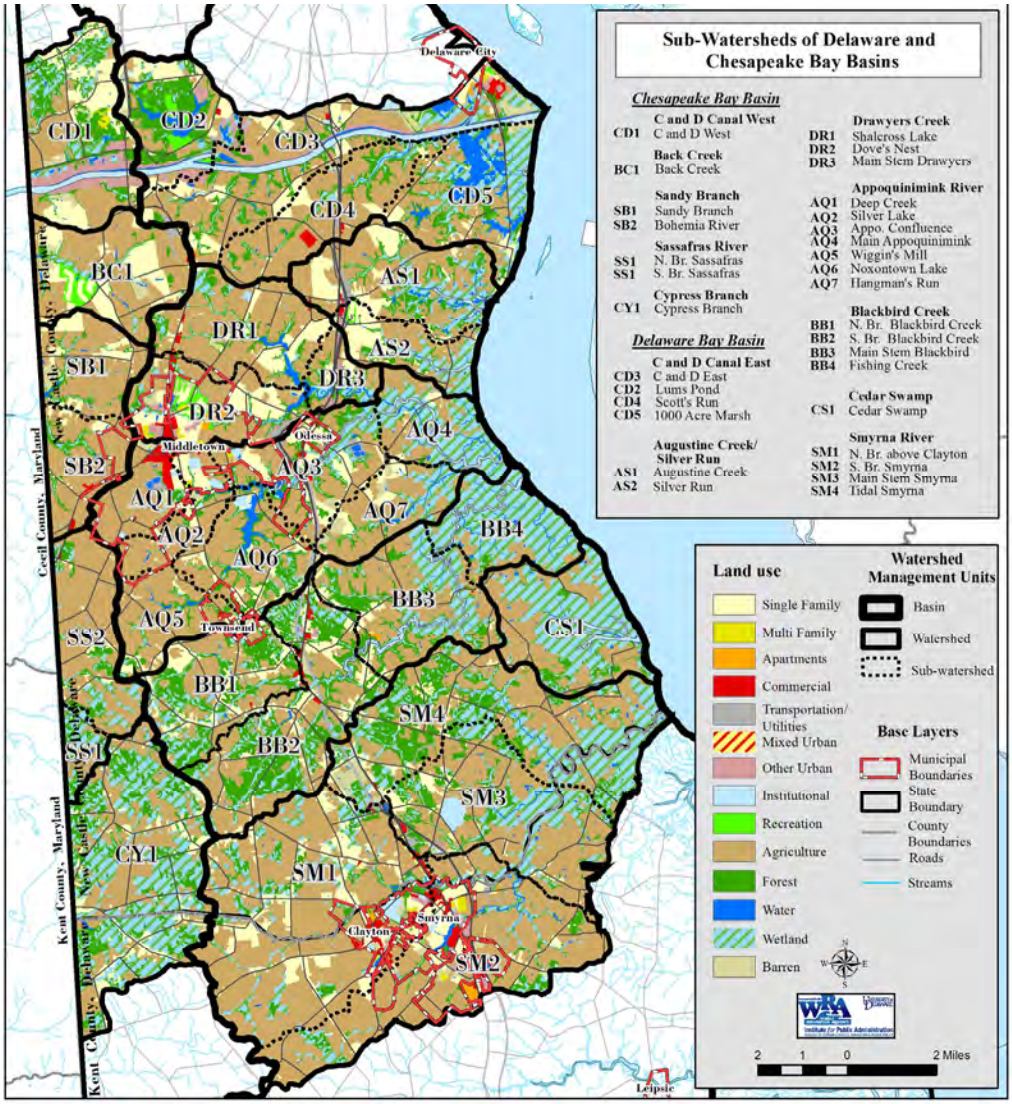

Figure 5. Watersheds in southern New Castle County (UDWRC 2017)

5. Water Supply

Southern New Castle County is served by: (1) potable water supplies from public community wells, self-supplied wells, and residential individual wells and (2) non-potable farm, nursery, golf course irrigation wells (Table 2 and Figure 6). As agriculture continues to convert to suburban land, irrigation well supplies for farms/nurseries in southern New Castle County are not projected to increase.

