Northampton County

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Northampton County Water Supply Plan

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Acronyms Used in the Report

A-N PDC	Accomack-Northampton Planning District Commission
BGS	below ground surface
CWS	community water systems
D0	unusually dry conditions (U.S. Drought Monitor)
D1	moderate drought conditions (U.S. Drought Monitor)
DACS	Department of Agriculture and Consumer Services
DCR	Department of Conservation and Recreation
DEQ	Department of Environmental Quality
DGIF	Department of Game and Inland Fisheries
DHR	Department of Historic Resources
DNH	Department of Natural Heritage
DOF	Department of Forestry
ESA	Endangered Species Act
ESGWMA	Eastern Shore Groundwater Management Area
FT	feet
JPA	Joint Permit Application
MG	million gallons
MGD	million gallons per day
MSL	mean sea level
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
TMDL	total maximum daily load
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
VDMTF	Virginia Drought Monitoring Task Force
VLR	Virginia Landmarks Register
VMRC	Virginia Marine Resources Commission
VPA	Virginia Pollution Abatement
VPDES	Virginia Pollutant Discharge Elimination System
VWPP	Virginia Water Protection Permit
WWTP	Wastewater Treatment Plant

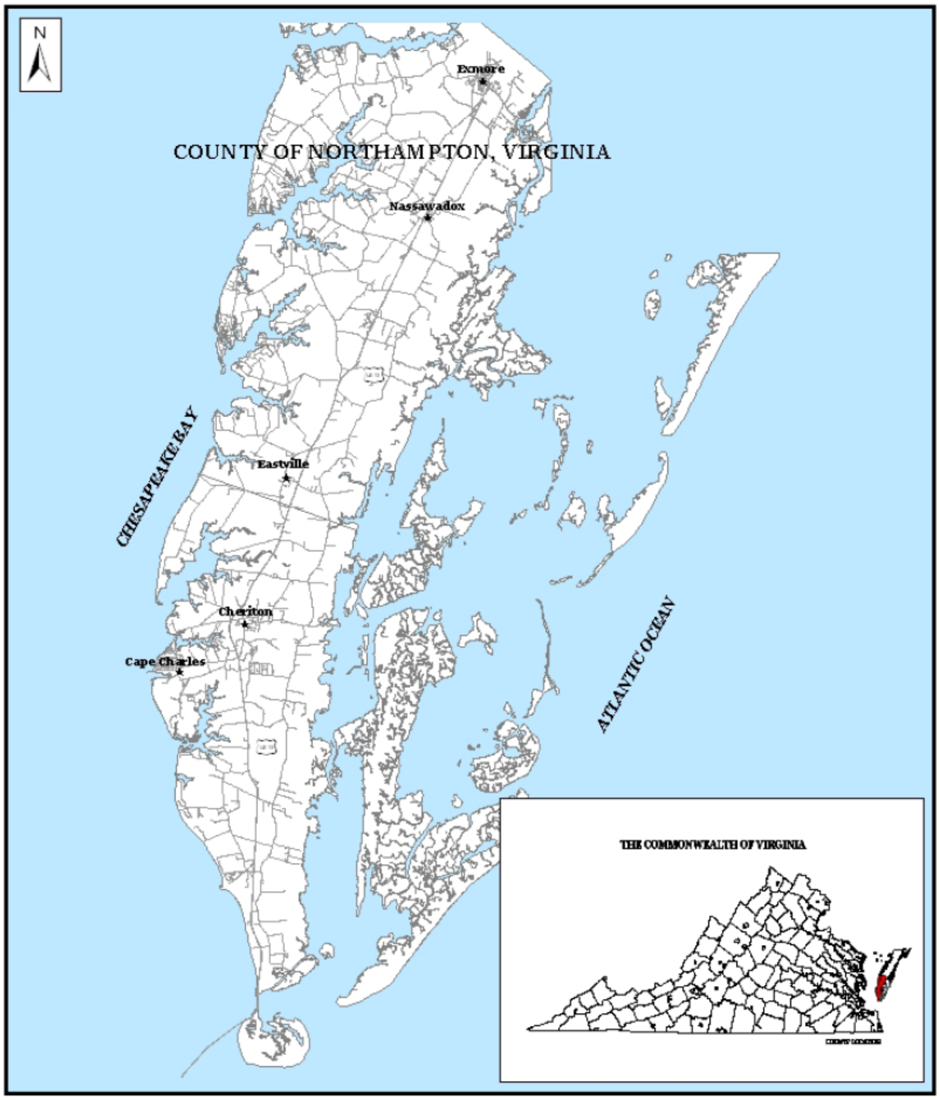
1. Introduction

This report comprises the Water Supply Plan for Northampton County. In 2003, the Virginia General Assembly amended the Code of Virginia to require the development of a comprehensive statewide water supply planning process that would (1) ensure that adequate and safe drinking water is available to all citizens of the Commonwealth, (2) encourage, promote, and protect all other beneficial uses of the Commonwealth's water resources, (3) encourage, promote and develop incentives for alternative water sources. In addition, the General Assembly required that local or regional water supply plans would be prepared and submitted to the Virginia Department of Environmental Quality (DEQ) in accordance with criteria and guidelines developed by the Virginia Water Control Board. The DEQ subsequently develop Local and Regional Water Supply Planning Regulations (9 VAC 25-780) to implement the mandates of the Code. In addition to administering the requirements of 9 VAC 25-780, DEQ has provided assistance for preparing local and regional water supply plans (WSPs) in the form of grants, workshops, and guidance documents.

In 2009, Northampton County commissioned Malcolm Pirnie Inc. to prepare a WSP that meets the requirements of 9 VAC 25-780 with financial assistance from the Accomack-Northampton Planning District Commission (A-N PDC) and from DEQ in the form of a Regional WSP Competitive Grant. All five of the incorporated towns in the County also agreed to participate in the development of the Northampton Regional WSP: Cape Charles, Cheriton, Eastville, Exmore, and Nassawadox.

The first phase of the planning process focused on the collection of water supply and water use information, identification of environmental resources affecting the use and potential development of water supplies, and a projection of future water demand by residential, commercial, industrial and agricultural users. The second phase of the planning process focused on demand management, drought contingency planning, identifying current or future water supply deficits or surpluses, and identifying existing or potential risks to ensuring that adequate water supplies are available for the Planning Region. Where the analysis identified current or future risks to ensuring adequate water supplies, the planning process evaluated alternatives for the enhancement of existing or the development of new water supplies.

Figure 1-1: Northampton Location Map



Source: Northampton Comprehensive Plan, 2009[1].

1.1. Background

Northampton County is composed of the southern portion of the Eastern Shore of Virginia peninsula and its surrounding islands and is situated between the Atlantic Ocean to the East and the Chesapeake Bay to the West and South (Figure 1-1). Northampton County is bordered on the north by Accomack County and connected to mainland of Virginia at Virginia Beach via the Chesapeake Bay-Bridge Tunnel (Route 13).

1.1.1. Water Resources

Northampton County is surrounded on three sides by saltwater and has no streams of any substantial size and therefore has no significant source of surface water and must depend on groundwater as its sole source of drinking water.

Fresh groundwater is present in a series of four major aquifers predominantly comprised of sand, gravel, and shell material. The four major aquifers are present in the majority of the County and are, in order of increasing depth below ground surface, the Columbia (unconfined), and the upper, middle, and lower Yorktown-Eastover (confined) aquifers. Aquifers deeper than the lower Yorktown-Eastover contain salty water which effectively limits their use for most applications and are currently not used as a source of drinking water.

The four freshwater aquifers are generally separated by sedimentary confining units comprised largely of very fine sand, silt, and clay, with each confining unit being named after the underlying aquifer. The entirety of Northampton County (and therefore its aquifers) is located within the Eastern Shore Groundwater Management Area (ESGWMA) as defined by the Virginia Ground Water Management Act of 1992, which requires a permit from DEQ for any person or entity wishing to withdraw in excess of 300,000 gallons per month from a declared GWMA.

The majority of drinking water needs in the County are met through withdrawals from groundwater water wells screened in the (confined) Yorktown-Eastover aquifers, while the rest is met through withdrawals from groundwater wells screened in the (surficial) Columbia aquifer. Groundwater availability in the Columbia Aquifer is characterized by relatively large recharge rates, lower aquifer storage, and a higher susceptibility to contamination; conversely, groundwater availability in the Yorktown-Eastover Aquifers is characterized by relatively low recharge rate, higher aquifer storage and lower susceptibility to contamination.

There are about one dozen tidal creeks in Northampton County, which are largely supplied from groundwater discharge. Although surface water is not used as a source of drinking water in the County, it is an important resource for irrigation water and for shellfish, finfish, and other wildlife habitat.

1.2. Organization of the WSP

The organization of the Northampton County WSP follows the same structure as the WSP regulation (9 VAC 25-780) and is as follows:

Section one consists of the present introductory information.

Section two provides a summary of current information on existing water sources including community water supply systems and self-supplied agricultural and non-agricultural users according to the requirements of 9 VAC 25-780-70.

Section three provides a summary of current water usage in Northampton County for each of the community water supply systems and for agricultural and non-agricultural self-supplied users according to the requirements of 9 VAC 25-780-80.

Section four is divided into two major subsections. The first subsection provides descriptions the geologic, hydrologic, and meteorologic conditions pertaining to the existing water resources of Northampton County according to the requirements of 9 VAC 25-780-90A. The second subsection provides descriptions of the relevant environmental conditions that pertain to or may affect existing water supply sources in the County according to the requirements of 9 VAC 25-780-90B.

Section five provides a description of the methodology and results of future water use projections through to the 2030 planning horizon for community water supply systems and for agricultural and non-agricultural self-supplied users according to the requirements of 9 VAC 25-780-100

Section six provides a description of planned water demand management strategies according to the requirements of 9 VAC 25-780-110.

Section seven provides a summary of drought response and contingency plans including three graduated stages of response for community water supply systems and self-supplied users who withdraw more than an average of 300,000 gallons per month according to the requirements of 9 VAC 25-780-120.

Section eight provides a description of the adequacy of existing sources to meet current and projected water demands, a statement of need based information contained in the preceding sections, and a description of potential alternatives to bridge the gap between existing sources and future demands according to the requirements of 9 VAC 25-780-130.

Sections nine and ten provide a list of conclusions and references, respectively.

2. Existing Water Sources (9 VAC 25-780-70)

This section summarizes water source information for Northampton County, and provides more detailed descriptions of water source information within each of the jurisdictions, in accordance with 9 VAC 25-780-70. The Eastern Shore peninsula contains no major streams or other surface water supplies capable of acting as a potable water supply; therefore, ground water is the primary resource for water needs in Northampton County. This section provides available well information for Community Water Systems and large self-supplied non-agricultural users, as well as a list of large agricultural users, and an estimate of the population served by individual wells using less than 300,000 gallons per month.