Table 2. Maximum allocated ground-water supplies in southern New Castle County

Water System	Daily Supply (mgd)	Monthly Supply (mgd)	Annual Supply (mgd)	Nonpotable Supply (mgd)
Artesian Water Company	8.8	7.3	6.7	
AWC: DE Correctional Center	2.1	2.1	2.1	
Tidewater Utilities, Inc.	2.7	2.5	1.3	
Middletown	1.7	1.7	1.5	
Mt. Pleasant Trailer Park	0.02	0.02	0.01	
Self-Supplied Non-Community Wells	0.3	0.2	0.1	
Public Water Supply	**15.7**	**13.9**	**11.7**	
Residential Individual Wells	1.5	1.5	1.5	
Farms, Nurseries				9.7
Golf Courses				0.3
Total	**17.2**	**15.4**	**13.2**	**10.0**

6. Water Demand

Population in southern New Castle County is projected to increase by 150% from 61,882 in 2020 to 91,002 by 2050 (DPC 20208). Table 3 projects public water demands through 2050 assuming increases in demands coincide with population growth. The population in 2020 includes 14,530 people on individual wells who are subtracted to calculate the population who depend on public water systems. Under the New Castle County UDC, new communities with 25 homes or more will be served by public water systems, therefore, we project little increase (1.0%/decade) in individual wells in southern New Castle County. Water demands at the Delaware Correctional Center are not expected to increase.

Table 3. Public water demand in southern New Castle County (2010-2050)

Year	2010	2020	2030	2040	2050
% increase in population	--	18.0	15.7%	13.6%	11.9%
Population	52,454	61,882	71,589	81,296	91,002
Less population individual wells	14,530	15,266	16,039	16,500	16,650
Population public water supply	37,924	46,616	55,550	64,796	74,352
% increase public water supply		22.9%	19.2%	16.6%	14.7%
Water Purveyor	**(mgd)**	**(mgd)**	**(mgd)**	**(mgd)**	**(mgd)**
Artesian Water Co.	2.3	2.8	3.4	3.9	4.5
AWC: DE Correctional Center	1.7	1.7	1.7	1.7	1.7
Tidewater Utilities	1.7	2.1	2.5	2.9	3.3
Middletown	1.7	2.1	2.5	2.9	3.3
Self-Supplied Non-Community Wells	0.3	0.3	0.3	0.3	0.3
Peak Daily Public Water Demand	**7.7**	**9.0**	**10.4**	**11.7**	**13.2**
Individual Wells (0.5% /yr)	1.5	1.5	1.5	1.5	1.6
Potable Peak Daily Demand	**9.2**	**10.5**	**11.9**	**13.3**	**14.7**
Farm Irrigation (wet)	0.8	1.0	1.1	1.3	1.5
Farm Irrigation (dry)	2.7	3.2	3.8	4.4	5.0