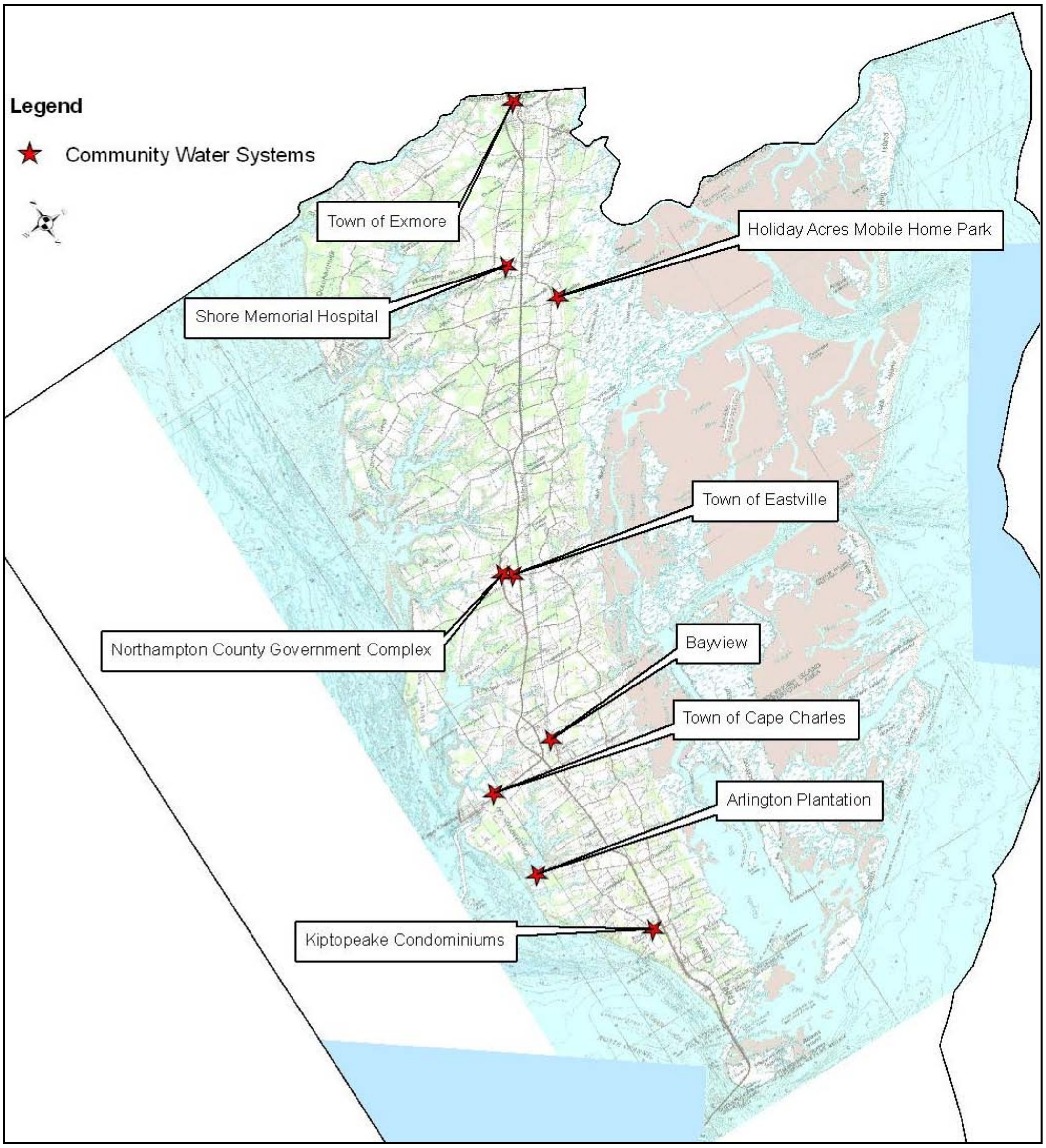
2.1. Community Water Systems

A Community Water System is defined as "a waterworks that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents, and is regulated by the Virginia Department of Health Waterworks Regulation" (12 VAC 5-590). In Northampton County, the following Community Water Systems utilize groundwater to supply their residents:

- Arlington Plantation
- Bayview
- Town of Cape Charles (Cape Charles Municipal Corporation)
- Town of Eastville
- Town of Exmore
- Holiday Acres Mobile Home Park
- Kiptopeake Condominiums
- Northampton County Government Complex
- Shore Memorial Hospital

Groundwater well details (i.e. Well ID, depth, casing and screen depth) are provided in Appendix A. In some cases, specific well information was not readily available after reasonable search and is therefore listed as N/A in the tables in Appendix A. The locations of these Community Water Systems are shown on Figure 2-1. Table 2-1,

Figure 2-1: Community Water Systems in Northampton County



below, summarizes the VDEQ permitted annual and maximum monthly withdrawals, as well as the VDH permitted capacities of the Community Water Systems in the County.

Table 2-1:
Northampton County CWS: Permitted Withdrawals

	VDEQ Permitted Withdrawals		
WATER SYSTEM NAME	Total Annual Withdrawal (MG)	Max. Monthly Withdrawal (MG)	VDH Permitted Capacity (GPD)
ARLINGTON PLANTATION			19,600
BAYVIEW			29,000
CAPE CHARLES, TOWN OF	252.2	25.3	360,000
EASTVILLE, TOWN OF	23.7	2.9	150,000
EXMORE, TOWN OF	60.8	9.92	400,000
HOLIDAY ACRES MOBILE HOME PARK			22,500
KIPTOPEAKE CONDOMINIUMS			
NORTHAMPTON COUNTY GOVERNMENT COMPLEX	16.206	2.03	19,600
SHORE MEMORIAL HOSPITAL	37.11	3.64	173,200

There are no community water systems supplied by surface water in Northampton County.

2.2. Purchased Water Source

No community water systems in Northampton County purchase water from outside of the County. Availability of water for community purchase outside of the County region was not evaluated as part of this water supply plan because the primary source of water in the County is groundwater, which typically serves the population in the immediate area.

2.3. Large Self-Supplied Users

Non-community water systems, or self-supplied users, of greater than 300,000 gallons per month are categorized into non-agricultural and agricultural users. The following sections provide information regarding the large self-supplied users in Northampton County. The majority of large self-supplied users in the County use groundwater as their primary source, however some agricultural users utilize surface water sources.

2.3.1. Non-Agricultural Large Self-Supplied Users

All non-agricultural large self-supplied users in Northampton County utilize groundwater as their primary source. The four large non-agricultural self supplied users of more than 300,000 gallons of groundwater per month that were identified in the County are as follows:

- Bayshore Concrete Products of Cape Charles
- Best Western Sunset Beach Resort
- Cherrystone Family Camping Resort
- YMCA Family Campground

Groundwater well details (i.e. Well ID, depth, casing and screen depth) are provided in Appendix B. In some cases, specific well information was not readily available after reasonable search and is therefore listed as N/A in the tables in Appendix B. Table 2-2 summarizes the VDEQ permitted annual and maximum monthly withdrawals, as well as the VDH permitted capacities for the large, non-agricultural self-supplied users of groundwater in the County.

Table 2-2:
Non-Agricultural Large Self-Supplied Users: Permitted Withdrawals

WATER SYSTEM NAME	VDEQ Permitted Withdrawals		VDH Permitted Capacity (GPD)
	Total Annual Withdrawal (MG)	Max. Monthly Withdrawal (MG)	
Bayshore Concrete Products Corp Cape Charles	27.70	2.80	124,000
Best Western Sunset Beach Resort	7.65	1.42	
Cherrystone Family Camping Resort	11.10	3.31	
YMCA Family Campground	5.50	1.10	30,000

2.3.2. Agricultural Large Self Supplied Users

Agriculture is the dominant land use in Northampton County, and groundwater is the primary source of irrigation for crops, nurseries and livestock operations. In some cases, groundwater is used to refill irrigation ponds. Some agricultural users utilize surface water for irrigation purposes, and both use types will be discussed in the following sections.

2.3.2.1. Groundwater Sources

A total of nineteen large agricultural self-supplied users were identified in the County that use more than 300,000 gallons per month of groundwater for irrigation. Table 2-3 lists the large agricultural groundwater users in the County, as well as the annual and monthly permitted withdrawal amounts for each user. As shown in this table, the total permitted agricultural groundwater use in the County is 575.6 million gallons (MG) per year.

Table 2-3.
Large Self-Supplied Agricultural Users of Groundwater

	Annual Permitted Withdrawal (gallons)	Monthly Permitted Withdrawal (gallons)
FACILITY/SYSTEM NAME		
Belote Farm	16,200,000	6,000,000
C and H Farms Incorporated	15,300,000	4,000,000
David's Nursery	150,000,000	25,000,000
Edgehill Farm	7,300,000	1,000,000
Edgewater Farm	13,400,000	6,000,000
Grapeland Farm	31,100,000	14,600,000
Guy Produce Farms	24,800,000	5,500,000
Herbert Nottingham Farm (Cheapside)	10,650,000	3,500,000
Holly Grove Farm	12,960,000	4,320,000
Holts Neck Farm	23,000,000	8,000,000
James Wharf Farm	17,000,000	4,300,000
Lumber Hall Farm	51,400,000	8,300,000
Machipongo Farm	48,800,000	14,100,000
Marshall/Johnson Farm	36,100,000	14,700,000
Midwood Farm	22,800,000	8,000,000
Silver Beach Farm	5,500,000	1,000,000
Tankard Farm	52,000,000	9,000,000
Twin Cedar Farms	22,100,000	10,200,000
Wyatt Farm	15,200,000	4,000,000
Total Permitted Withdrawals (MG)	**575.61**	**151.52**

2.3.2.2. Surface Water Sources

A number of farms and nurseries in the County utilize surface water sources such as ponds for irrigation. While these withdrawals are not permitted by the state, they are required to report their surface water withdrawals. Table 2-4 lists the large agricultural self-supplied users of surface water in the County, as well as the average annual reported use between 2001 and 2006.

Table 2-4.
Large Self-Supplied Agricultural Users of Surface Water

USER NAME	2001-2006 Average Annual Use (MG)
BLACK FARMS	35.20
CHERITON FARMS	2.85
CHEROKEE POINT FARMS	4.32
DAVIDS NURSERY	7.03
HERMITAGE FARMS NURSERY	16.69
KELLAM FARM	12.00
MIDWOOD FARM	4.99
NOTTINGHAM ENTERPRISES INC	16.50
WAYNE T HEATH FARMS INC	16.20
YAROS FARMS INC	289.83

2.4. Small Self-Supplied Users

The Water Supply Planning regulations require that a water plan shall include an estimate of the number of residents and business that are self-supplied by individual wells withdrawing less than 300,000 gallons per month and an estimate of the population served by individual wells" (9 VAC 25-780-70.J).

The estimate of small self-supplied residential users is 9,189 persons. This estimate was developed by subtracting total population served by the Community Water Systems (see Section 3.0) from the estimated 2008 population in Northampton County (as reported in the Northampton County Comprehensive Plan, Part 2, Table 3.3):

County Population – CWS Population Served = Population served by individual wells
(13,517 – 4,328 = 9,189 persons)

For planning purposes, it was assumed than an average of 2.39 persons occupy a residence (based on 2000 estimates, Northampton County Comprehensive Plan); therefore, based on a population served of 9,189 persons, there are an estimated 3,845 small, self supplied residential wells.

Estimating the number of businesses that are self-supplied by groundwater in the County is a bit more difficult. A review of the VDH groundwater permit holders in the County showed that a total of ten non-transient, non-community small users and 29 transient non-community small users rely on groundwater as their primary water source. Table 2-5 contains a list of the transient and non-transient small self-supplied businesses, along with the population served and the water system ID number.

Table 2-5:
Small Self-Supplied Groundwater Users and Population Served

	Population Served	Water System ID
NON-TRANSIENT, NON-COMMUNITY		
BROADWATER ACADEMY	456	VA3131095
CHERITON MIGRANT HEAD START	80	VA3131137
CHESAPEAKE BAY BRIDGE TUNNEL	25	VA3131150
EASTERN SHORE PHYSICIANS & SURGEONS	40	VA3131325
FOOD LION-CAPE CHARLES	90	VA3131220
HARE VALLEY ESAAA/CAA	190	VA3131290
KIPTOPEKE ELEMENTARY SCHOOL	700	VA3131375
NORTHAMPTON COUNTY COMMUNITY FACILITIES	61	VA3131555
OCCOHANNOCK ELEMENTARY SCHOOL	549	VA3131875
STING-RAY`S RESTAURANT	96	VA3131118
TRANSIENT, NON-COMMUNITY		
AMERICAN LEGION POST #400	100	VA3131005
BAYVIEW COMMUNITY HEALTH CENTER	50	VA3131060
BEST VALUE INN (NASSAWADOX)	420	VA3131042
BURROUGHS & BURROUGHS (LANKFORD HIWAY)	46	VA3131100
CAPE MOTEL	36	VA3131124
CURTIS H JONES & SON INC MLC	40	VA3131350
DO-DROP INN	50	VA3131160
EASTERN SHORE NATIONAL WILDLIFE REFUGE	25	VA3131122
EASTVILLE AREA HEADQUARTERS	40	VA3131180
EDGEWOOD MOTEL	30	VA3131205
FRANKTOWN COMMUNITY HEALTH CENTER	99	VA3131155
GREAT MACHIPONGO CLAM SHACK	55	VA3131390

	Population Served	Water System ID
HARDEE`S (CAPE CHARLES)	70	VA3131288
HEATH-KELLAM MLC	28	VA3131760
J.H. WEST SEAFOOD, INC.	32	VA3131920
KIPTOPEAKE INN	100	VA3131302
KIPTOPEKE STATE PARK	555	VA3131373
KIPTOPEKE STATE PARK - CABINS	112	VA3131374
KUZZENS (KMC)	363	VA3131855
KUZZENS (P C KELLAM MLC)	52	VA3131359
LITTLE ITALY PIZZA & DELI	76	VA3131372
MCDONALD`S (CAPE CHARLES)	58	VA3131391
PACIFIC TOMATO GROWERS (CARPENTER MLC)	36	VA3131121
PACIFIC TOMATO GROWERS (EASTVILLE MLC)	74	VA3131216
PEACOCK MOTOR INN	40	VA3131610
RITTENHOUSE MOTOR LODGE	25	VA3131720
ROCK`N ROBIN`S	77	VA3131097
THOMAS B. LONG JR. MLC	50	VA3131371
UVA LONG TERM ECOLOGICAL RESEARCH CENTER	40	VA3131857

Source: USEPA Envirofacts SDWIS (Query 2-22-2010)

2.5. Source Water Assessment Plans or Wellhead Protection Programs

The Eastern Shore of Virginia was designated a Ground Water Management Area in 1976 and any withdrawal of 300,000 gallons per month or more in this area requires a ground water withdrawal permit from DEQ. At the local level, the Eastern Shore of Virginia Ground Water Committee was formed in 1990 to assist local governments and residents in understanding, protecting and managing the ground water resource. The Ground Water Supply Protection and Management Plan for the Eastern Shore of Virginia (1992) provides the basis and guidelines for protecting the ground water resource. In addition to the Ground Water Committee, the two counties have adopted provisions in their ordinances that provide protection to the ground water resource. In November 1998, Accomack County passed an ordinance that includes provisions specific to ground water resource protection. In June 2003, Northampton County passed an ordinance requiring that certain new developments implement specific measures designed to protect and preserve the water resource (Source: http://www.a-npdc.org/groundwater).

3. Existing Water Use (9 VAC 25-780-80)

This section will describe the existing water use in Northampton County, in accordance with the provisions of 9 VAC 25-780-80. Water use is broken down into the following user categories:

- Community Water Systems – including residential use, commercial institutional and light industrial use, heavy industrial use, military use, water production, unaccounted for water losses, and sales to other community water systems.
- Self-Supplied Non-Agricultural Users of more than 300,000 gallons per month
- Self-Supplied Agricultural Users of more than 300,000 gallons per month
- Self-Supplied Users of less than 300,000 gallons per month

Information contained in this section was derived from a number of sources including 2009 VDH waterworks permit/water use reports, individual groundwater permit applications and VDEQ data.

3.1. Community Water Systems

The following information is required for all Community Water Systems (CWS), as stated in 9 VAC 25-780-80.B:

- Population within CWS service area
- Number of connections within CWS service area
- Average and maximum daily withdrawal for each CWS
- The amount of water used within the CWS service area on an average annual basis and on an average monthly basis
- The peak daily use by month
- Disaggregated estimates of water use by different user types (i.e. residential, commercial institutional and light industrial, heavy industrial, etc).

Table 3-1 contains the population and current number of service connections within the service area of each CWS, as reported by VDH. The total population served by

Community Water Systems in Northampton County is 4,328 across 2,123 service connections.

Table 3-1.
Community Water System Service Area Connections and Population

	No. of Service Connections	Service Area Population
WATER SYSTEM NAME		
ARLINGTON PLANTATION	16	30
BAYVIEW	80	160
CAPE CHARLES, TOWN OF	1,113	1,134
EASTVILLE, TOWN OF	161	210
EXMORE, TOWN OF	689	2,000
HOLIDAY ACRES MOBILE HOME PARK	39	80
KIPTOPEAKE CONDOMINIUMS	17	30
NORTHAMPTON COUNTY GOVERNMENT COMPLEX	4	64
SHORE MEMORIAL HOSPITAL	4	620
TOTAL	**2,123**	**4,328**

Historical use for Community Water Systems was extracted from several sources. Total annual use (MG), average daily use and average monthly use was calculated for use reported to the VDEQ between 2003 and 2009 for the following CWS:

- Town of Cape Charles
- Town of Eastville
- Town of Exmore
- Shore Memorial Hospital

Tables 3-2, 3-3 and 3-4 present the total annual use, average daily use, and average monthly use, respectively.

Table 3-2:
VDEQ-Reported Total Annual Use (MG): CWS

	2003	2004	2005	2006	2007	2008	2009
Community Water Systems							
Cape Charles, Town of	48.31	53.52	57.12	57.38	48.42	41.02	30.77
Eastville, Town of	18.69	16.54	16.33	17.09	18.31	17.40	16.80
Exmore, Town of	60.62	61.32	60.54	58.01	48.78	49.78	40.54
Shore Memorial Hospital	30.50		28.95	30.56	30.51	27.22	20.19

Table 3-3:
VDEQ-Reported Average Daily Use (MGD): CWS

	2003	2004	2005	2006	2007	2008	2009
Community Water Systems							
Cape Charles, Town of	0.132	0.147	0.156	0.157	0.133	0.112	0.084
Eastville, Town of	0.051	0.045	0.045	0.047	0.050	0.048	0.046
Exmore, Town of	0.166	0.168	0.166	0.159	0.134	0.136	0.111
Shore Memorial Hospital	0.084		0.079	0.084	0.084	0.075	0.055

Table 3-4:
VDEQ-Reported Average Monthly Use (MG): CWS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Community Water Systems												
Cape Charles, Town of	2.05	1.66	1.80	1.85	2.17	2.30	2.61	2.42	2.14	2.09	1.91	1.87
Eastville, Town of	1.37	0.90	1.07	0.99	1.16	1.15	1.20	1.29	1.17	1.16	1.02	0.87
Exmore, Town of	2.30	2.02	2.16	2.15	2.34	2.61	2.77	2.63	2.43	2.33	2.09	2.24
Shore Memorial Hospital	1.11	0.99	1.10	1.10	1.25	1.35	1.42	1.52	1.27	1.26	1.13	1.09

3.1.1. Holiday Acres Mobile Home Park

Recent water use records were not available for Holiday Acres Mobile Home Park. VDH monthly water use records were available for 1998 - 2002. The total average annual use over this time period was 3.02 MG per year, with an average daily withdrawal of 0.01 MGD (Table 3-5). The average monthly use is presented in Table 3-6, which shows a maximum monthly withdrawal of 0.328 MG in the month of July.

Table 3-5:
VDH-Reported Total Annual and Average Daily Use: Holiday Acres MHP

	1998	1999	2000	2001	2002	Average
Total Annual Use (MG)	2.71	2.52	3.35	3.43	3.11	2.71
Average Daily Use (MGD)	0.007	0.007	0.009	0.009	0.009	0.007

Table 3-6:
VDH-Reported Average Monthly Use (MG): Holiday Acres MHP

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Average Monthly Use (MG)	0.251	0.265	0.223	0.304	0.228	0.311	0.328	0.288	0.293	0.259	0.284	0.207

3.1.2. Northampton County Government Complex

While water use records were not available for the Northampton County Government Complex, according to groundwater withdrawal permit documentation, the average monthly maximum withdrawal is estimated to be 1.086 MG, while the peak monthly withdrawal is 1.120 MG (during landscaping season).

Water use records were not available for the following Community Water Systems in Northampton County:

- Arlington Plantation
- Bayview
- Kiptopeake Condominiums

Maximum day and peak day water use by month data were not available for any of the Community Water Systems in the County. Water use records are reported to the VDEQ and VDH on a monthly basis, so peak day use is not able to be calculated using existing records.

There are no large, self-supplied non-agricultural or agricultural users of groundwater or surface water within the service areas of the Community Water Systems. All users within the service area boundaries rely on water supplied by the CWS.

According to information available through VDEQ groundwater withdrawal permits, the primary use type for Community Water Systems in the County is residential use, with the exception of the Town of Exmore (18% of use in the Town is Commercial use). It is assumed that Unaccounted for Water Losses are present in each CWS; however, precise estimates of this use were not readily available.

3.2. Large Self-Supplied Non-Agricultural Users

In accordance with 9 VAC 25-780-80.C, this section provides an estimate of the water used on an average annual basis by all self-supplied non-agricultural users (outside of the Community Water System service areas) of more than 300,000 gallons per month of surface water and groundwater. As discussed earlier, all large self-supplied non-agricultural users in Northampton County rely on groundwater for their water supply needs. Based on VDEQ reported withdrawals, the four large-self supplied groundwater users in the County used a total of 9.98 MG in 2009, which was down from the previous six years of use. Table 3-7 presents the total annual use (in MG) reported to the VDEQ between 2003 and 2009.

Table 3-7:
Total Annual Use by Large-Self Supplied Non-Agricultural Groundwater Users

	2003	2004	2005	2006	2007	2008	2009
SELF-SUPPLIED NON-AGRICULTURAL USERS							
Bayshore Concrete Products Corp Cape Charles	3.59	3.57	3.34	2.13	1.64	2.50	1.36
Best Western Sunset Beach Resort	4.06	3.85	4.63	3.54	3.66	2.96	1.87
Cherrystone Family Camping Resort	6.89	6.55	6.66	5.25	7.11	4.67	3.98
YMCA Family Campground	2.02	2.41	3.20	3.22	4.27	2.88	2.76
Total (MG)	**16.57**	**16.39**	**17.84**	**14.13**	**16.69**	**13.02**	**9.98**

3.3. Large Self-Supplied Agricultural Users

In accordance with 9 VAC 25-780-80.D, this section provides an estimate of the water used on an average annual basis by all self-supplied agricultural users (outside of the Community Water System service areas) of more than 300,000 gallons per month of surface water and groundwater. Average annual surface water use by agricultural large self-supplied users was presented previously in Table 2-4. These use estimates were calculated as the average annual use between 2001 and 2006, based on withdrawals reported to the VDEQ.

Table 3-8 presents the total annual groundwater withdrawals that were reported to the VDEQ between 2003 and 2008 by large, self-supplied agricultural users in the County.