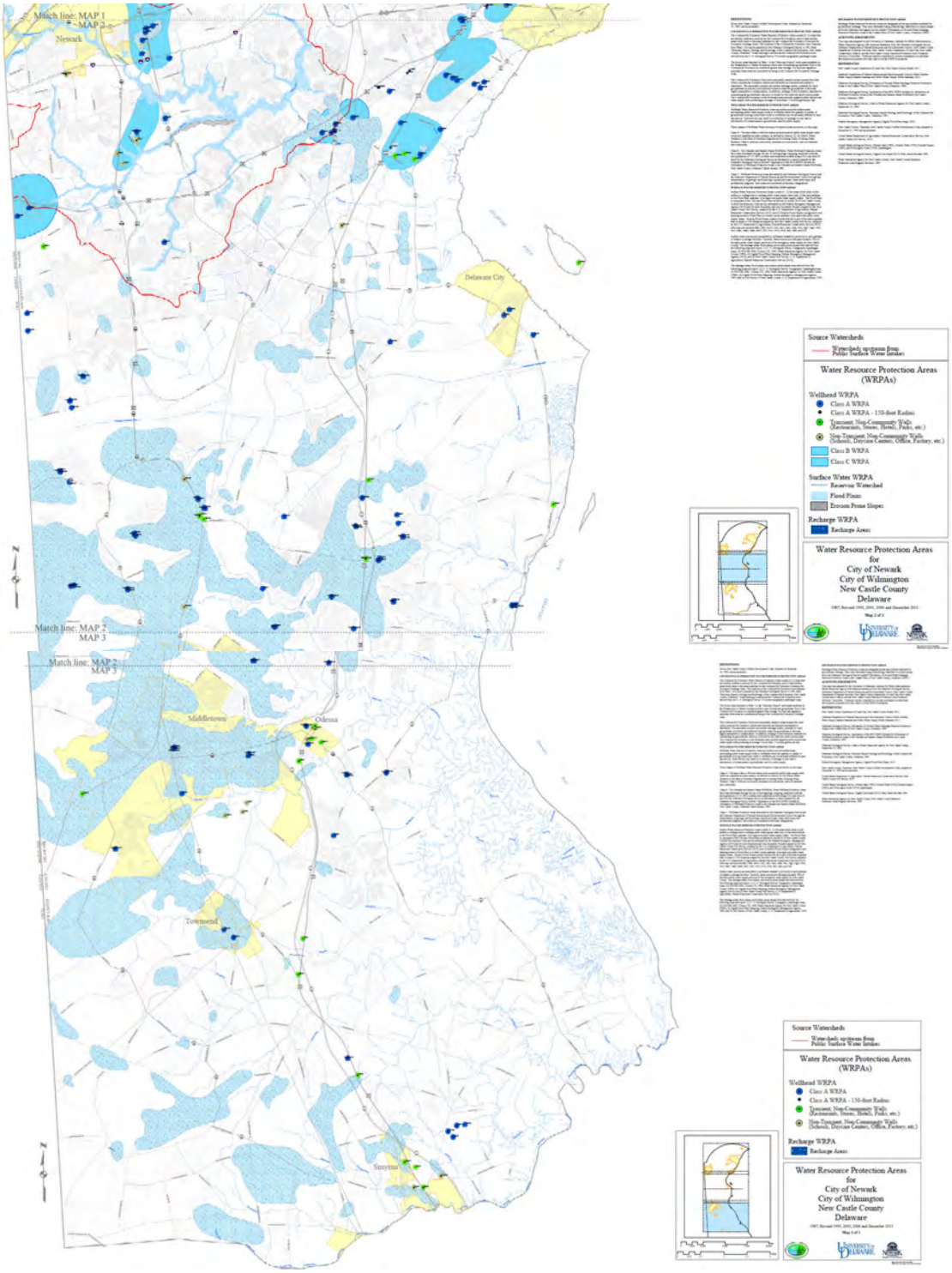

Figure 6. Public water supply wells in southern New Castle County

7. Irrigation Demand

The University of Delaware Cooperative Extension recommends optimum moisture for a high-yield bushel of corn is 20 to 25 inches over a 92-day growing season from June through August. UD agronomy extension specialists report that a crop needs 30 to 40 inches of irrigation plus rain to have moisture for optimal yield of 200 bushels per acre for corn. Delaware Statute Title 7, Del. C., Section 6010 (House Bill 320) signed in August 2003 allows for a maximum yearly irrigation rate of 20 ac-in and maximum monthly rate of 10 ac-in.

The water demand for farm irrigation is projected to continue to rise slightly in southern New Castle County. From 2012 to 2017, the number of farms has declined from 374 to 361 and farmland has increased slightly from 64,169 to 67,455 acres in southern New Castle County while irrigated farmland has increased by 510 acres (Figure 7). At this growth rate, irrigated farmland in southern New Castle County is projected to increase from 5,140 acres in 2017 to 5,446 acres by 2020, 6,466 acres by 2030 and 8,506 acres by 2050

The DGS estimates irrigation use by a KanSched scheduler with weather station evapotranspiration (ET) and precipitation data and mapped irrigated farmland. For a wet case (17 in rain during June-August) and dry case (9 in rain during June-August), farm irrigation demand in 2017 ranges from 0.9 to 3.0 mgd in southern New Castle County on 5,140 acres of irrigated land. At a growth rate of 100 acres of irrigated farm land per year in southern New Castle County, irrigation water demand is projected to grow to 1.0 to 3.2 mgd in 2020, 1.1 to 3.8 mgd by 2020, and 1.5 to 5.0 mgd by 2050 (Table 4).