Table 3-8:
Total Annual Use by Large-Self Supplied Agricultural Groundwater Users

Agricultural User	2003	2004	2005	2006	2007	2008
Belote Farm	2,160,000	1,260,000	8,280,000	3,888,000	15,516,000	2,160,000
C and H Farms						
David's Nursery	75,142,000	65,560,000	74,184,000	83,045,000	100,187,000	44,207,000
Edgehill Farm	2,808,000	2,851,200	2,818,800	1,879,200	2,095,200	766,800
Edgewater Farm	154,000	2,890,000	344,000	3,030,000	10,590,000	5,960,000
Grapeland	86,335	447,282	726,638	598,256	30,050,459	13,254,900
Guy Produce Farm	2,909,700	4,481,300	287,300			
Herbert Nottingham Farm		2,500,000				
Lumber Hall Farm	43,119,050	41,473,030	45,232,730	40,175,260	39,420,120	13,540,330
Machipongo Farm					6,000	6,000
Marshall/Johnson Farm	4,778,500	21,705,700	1,185,582	1,042,749	33,367,415	9,834,600
Midwood Farm	791,610	652,590	4,949,080	836,700	2,105,890	2,939,790
Silver Beach Farm	1,195					
Tankard Farm		1,748,500	5,336,700	3,231,500	16,891,900	7,080,600
Twin Cedar Farm	172,600	1,102,425	169,033	1,237,386	32,517	8,392
Wyatt Farm	1,190,000				6,600,000	

3.4. Small Self-Supplied Use Outside of the Community Service Areas

In accordance with 90 VAC 25-780-80.E, this section contains an estimate of water use by small self-supplied users of groundwater that are outside of the Community Service Areas. This use includes residential and business and is calculated as follows:

- Residential Use: Estimate of Population Served by Individual Wells * Average Per Capita Use Rate of 75 gpcd
    - 9,189 persons * 75 gpcd = 0.69 MGD

- Business Use: Estimate of Total Population Served (as presented in Table 2-5) * Average Per Capita Use Rate
  - 5,066 persons served * 50 gpcd = 0.25 MGD

- Total Small Self-Supplied Use: Residential Use plus Business Use
  - 0.69 MGD + 0.25 MGD = 0.94 MGD

4. Existing Water Resource Conditions (9 VAC 25-780-90)

This section is divided into two parts, which contain: 1) a description of the physical environment pertaining to the geologic, hydrology, and meteorological conditions in Northampton County and 2) a description of existing environmental conditions that pertain to, or may affect sources that provide the current supply in fulfillment of requirements of 9 VAC 25-780-90. Potential environmental resource issues pertaining to new water supplies are discussed Section **Error! Reference source not found.**. Special attention is given to the potential effects of water usage on current environmental conditions and to mitigating strategies and which reduce or avoid such potential effects.

4.1. Physical Environment

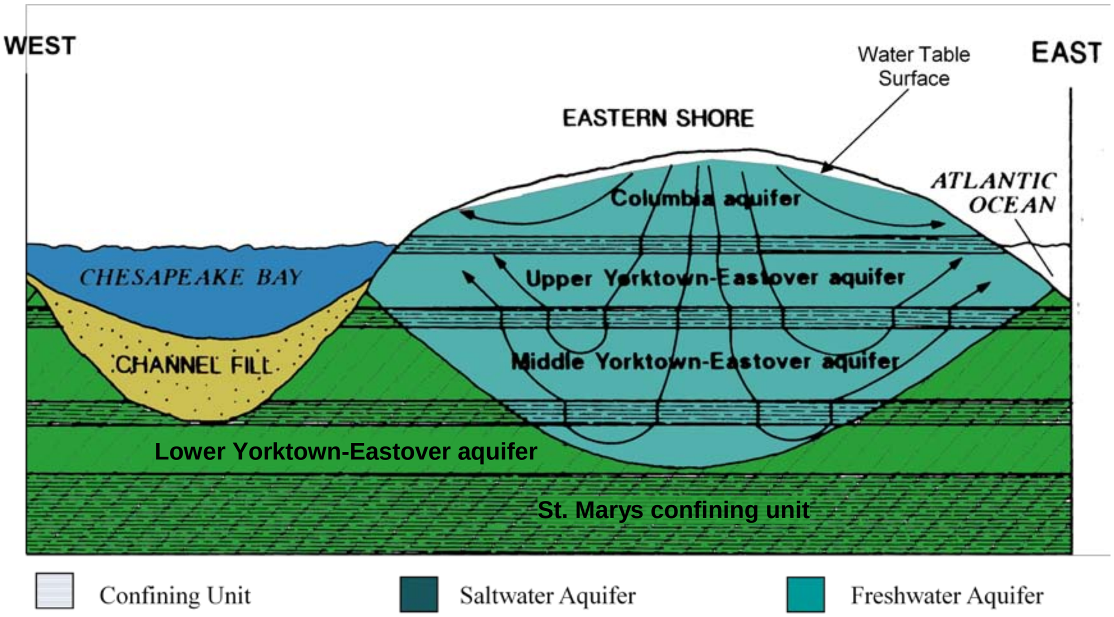
4.1.1. Geologic/Hydrogeologic Setting

There have been a substantial number of local and regional studies on the geologic and hydrologic characteristics of the sediments on the Eastern Shore of Virginia and adjacent areas of Maryland. Many of these studies have dealt principally with geologic descriptions of the formational units. The geology of the Eastern Shore consists of unconsolidated deposits of interbedded clay, silt, sand, and gravel, with variable amounts of shell material. These deposits thicken and slope eastward, and form a system of layered aquifers and confining units. The total sediment thickness ranges from approximately 2,000 feet in the western areas to as much as 7,000 feet to the east[2]. These sediments generally overlie a bedrock basement that also dips northeastward.

The aquifers are comprised of sand, gravel, and shell material, and confining units are comprised of clay and silt and are divided into the unconfined Columbia aquifer (water table aquifer), and a series of confined aquifers and intervening semi-confining units (Figure 4-1). The low permeability confining units restrict downward ground water movement. The confined aquifers, in order of increasing depth, are: Yorktown-Eastover (includes upper, middle, and lower Yorktown aquifers), St. Marys Choptank aquifer, Brighteast aquifer, and upper, middle, and lower Potomac aquifers. Fresh ground water generally occurs only in the upper 300 feet of sediments and at shallower depths along the coastlines of the Easter Shore and is limited to the Columbia and Yorktown aquifers.

These aquifers have been designated by the EPA as the sole source aquifers for the entirety of Northampton County and the majority of Accomack County to the North.

Figure 4-1: Conceptual Groundwater Flow System of the Virginia Eastern Shore



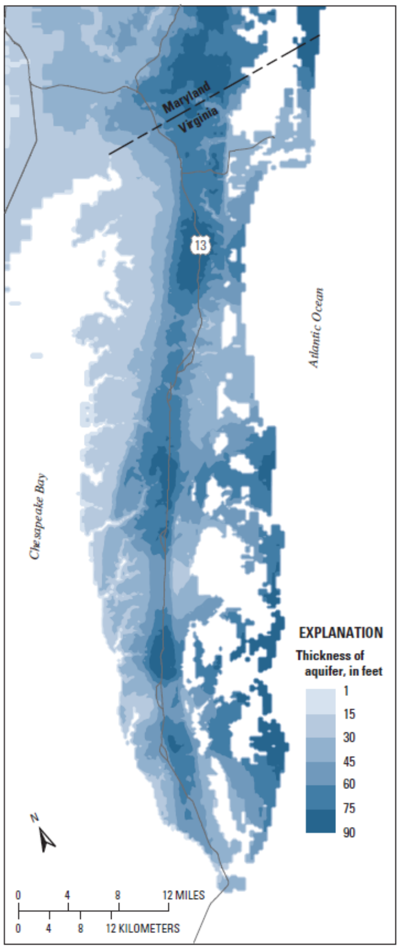
Source: Richardson, 1992[3].

The Columbia and Yorktown aquifers consist of a sequence of sandy units separated by fine-grained facies, which are predominately fine sandy silts and clayey fine sands. The confining units separating the aquifers are leaky, and there is significant ground water flow through these layers. Flow through the confining units is the sole source of recharge for the Yorktown aquifer in the Eastern Shore of Virginia. Within the individual aquifers there commonly exist discontinuous silty and clayey layers that locally serve to restrict vertical flow.

4.1.1.1. Columbia Aquifer

The Columbia aquifer is the uppermost aquifer and is unconfined over most of the area. Sediments comprising this aquifer unconformably overlie the Yorktown aquifers, and are in turn, unconformably overlain by Holocene sediments. Aquifer properties are primarily dependent on lithology and thickness of the water producing sands, gravels and shell materials. Thickness of the Columbia aquifer and depth to water vary with topography.

Figure 4-2: Thickness of the (surficial) Columbia Aquifer



Source: Sanford, et al, 2009[2]

Beneath most of the Eastern Shore of Virginia, thickness of the Columbia aquifer generally ranges from 20 feet near the coast to 60 feet inland (Figure 4-2). Thickness near the central corridor of the Eastern Shore can exceed 100 feet in some areas, and depth to ground water is typically within 10 feet of the surface. To the northwest, the Columbia aquifer generally does not exceed 20 feet in thickness, and to the south and east, the aquifer thickness typically ranges from 40 to 140 feet.

The principal water-bearing unit for the Columbia aquifer on the Eastern Shore of Virginia is generally comprised of Beaverdam Sand. The thickness of the Beaverdam Sand typically ranges between 15 and 30 feet on the Eastern Shore, and in some local areas is has been eroded and replaced by younger channel deposits.

Overlying the Beaverdam Sands are generally discontinuous sand and silt units interbedded with silty and clayey units that serve as local sources of ground water. These sediments include the Walston Silt, the Omar Formation, the Ironshire Formation, the Parsonburg Sand, and the Sinepuxent Formation.

Transmissivities reported for the Columbia aquifer range from 100 to 50,000 ft^2/day. On the Eastern Shore of Virginia, transmissivities are somewhat lower, typically ranging between 1,000 and 4,000 ft^2/day. The general increase in transmissivity to the north appears to be a function of both increasing thickness and increasing hydraulic conductivity.

Water levels in the Columbia aquifer on the Eastern Shore are generally subparallel to surface topography. The highest elevations on the Eastern Shore are along the central ridge, with maximum elevations of +30 to +45 feet (ft) above mean sea level (msl) in the central portion of the peninsula decreasing toward the coastline to approximately +10 ft msl near the tidal marshes. Overall, it appears that depth to ground water is between 10 and 20 ft below ground surface (bgs) for the upland areas and 5 to 10 ft bgs beneath the lower terrace deposits. Ground water from the Columbia aquifer is not used for any single large withdrawals on the Eastern Shore, therefore there are not any mappable cones of depression in this aquifer. However, the Columbia aquifer is extensively used as a supply source for self-supplied domestic, smaller non-domestic, and irrigation water demands.

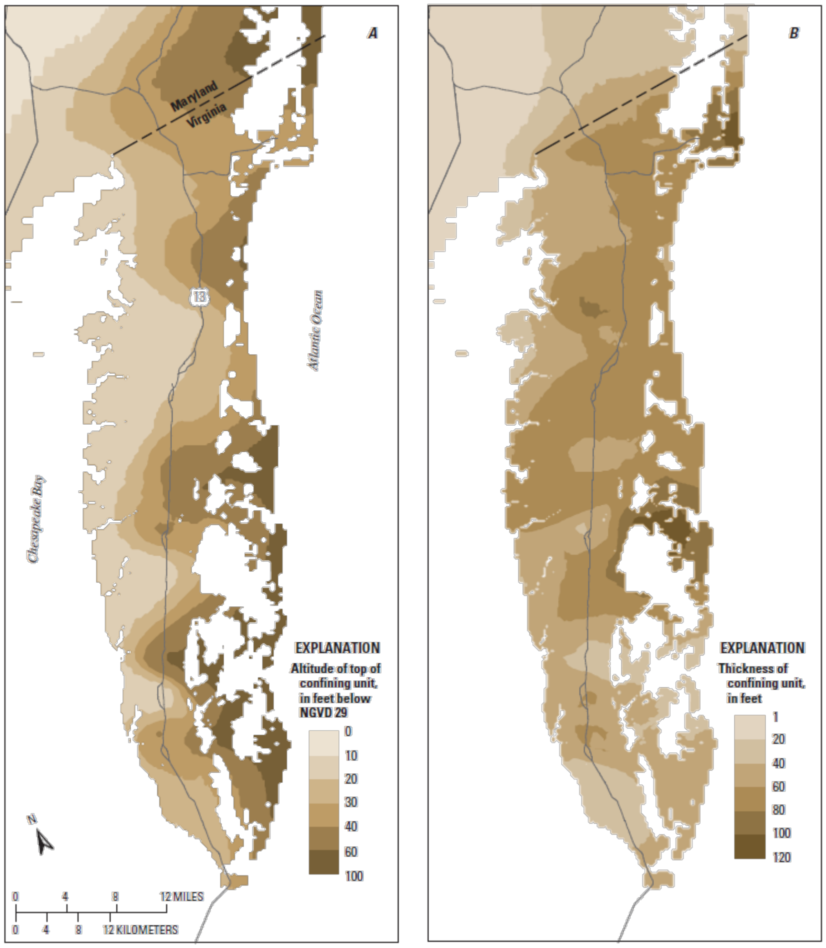
The Columbia aquifer on the Eastern Shore subcrops into the Chesapeake Bay to the west and Atlantic Ocean to the east. Where it subcrops, freshwater discharges directly from the aquifer into the estuarine and ocean water, respectively.

4.1.1.2. Upper Yorktown Confining Unit

The upper Yorktown confining unit consists predominately of marine fine sandy silt with some clay and averages 15 to 30 ft thick (Figure 4-3). These sediments are for the most part reworked sediments from the upper Yorktown Formation and may locally contain fluvial silts and clays. The upper Yorktown confining unit typically consists of a sequence of lenticular interbedded silts, clays, and fine sands and is not massive. In some locations, sandy channel deposit shave breached the confining unit and cut into the underlying upper Yorktown aquifer. There are two such paleochannels on the Eastern Shore of Virginia located near Exmore and Eastville. While this unit is aerially extensive, and only locally absent, it serves to restrict vertical movement of ground water and not effectively preclude it, as evidenced by the fact that the principal source of freshwater recharge and discharge for the Yorktown aquifers on the Eastern Shore is through the confining units. Recharge is discussed in Section 4.1.3 below.

The top of the upper Yorktown confining unit in the Eastern Shore is approximately -10 ft msl along the western margin (Chesapeake Bay) to -60 ft msl along the eastern margin (ocean side). Dip of this unit is 2 to 3 feet per mile and strikes northeast, parallel with the orientation of the peninsula.

Figure 4-3: Top elevation (a) and thickness (b) of the Upper Yorktown Confining Unit



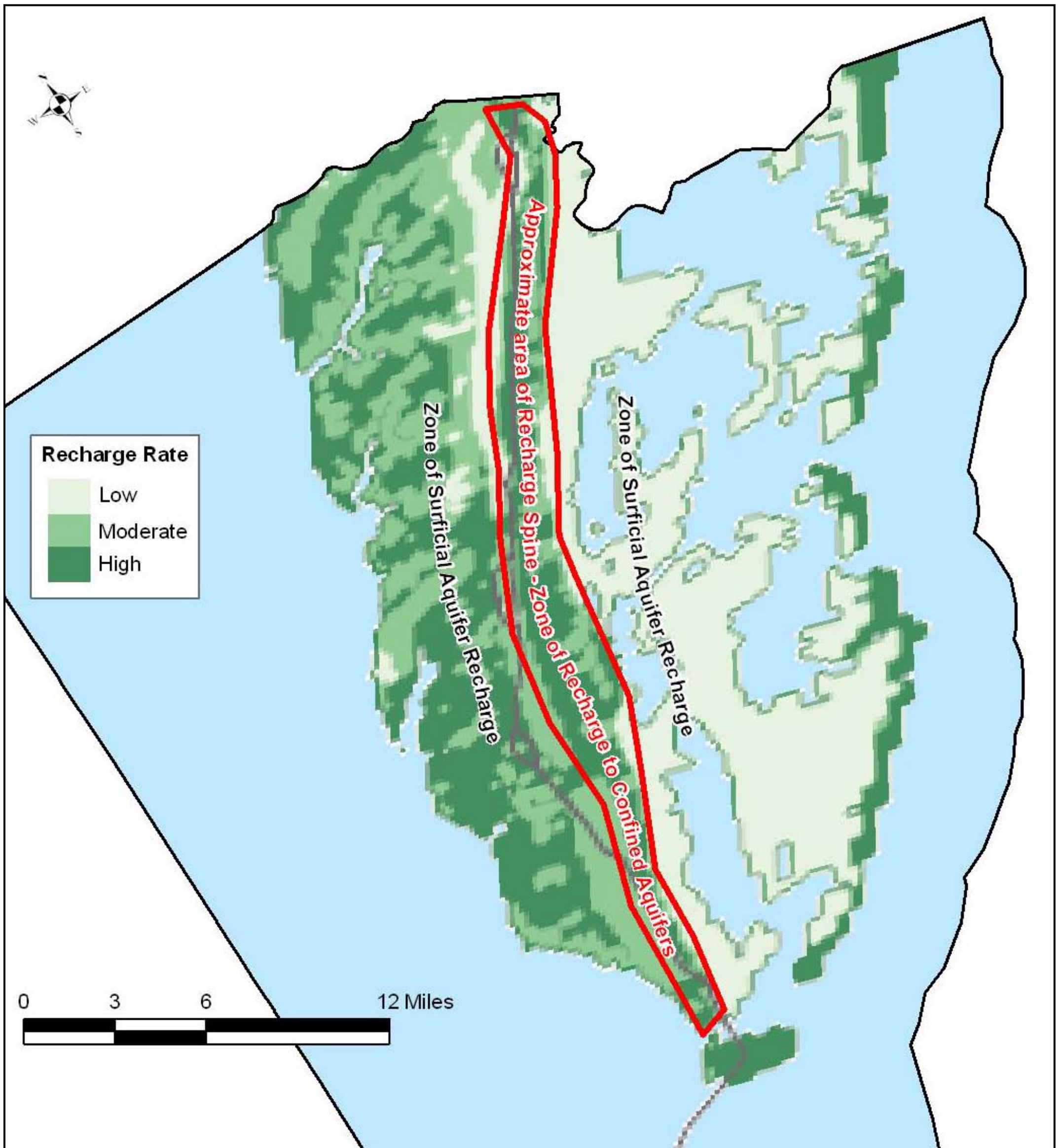
Source: Sandford, et al, 2009[2].

4.1.1.3. Upper Yorktown Aquifer

The upper Yorktown aquifer is the uppermost unit of the Yorktown-Eastover aquifer system, and is generally defined as the first significant sand unit occurring below the unconformity separating the basal Columbia Group sediments from the Chesapeake Group sediments. Sediments deposited in channel fills which incised into the Yorktown Formation have also been identified as the upper Yorktown aquifer, even though it is not clear if there is a good hydraulic connection between the channel fill sediments and the Yorktown Formation sediments. These channel fill deposits have been identified in the Eastern Shore near Exmore and Eastville. Over most of its extent, the Upper Yorktown aquifer consists of gray fine to medium sand with shell fragments commonly present. Locally, discontinuous coarse sand and gravel layers and thin lenses of blue clayey silt are often present.

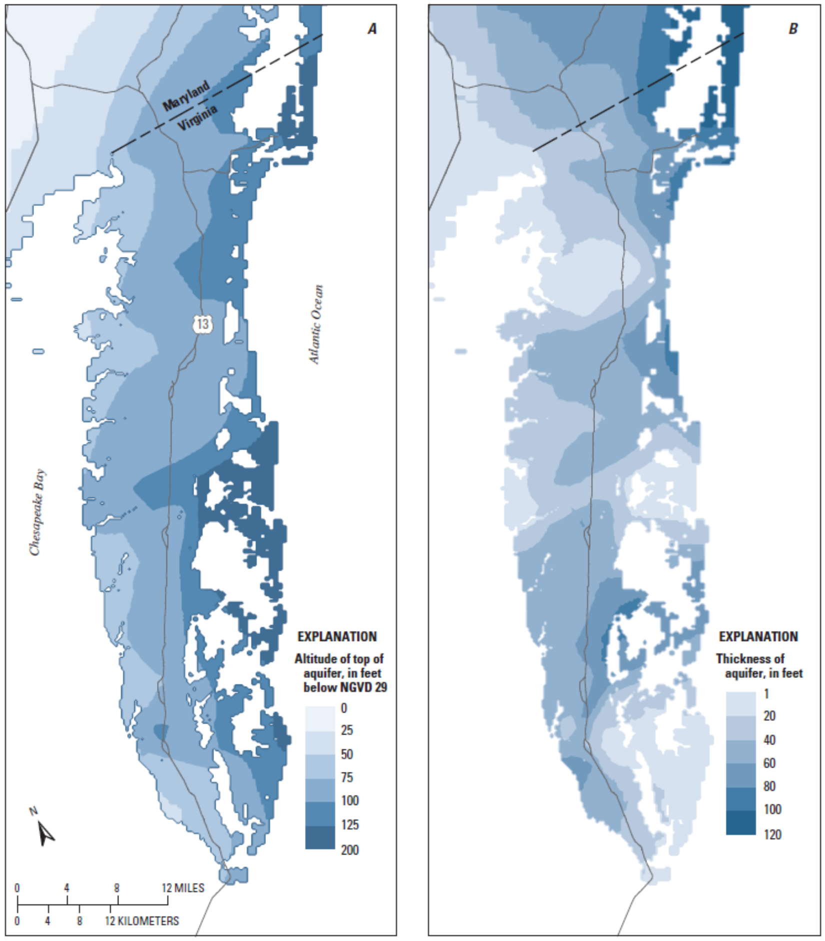
Surficial recharge to the upper Yorktown aquifer occurs along a northeast striking belt, called the "recharge spine", approximately 1.5 to 4 miles wide. This recharge area is present along the length of the Eastern Shore and provides freshwater recharge through the overlying confining unit (Figure 4-4). There are also significant, somewhat discontinuous, areas with relatively high recharge rates in the western half of the County, that provide recharge to the surficial aquifer only.

Figure 4-4: Relative Recharge Rates in Northampton County



Source: Sanford, et al, 2009[2].

Figure 4-5: Top elevation (a) and thickness (b) of the Upper Yorktown Aquifer



Source: Sanford, et al, 2009[2]

The top of the aquifer in the Eastern Shore is approximately -75 feet msl along the western edge to -125 ft msl to the east (Figure 4-5). Dip of the upper Yorktown aquifer is approximately 3 feet per mile and strike is northeast, parallel to the peninsula. The upper Yorktown aquifer is typically thinner to the west, where more of the sediments were eroded, and thickens to the east. On the Eastern Shore, the thickness of the upper Yorktown ranges between 15 feet in southwest Northampton County to greater than 100 feet near Assateague Island and is typically between 30 and 60 feet thick (Figure 4-5).