Table 4. Future irrigation demand in New Castle County, Delaware
(USDA Agriculture Census)

County	2012	2017	% Change ('12-'17)	2020	2030	2040	2050
New Castle County							
Farms (#)	374	361	-3%	351	325	310	295
Farmland (ac)	64,169	67,455	6%	67,455	67,455	67,455	67,455
Irrigated land (ac)	4,630	5,140	10%	5,446	6,466	7,486	8,506
Irrigation, wet (mgd)	0.8	0.9	10%	1.0	1.1	1.3	1.5
Irrigation, dry (mgd)	2.7	3.0	10%	3.2	3.8	4.4	5.0

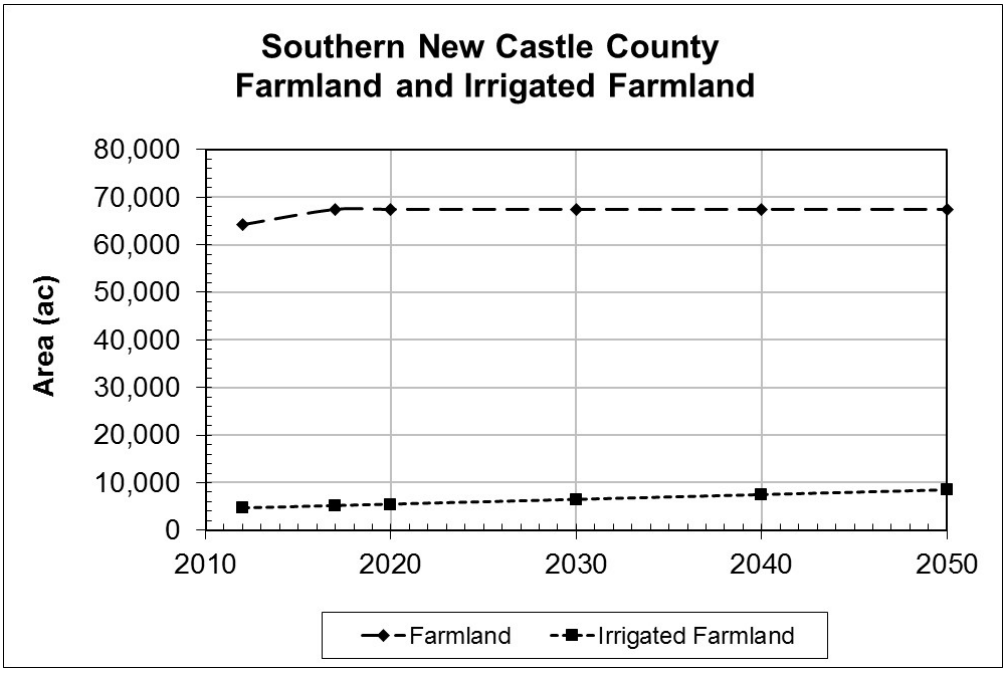

Figure 7. Farmland and irrigated farmland in New Castle County (USDA 2004, 2009, 2014)

Since farm irrigation draws mostly from shallow aquifers and public water supplies pump from deeper aquifers, conflicts between the users can be minimized. Land disposal of treated effluent such as spray irrigation and rapid infiltration basins (RIBS) can be used to recharge and augment availability of groundwater for irrigation uses.

8. Climate Change

Climate change during the 21st century may increase water demands in southern New Castle County. The Delaware Climate Change Impact Assessment (DNREC 2014) concluded that summer maximum temperatures may increase by 3°F from 1981-2010 to 2020-2039 (Figure 8). The assessment also projects that the annual number of days with maximum temperatures greater than 95°F may increase from 2-3 days during 1981-2010 to 15-17 days by 2020-2039.

A review of air temperature data for Wilmington Airport and water demand data in New Castle County indicates that water demand increases by 3% for every 1% increase in maximum air temperature. At 90°F, peak potable water demand was 9.2 mgd during 2010 in southern New Castle County. If summer maximum air temperatures are projected to increase by 3°F by 2020-2039 (or 3/90 = 3.3%), then peak water demand may increase 9.9% to 10.1 mgd by 2020-2039 due to warming. Resources for the Future published a report that concluded a 1% rise in air temperature would increase water demand by as much as 3.8% (Frederick 1997). A study in northeastern Illinois concludes that by 2050, future water demand would increase by 9.1% with an air temperature increase of 6°F or 1.5% for every degree Fahrenheit (Dziegielewsky and Chowdhury 2008).