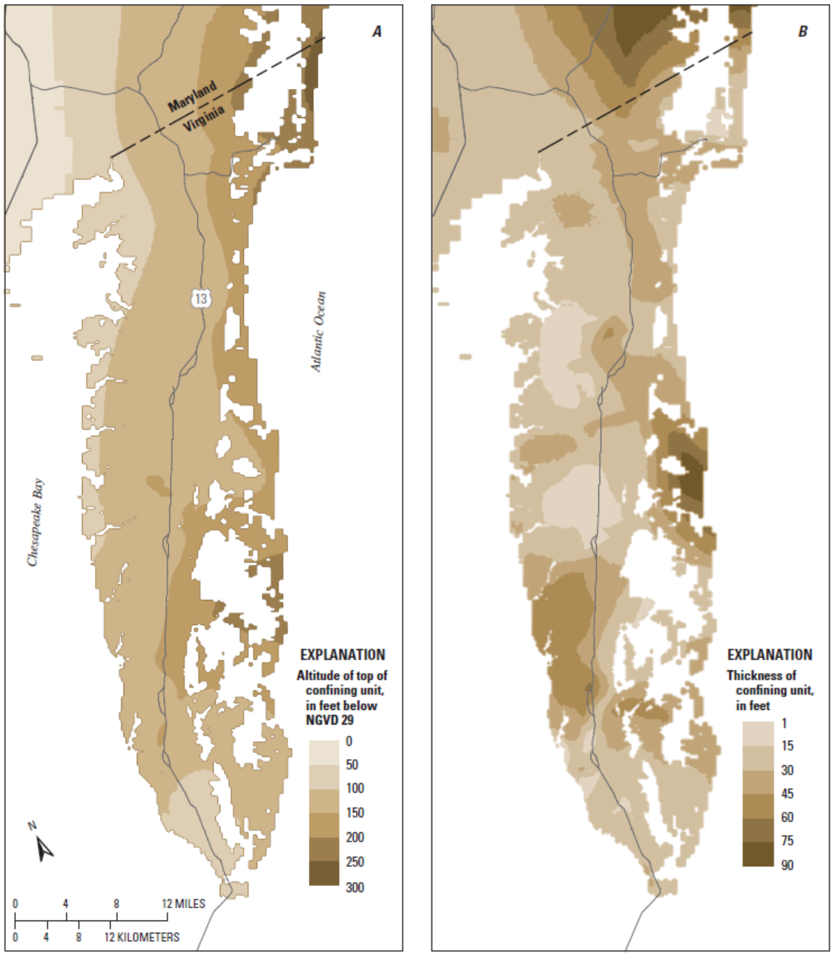
Transmissivity for the upper Yorktown aquifer is generally lower than the Columbia aquifer, and has a lower variability. Transmissivity for this aquifer typically ranges between 1,000 to 5,000 ft^2/day.

Ground water levels on the Eastern Shore follows the same general pattern as the overlying Columbia aquifer, since recharge to this aquifer is from the Columbia. Because the confining unit separating the two aquifers is consistently present over most of the area, there is significant head loss between the two aquifers. A maximum ground water level of +25 ft msl occurs in south central Accomack County, decreasing radially from this point. In Northampton County, ground water level is between +5 and +10 ft , and in central Accomack County, ground water level is +15 to +20 feet MSL, decreasing to +8 to +12 ft msl near the state boundary with Maryland. At the eastern and western coastline, ground water level decreases to approximately +5 ft msl. A short distance offshore, vertical ground water flow direction is expected to reverse, with fresh ground water flow from the upper Yorktown aquifer into the overlying Columbia aquifer. There are several prominent cones of depression resulting from significant ground water withdrawals centered around Temperanceville (Tyson Food), Accomack (Perdue), Exmore, and Cape Charles.

4.1.1.4. Middle Yorktown Confining Unit

The middle Yorktown confining unit is not as continuous or impermeable as the upper Yorktown confining unit, and has been described as allowing substantial leakage between the upper and middle Yorktown aquifers. In some areas this confining unit is absent, and over most of the Eastern Shore, it consists of a zone of interbedded silts and clays with numerous fine sand layers. Thickness of the middle Yorktown confining unit ranges between 15 and 100 ft, and tends to be thinner to the west and south (Figure 4-6).

Figure 4-6: Top elevation (a) and thickness (b) of the Middle Yorktown Confining Unit



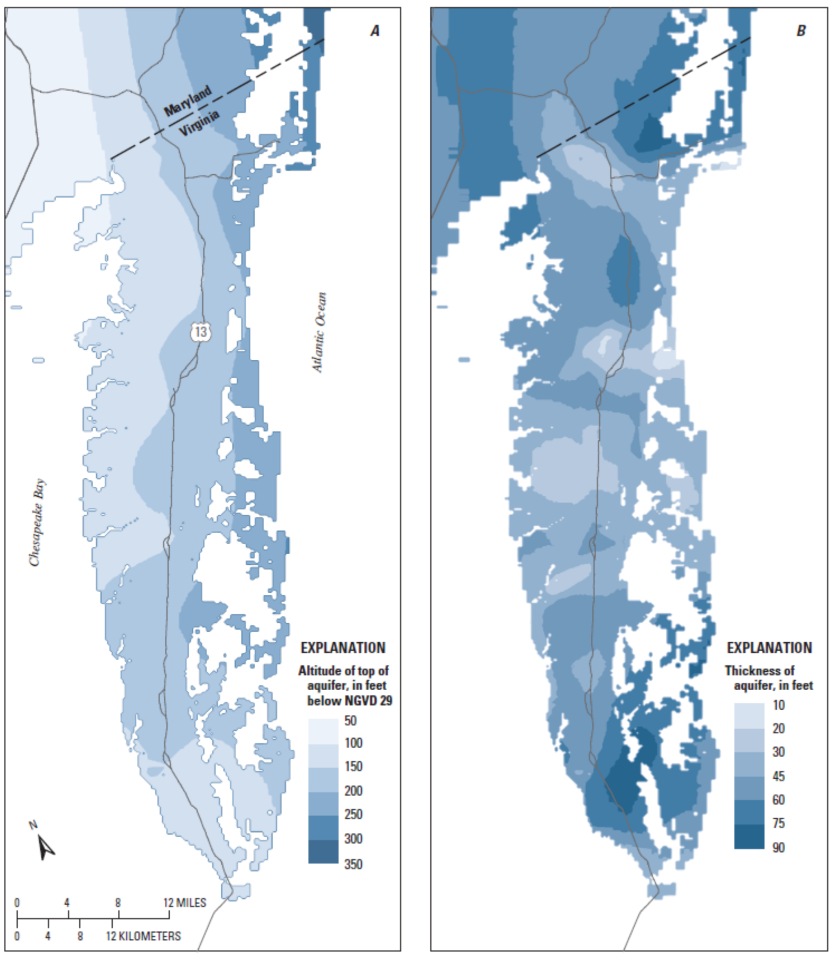
Source: Sanford, et al, 2009[2]

4.1.1.5. Middle Yorktown Aquifer

The middle Yorktown aquifer is an aerially extensive hydrologic unit of the Yorktown-Eastover aquifer system. The middle Yorktown aquifer, over most of its extent in the Eastern Shore is a gray fine sand to silty fine sand with shell fragments prevalent. In some areas, such as near the southern tip of the Eastern Shore, the middle Yorktown aquifer is coarser, consisting of gray medium to fine sand. This unit fines toward central Northampton County to a silty fine sand. Thickness of the middle Yorktown aquifer typically ranges between 30 ft and 60 ft, although locally is can be absent or up to 100 feet thick. The top of the aquifer in the Eastern Shore is between -125 ft msl to -150 ft msl along the western coast increasing to -225 to -250 ft msl to the east (Figure 4-7). The dip of the middle Yorktown is approximately 6 feet per mile, or roughly twice the dip as the overlying Upper Yorktown aquifer beds. As with the other units, strike is northeast, parallel with the peninsula. Transmissivities for the middle Yorktown in the Eastern Shore range between 1,000 and 3,000 ft^2/day.

Ground water levels for the middle Yorktown aquifer on the Eastern Shore are only slightly lower in the central portion than the upper Yorktown, with a maximum ground water elevation between +20 and +25 ft msl near Accomac. At the coast and a short distance offshore, the ground water level in the middle Yorktown is expected to be slightly higher than the upper Yorktown, with the vertical ground water flow reversed to an upward direction. In Northampton County, ground water level typically ranges between +10 and +5 ft msl.

Figure 4-7: Top elevation (a) and thickness (b) of the Middle Yorktown Aquifer

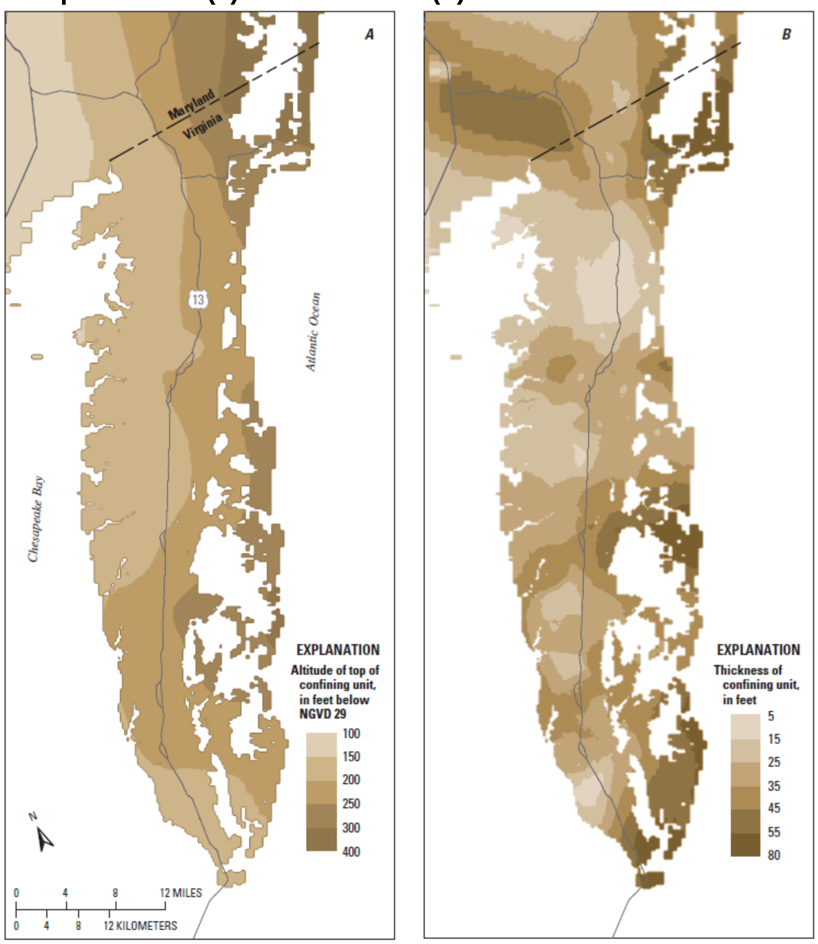


Source: Sanford, et al, 2009[2]

4.1.1.6. Lower Yorktown Confining Unit

The lower Yorktown confining unit has been described only in the Eastern Shore and has not been identified to the north in Maryland. The confining unit is thickest in central and northern Accomack County, thinning to the south and pinching out to the north in Maryland (Figure 4-8). Over the Eastern Shore area, the sediments comprising lower Yorktown confining unit tend to be finer grained than sediments from the middle Yorktown confining unit. As such, the lower Yorktown confining unit appears to restrict vertical flow more than the middle Yorktown confining unit.

Figure 4-8: Top elevation (a) and thickness (b) of the Lower Yorktown Confining Unit



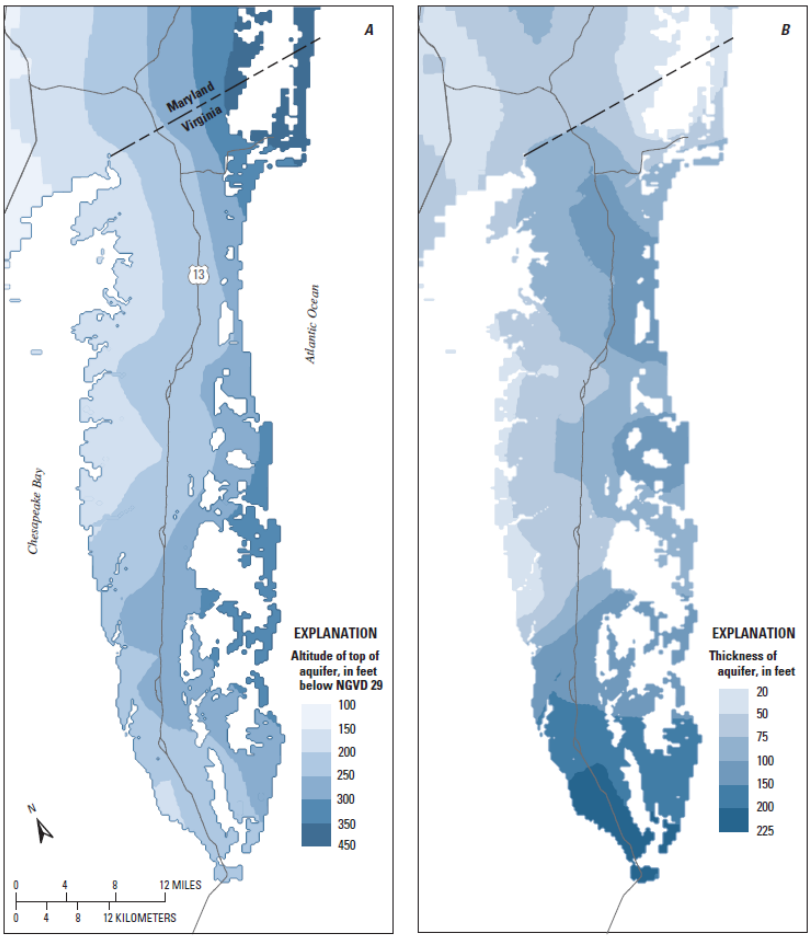
Source: Sanford, et al, 2009[2]

4.1.1.7. Lower Yorktown Aquifer

The lower Yorktown aquifer in the Eastern Shore typically consists of a fining upward sequence of gray fine sand to silty fine sand with shell fragments. In the Eastern Shore, the lower Yorktown aquifer is usually slightly thicker than the overlying middle

Yorktown aquifer, and is generally between 60 and 80 feet thick throughout the area. The top of the lower Yorktown ranges between -175 and -225 ft msl along the western coast to -300 to -350 ft msl along the eastern coast. The dip of the lower Yorktown aquifer is approximately 8 feet per mile, continuing the progressive increase in bed dip with depth exhibited by the overlying units.

Figure 4-9: Top elevation (a) and thickness (b) of the Lower Yorktown Aquifer



Source: Sanford, et al, 2009[2]

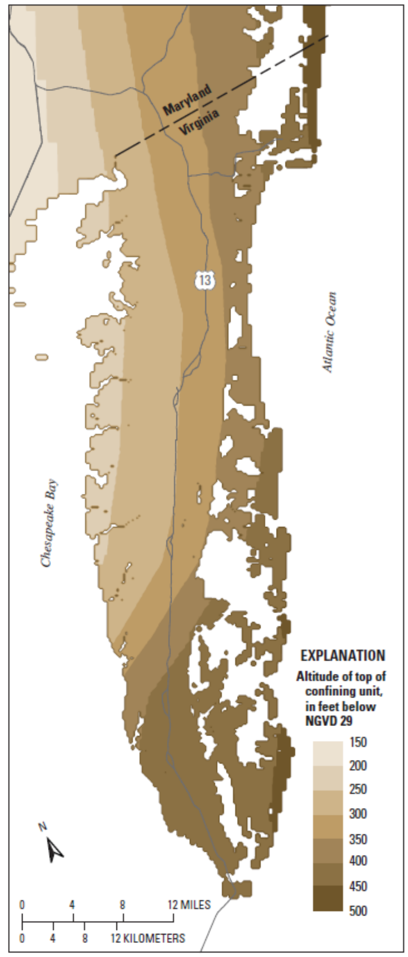
Transmissivity for this aquifer in the Eastern Shore is roughly the same or slightly lower than the middle Yorktown, averaging around 1,200 ft^2/day in areas where the sediments are productive. There are only a few pumping tests conducted in the lower Yorktown of the Eastern Shore and the lower and middle Yorktown aquifer are not differentiated in Maryland. Therefore, there is not a great deal of information on areal variability in transmissivity of the Lower Yorktown.

4.1.1.8. St. Marys Confining Unit

The St. Marys confining unit is defined by the top of the St. Marys Formation and is the most correlative stratigraphic horizon for the sediments in the Eastern Shore and Maryland. The St. Marys confining unit consists of offshore marine very fine sandy silts and clays with abundant shells. This unit comprises sediments from the St. Marys Formation, and separates the lower Yorktown aquifer from the underlying Choptank aquifer. Thickness of the St. Marys confining unit is greater than 100 feet across the entire area, and in most locations exceeds 150 feet. Owing largely to the thickness of this unit, the St. Marys forms an effective confining layer restricting flow between the two aquifers.

In the vicinity of the Virginia Eastern Shore, with the exclusion of Tangier Island, water bearing aquifers below the St. Mary's confining unit are considered too brackish or saline for use as a source of water supply.

Figure 4-10: Tope elevation of the St Marys Confining Unit



Source: Sanford, et al, 2009[2]

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There are two major concerns regarding groundwater in Northampton County, quantity and quality. Groundwater quantity is limited by the nature of the aquifers and must be carefully managed to prevent overuse that can result in saltwater intrusion. Groundwater quality depends on proper management of land use activities that can contaminate aquifers. In recognition of the limited groundwater supply and the potential for contamination, the U.S. Environmental Protection Agency designated the Eastern Shore of Virginia a Sole Source Aquifer in 1997. The designation provides protection to the Shore's water supply by requiring the EPA to review proposed projects on the Shore that are receiving federal financial assistance to ensure they do not endanger the water supply.

4.1.2. Hydrologic Setting

Surface features characteristic of the Coastal Plain of the Eastern Shore include terraces, stream channels, drowned valleys, Carolina bays, swamps and marshes, remnant dunes, and bar-like features formed during the Pleistocene time. The central portion of the Eastern Shore peninsula forms a broad, low ridge which trends northeast-southwest and stands at an elevation ranging from about +25 to +50 ft msl. This central highland area is the principal fresh ground water recharge area for the peninsula and is referred to as the "recharge spine" of the Eastern Shore (Figure 4-4), along with some areas of recharge to the surficial aquifer in the western half of the County. The terrace has maintained the same strand line for almost the entire length of the Atlantic Coastal Plain and is divided into a lower and upper terrace which directs the drainage of the Eastern Shore[4].

The lower terrace, generally located west of Route 13, consists of broad flats broken by large meandering tidal creeks and bordered by tidal marshes[5]. The upper terrace ranges in elevation from +25 to +45 ft msl. The topography of the upper terrace, more complex than the lower terrace, is characterized by shallow sand-rimmed depressions known as Carolina bays. The bays, predominantly oval in shape, exert an important influence on the infiltration, retardation of runoff, and movement of ground water. Between the mainland and the barrier islands are extensive tidal marshes flooded regularly by saltwater and drained by an extensive system of creeks[5]. These systems accept ground water discharge.

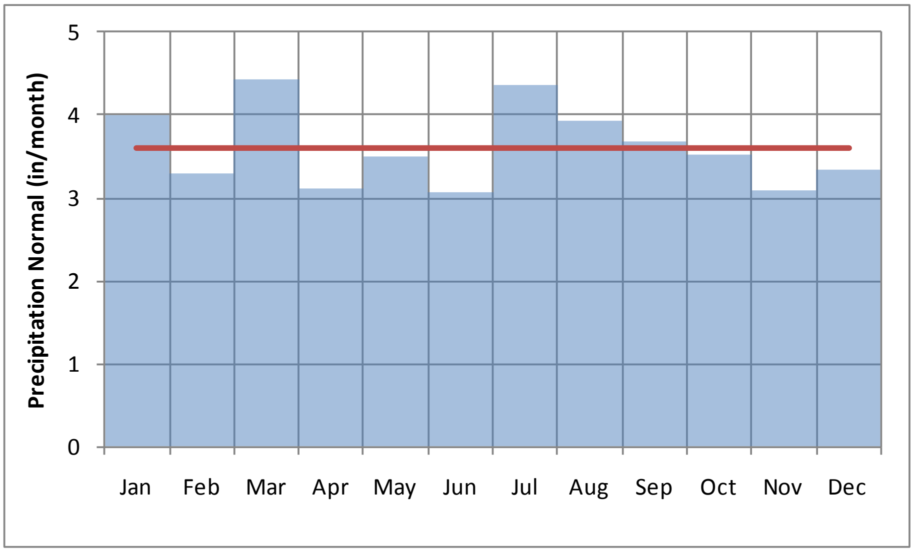
The Eastern Shore is drained by a total thirty small creeks flowing bayward or seaward from the drainage divide which passes the length of the peninsula. The lower reaches of the creeks form tidal estuaries fed by narrow, meandering branches. Because of the low topography and low inflow of freshwater, the creeks are brackish to saline everywhere except for the upper reaches. The estuaries are more pronounced on the Chesapeake Bay side and receive more of the surface and ground water drainage than the smaller creeks on the ocean side[6].

Numerous drainage basins exist on the shore ranging in size from approximately four to six square miles. These basins consist of several small creeks and interconnected ditches. Primary drainage basins of the Eastern Shore of Virginia are Gargathy Creek, Folloy Creek, Finney Creek, Occohannock Creek, and Pungoteague Creek basins in Accomack County; and Mattawoman Creek and Nassawadox Creek basins in Northampton County[7].

4.1.3. Meteorologic Setting

The average annual precipitation on the Eastern Shore is approximately 44 inches. The precipitation normals vary seasonally between 3.0 and 4.5 inches; with the highest months being March and July and the lowest being June and November. Aquifers of the Eastern Shore are recharged by precipitation; however the majority of the precipitation is lost to runoff and evapotranspiration.

Figure 4-11: Precipitation Normals for the Eastern Shore of Virginia



Source: NOAA, 2002[8].

Ground water recharge can be divided into a number of components. Total ground water recharge is the amount of precipitation which is not lost as runoff or evaporation (and evapotranspiration in the unsaturated zone). Of the total ground water recharge to the saturated zone, the principal losses are through evapotranspiration or discharge to surface waters. Loss through evapotranspiration and surface water discharge is most significant in the low lying areas where the water table aquifer is near the surface. The remaining recharge water goes into storage (in the water table aquifer) or recharges the underlying confined aquifers.

There have been a number of ground water recharge values previously estimated for the Eastern Shore. Holme[4] conducted a detailed two year study of ground water recharge from monthly ground water budgets in the Beaverdam Creek basin in Maryland, near the border with Accomack. From his work a recharge value of 12 inches/year was determined, after subtracting ground water loss through evapotranspiration. The 12 inches/year estimate includes recharge which is later lost through discharge to surface waters. Harsh and Laczniak conducted a study of the regional aquifer system of the Northern Atlantic coastal Plain[9]. In this study they estimated that ground water recharge to the water table aquifer is approximately 15 inches/year. A digital-flow-model study in the Coastal Plain of central and southern Delaware[10] used 14 inches/year as an estimate of ground water recharge for the area. More recent studies on the Eastern Shore have estimated that recharge to the unconfined aquifer ranges between 8.5 and 15 inches/year[3] and 12 and 26 inches/year[11].

Fresh groundwater recharge to the underlying confined Yorktown aquifer is generally restricted to the central "spine recharge" area of the peninsula (Figure 4-4). Some of the water that recharges near the center of the peninsula flows vertically through the water table aquifer and underlying confining units to recharge the confined aquifers. This downward flow component decreases with distance from the central recharge area. Ground water flow in the confined aquifers is also primarily horizontal, with some downward flow in the central peninsula and upward flow in coastal discharge areas.

4.2. Existing Environmental Conditions

4.2.1. Threatened and Endangered Species

Northampton County supports populations of a wide variety of flora, and fauna, some of which are of significant economic, recreational, or cultural importance to the county, and several of which are listed as rare, threatened or endangered.

The Virginia Department of Conservation and Recreation (DCR), with authority from the Code of Virginia, established a program to protect habitats of rare, threatened, and endangered plant and animal species; exemplary natural communities, habitats, and ecosystems; and others natural features of the Commonwealth. Resources protected under this program are called "Natural Heritage Resources" under this program. DCR maintains a list of Natural Heritage Resource species believed to be sufficiently uncommon to merit an inventory of their status for each county in the Commonwealth. In all DCR, has listed thirty-eight plant species and twenty-six animal species as Natural Heritage Resources in Northampton County (**Table 4-1**).