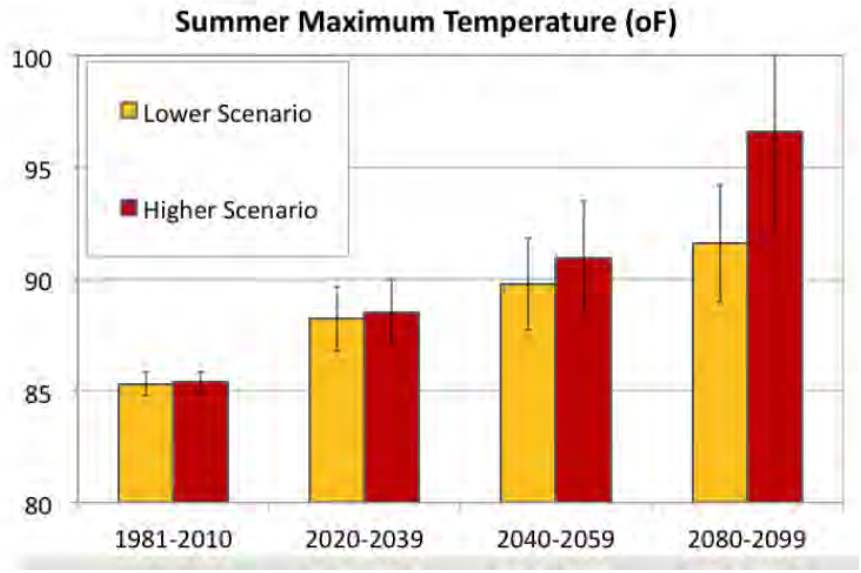

Figure 8. Change in summer maximum temperature in Delaware (DNREC 2014)

Table 5 summarizes future water demands southern New Castle County with and without the effects of a 3°F rise in maximum summer air temperature by 2020-2039. By 2050, projected water demands in southern New Castle County will increase 52% due to population growth and 59% if climate change is accounted for.

Table 5. Future water demands with climate change in southern New Castle County from 2020-2050

Southern New Castle County	**2020 (mgd)**	**2030 (mgd)**	**2040 (mgd)**	**2050 (mgd)**
w/o climate change				
Public Water Demand	7.7	9.0	10.4	11.7
Individual Wells	1.5	1.5	1.5	1.5
Total Potable Demand	9.2	10.5	11.9	13.3
w/ climate change				
Public Water Demand	7.7	9.9	11.4	12.9
Individual Wells	1.5	1.7	1.7	1.7
Total Potable Demand	9.2	11.6	13.1	14.6

Since farm irrigation draws mostly from shallow aquifers and public water supplies pump from deeper aquifers, conflicts between the users can be minimized. Land disposal of treated effluent such as spray irrigation and can be used to recharge and augment availability of groundwater for irrigation uses.

9. Water Supply and Demand

Table 6 compares water supply and demand for public water purveyors for existing (2020) and future (2050) population conditions. In 2020, public water suppliers have existing supplies (15.7 mgd) that exceed peak daily demands (9.0 mgd) thus accounting for a healthy surplus (+6.7 mgd). By 2050, the public water purveyors are projected to have supplies (15.7 mgd) that exceed the forecasted peak daily demand (13.2 mgd) for a surplus of 2.5 mgd. Surplus/deficit calculations are based upon peak daily supplies in accordance with current DNREC water allocation permits. Water purveyors will apply for additional allocations to meet projected demands particularly in the Tidewater Utilities and Middletown service areas. Since this analysis compares peak day supply and demands with average ground-water availability, these projections are conservative and indicate public water purveyors are comfortably equipped to meet future peak water demands by 2050 in southern New Castle County.

Table 6. Water supply and demand in southern New Castle County (2020-2050)

Water Purveyor	Current Max Daily Allocation (mgd)	2020 Peak Day Demand (mgd)	2030 Peak Day Demand (mgd)	2040 Peak Day Demand (mgd)	2050 Peak Day Demand (mgd)	2020 Surplus/ Deficit (mgd)	2030 Surplus/ Deficit (mgd)	2040 Surplus/ Deficit (mgd)	2050 Surplus/ Deficit (mgd)
Artesian Water Co.	8.8	2.8	3.4	3.9	4.5	6.0	5.4	4.9	4.3
AWC: DE Correctional Center	2.1	1.7	1.7	1.7	1.7	0.4	0.4	0.4	0.4
Tidewater Utilities, Inc.	2.7	2.1	2.5	2.9	3.3	0.6	0.2	-0.2	-0.6
Middletown	1.7	2.1	2.5	2.9	3.3	-0.4	-0.8	-1.2	-1.6
Self-Supplied	0.4	0.3	0.3	0.3	0.3	0.1	0.1	0.1	0.1
Public Water Supply	**15.7**	**9.0**	**10.4**	**11.7**	**13.2**	**6.7**	**5.3**	**4.0**	**2.5**
Individual Wells	1.5	1.5	1.5	1.5	1.6	0.0	0.0	0.0	-0.1
Total Potable Water	**17.2**	**10.5**	**11.9**	**13.3**	**14.7**	8.8	2.8	3.4	3.9

The projections (Figure 9) indicate there is sufficient supply (17.2 mgd) to meet projected demand (14.7 mgd) in 2050 from potable water supply in southern New Castle County provided DNREC continues to monitor public water supply and irrigation wells during the summers so as not to diminish the capacity of farmers who wish to remain competitive and sustain agriculture in southern New Castle County.

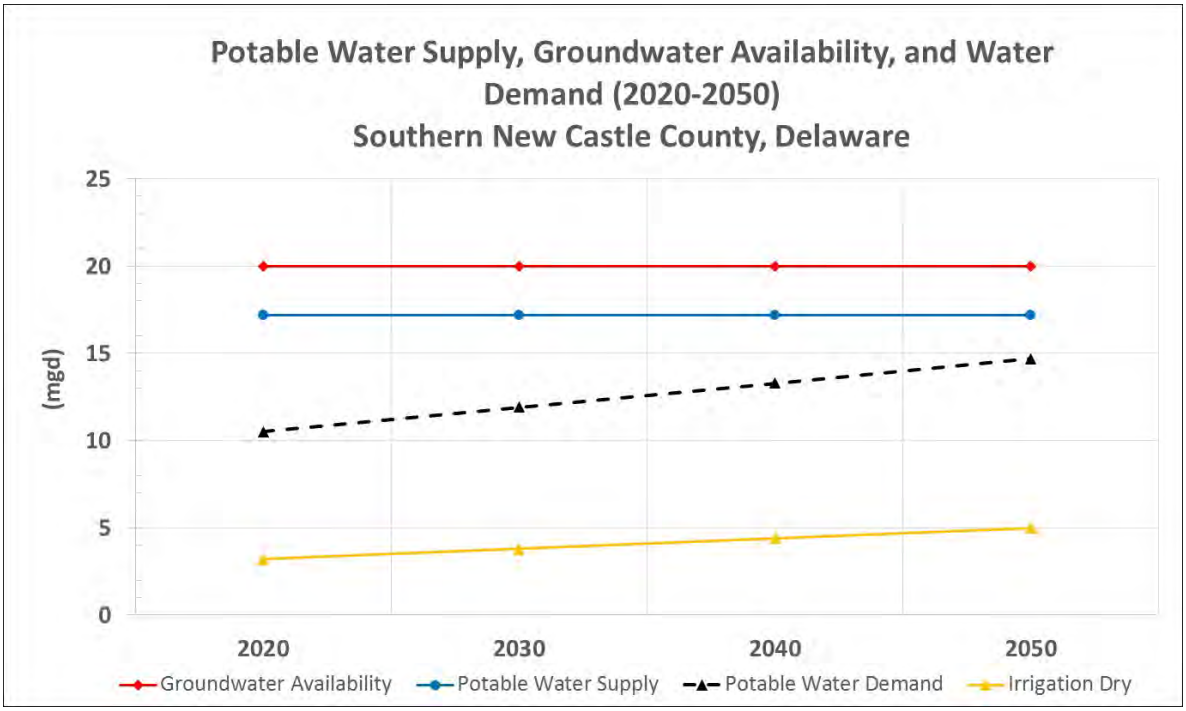

Figure 9. Public water supply and demand in southern New Castle County (2010-2050)

10. Conclusions/Recommendations

To protect the quantity and quality of aquifers that provide sole source drinking water and to manage water supplies by the principles of contiguity and compactness, subdivisions should be served by public water systems rather than by individual wells. The New Castle County Unified Development Code (Section 40.12.115) requires that subdivisions with more than 25 lots should be served by public water systems. New Castle County should work with public water suppliers to hook up public water systems to neighborhoods with more than 25 lots that are presently served by individual wells to bring these areas in to compliance with the UDC.

The population of southern New Castle County is expected to increase by 50% from 61,882 in 2020 to 91,002 by 2050, thus the demand for public water supply is projected to increase at a similar rate. In 2020 there is sufficient ground-water availability to meet peak demands from public water supply uses and by 2050 projections indicate sufficient public water supply to meet peak water demands provided:

- Public water supply and irrigation wells are pumped in accordance with Delaware Department of Natural Resources and Environmental Control (DNREC) water allocation limits. DNREC should continue to monitor demands and water levels from allocated public water supply wells and irrigation wells so as not to diminish the capacity of irrigation wells for producers that wish to sustain farming in southern New Castle County.

- Water purveyors interconnect between and within systems, add new finished water storage and aquifer storage and recovery, and transport water from aquifers with excess availability south of Townsend to growth areas between Middletown/Odessa and the Chesapeake & Delaware Canal (Figure 10).

11. References

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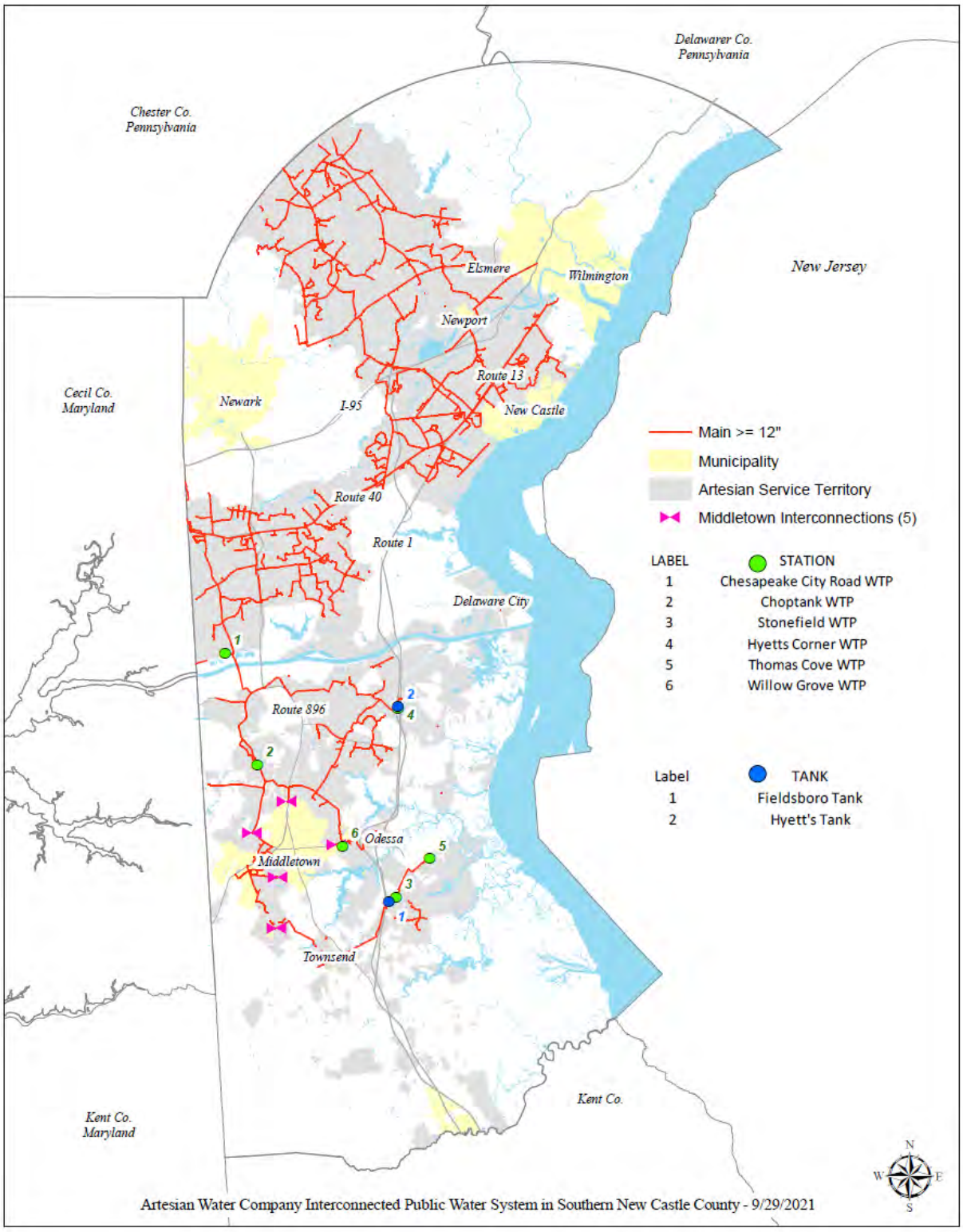

Figure 10. Artesian Water Co. interconnected public water system southern New Castle County (Sep 29, 2021)