Ranking systems have been developed to designate a species' rarity based on its range-wide status. A species' global rank is based on its level of occurrence world-wide, whereas its state rank is based on its occurrence within the boundaries of the state of Virginia. Species which are fairly common in other parts of the country but seldom found in Virginia will have different global and state ranks.

The U.S. Fish and Wildlife Service and the National Marine Fisheries Service identify species which receive protection under the Federal Endangered Species Act. Federal status lists a species as endangered, threatened, or as proposed or candidates for listing.

The Endangered Species Act (ESA) of 1973 (7 USC 136; 16 USC 1535 et seq.) was designed to conserve and protect imperiled plant and animal species and the ecosystems on which they depend from extinction. Programs under the ESA are administered individually and jointly by the US Fish and Wildlife Service and by the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service. The law prohibits the "taking" of a listed species or adversely impacting relevant habitat through real or administrative actions. In accordance with the ESA, any future water supply project would be required to consider and avoid potential impacts to listed species within the proposed project footprint as part of federal permitting processes. A permit is usually required by the U.S. Army Corps of Engineers for construction projects, including surface water intakes disturbing "waters of the United States" which includes most rivers and streams. Virginia law also affords protection to state listed species and may affect the permitting process for developing new water supplies. A Virginia Water Protection Permit (WPP) from DEQ is required for both ground and surface water withdrawals. In evaluating the permit application, DEQ may consult with other state agencies responsible for the protection of listed species. Relevant Virginia agencies include the Department of Game and Inland Fisheries (DGIF), the Department of Agriculture and Consumer Services (DACS), and DCR's Division of Natural Heritage (DNH). Protected animal species in Virginia are the responsibility of DGIF, while plant and insect species are the responsibility of DACS. Both agencies work jointly with DNH to maintain an inventory of listed species and their known occurrences in Virginia.

The documented occurrence of a rare, threatened or endangered species within the footprint of a proposed project may necessitate a redesign, mitigation actions, or project limitations, but does not typically prevent approval. Common direct impacts to projects with the potential for impacts to occurring rare, threatened, or endangered species and their habitats include limitations on water withdrawals (often on a seasonal basis) and to require project design, construction, and timing considerations which limit habitat disruption and organism capture, particularly in the case of surface water intakes.

As all of the potable water withdrawals in the County are derived directly from groundwater sources, impacts to rare, threatened and endangered species are usually avoided or relatively simple to mitigate. Water supplies relying on withdrawals from groundwater wells can be designed with small project footprints, limiting habitat disruption, and tend to have a much smaller direct impact on the hydrology of habitats, particularly in the case of wells that are deeply screened.

Proposals for new or expanded water withdrawals and for associated infrastructure should include considerations of the potential to encounter or impact rare, threatened or endangered species. Such development should incorporate consultations with relevant federal and state agencies to determine whether the potential for impacts to listed species is present. Written requests can be made to DGIF and DNH to search for known occurrences of listed species in the vicinity of the project and to determine the likelihood of impacts to the listed species based on the proposed project location and description.

Table 4-1:
Threatened and Endangered Species in Northampton County

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status
PLANTS					
Amaranthus pumilus	Seabeach Amaranth	G2	S1	LT	LT
Carex lupuliformis	False Hop Sedge	G4	S2		
Chamaesyce bombensis	Southern Beach Spurge	G4G5	S2		
Cyperus engelmannii	Engelmann's Umbrella-sedge	G4Q	S1		
Cyperus plukenetii	A Galingale Sedge	G5	S2		
Desmodium ochroleucum	Creamflower Tick-trefoil	G1G2	SH	SOC	
Echinodorus tenellus	Dwarf Burhead	G5?	S1		
Hydrocotyle bonariensis	Coastal-plain Penny-wort	G5	S1?		
Juncus megacephalus	Big-head Rush	G4G5	S2		
Osmanthus americanus var. americanus	Wild Olive	G5T5	S1		
Physalis walteri	Sticky Ground-cherry	G4	S2		
Polygonum glaucum	Sea-beach Knotweed	G3	S1S2		
Solidago latissimifolia	Elliott Goldenrod	G5	S2		
Solidago tortifolia	A Goldenrod	G4G5	S1		
Thelypteris simulata	Bog Fern	G4G5	S1S2		
Tillandsia usneoides	Spanish Moss	G5	S2		
Utricularia juncea	Southern Bladderwort	G5	S2		
ANIMALS					
Anas strepera	Gadwall	G5	S2B,S3N		
Ardea alba	Great Egret	G5	S2S3B,S3N		SC
Charadrius melodus	Piping Plover	G3	S2B,S1N	LT	LT
Charadrius wilsonia	Wilson's Plover	G5	S1B		LE
Cicindela dorsalis dorsalis	Northeastern Beach Tiger Beetle	G4T2	S2	LT	LT
Circus cyaneus	Northern Harrier	G5	S1S2B,S3N		SC
Egretta caerulea	Little Blue Heron	G5	S2B,S3N		SC
Egretta thula	Snowy Egret	G5	S2B,S3N		
Egretta tricolor	Tricolored Heron	G5	S2B,S3N		SC
Eudocimus albus	White Ibis	G5	S1B		
Falco peregrinus	Peregrine Falcon	G4	S1B,S2N		LT
Gelochelidon nilotica	Gull-billed Tern	G5	S2B		LT
Haliaeetus leucocephalus	Bald Eagle	G5	S2S3B,S3N		LT
Hydroprogne caspia	Caspian Tern	G5	S1B,S2N		SC

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status
Nyctanassa violacea	Yellow-crowned Night-heron	G5	S2S3B,S3N		SC
Pelecanus occidentalis	Brown Pelican	G4	S2B,S3N		SC
Plegadis falcinellus	Glossy Ibis	G5	S2B,S1N		SC
Rynchops niger	Black Skimmer	G5	S2B,S1N		
Sciurus niger cinereus	Delmarva Fox Squirrel	G5T3	S1	LE	LE
Sternula antillarum	Least Tern	G4	S2B		SC
Thalasseus maximus	Royal Tern	G5	S2B		
Thalasseus sandvicensis	Sandwich Tern	G5	S1B		SC

Global Ranking System

RANK	DESCRIPTION
G1	Extremely rare and critically imperiled with 5 or fewer occurrences or very few remaining individuals; or because of some factor(s) making it especially vulnerable to extinction
G2	Very rare and imperiled with 6 to 20 occurrences or few remaining individuals; or because of some factor(s) making it vulnerable to extinction
G3	Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range; or vulnerable to extinction because of other factors
G4	Common and apparently secure globally, though it may be rare in parts of its range, especially at the periphery
G5	Very common and demonstrably secure globally, though it may be rare in parts of its range, especially at the periphery
GH	Formerly part of the world's biota with expectation that it may be rediscovered
GX	Believed extinct throughout its range with virtually no likelihood of rediscovery
G?	Unranked, or, if following a ranking, rank uncertain (ex. - G3?)
G_Q	The taxon has a questionable taxonomic assignment, such as G3Q
G_T	Signifies the rank of subspecies or variety. For example, a G5T1 would apply to a subspecies of a species that is demonstrably secure globally (G5) but the subspecies warrants a rank of T1, critically imperiled

State Ranking System

RANK	DESCRIPTION
S1	Extremely rare and critically imperiled with 5 or fewer occurrences or very few remaining individuals in Virginia; or because of some factor(s) making it especially vulnerable to extirpation in Virginia
S2	Very rare and imperiled with 6 to 20 occurrences or few remaining individuals in Virginia; or because of some factor(s) making it vulnerable to extirpation in Virginia
S3	Rate to uncommon in Virginia with between 20 and 100 occurrences; may have fewer occurrences if found to be common or abundant at some of these locations; may be somewhat vulnerable to extirpation in Virginia
S4	Common and apparently secure with more than 100 occurrences; may have fewer occurrences with numerous large populations
S5	Very common and demonstrably secure in Virginia
SH	Formerly part of Virginia biota with expectation that it may be rediscovered
SX	Believed extirpated from Virginia with virtually no likelihood of rediscovery
SE	Exotic; not believed to be a native component of Virginia's flora
SU	Possibly rare, but status uncertain and more data needed
S_?	Rank uncertain; for example, an S2? denotes a species with rarity that may range from S1 to S3, an SE? means a species may or may not be native to Virginia

Source: Virginia DCR, 2010[12]

4.2.2. Anadromous, Trout, and other Significant Fisheries

The Magnuson-Stevens Act, passed by Congress in 1996, promotes direct action to prevent or reverse habitat loss of marine fishery resources. Measures of the Magnuson-Stevens Act are overseen by NOAA's National Marine Fisheries service which coordinates with Regional Fishery Management Councils, resource users, federal and state agencies, to protect, conserve and enhance "essential fish habitat".

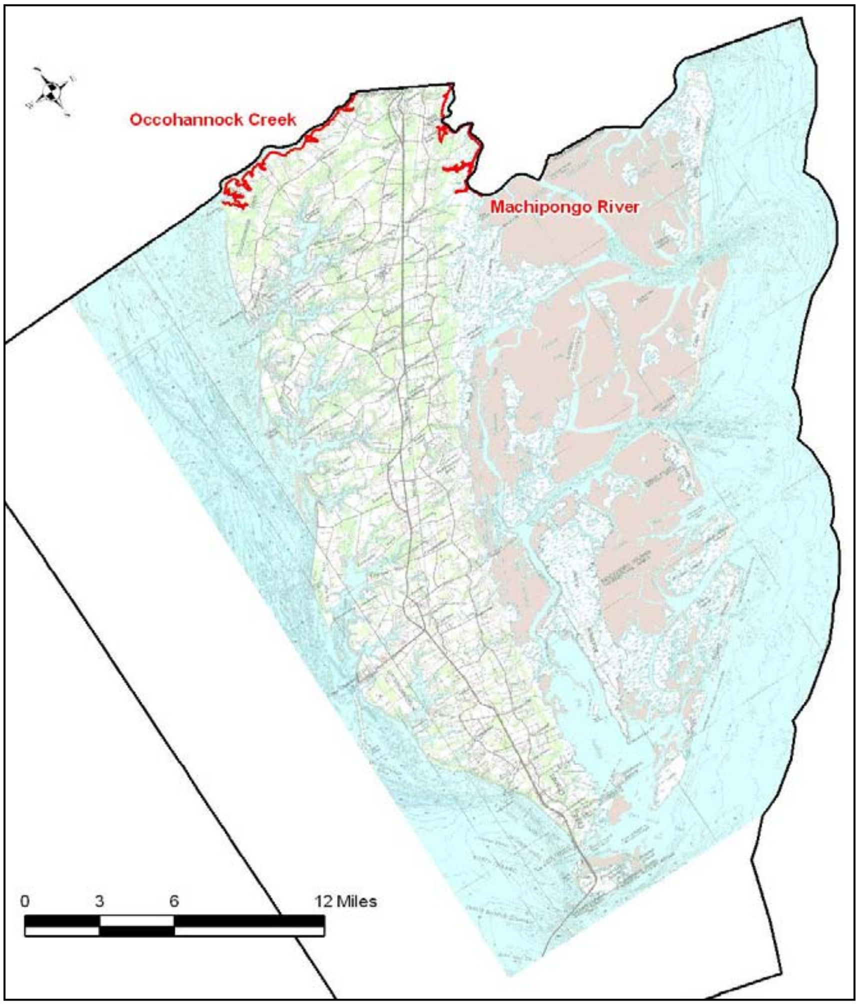
Given that streams and rivers in Northampton County are almost exclusively tidally influenced, freshwater withdrawals, particularly groundwater withdrawals have little impact on anadromous fish and trout. Hard clam aquaculture, which is a significant and growing part of the economy of the Eastern Shore ($24 million in 2004)[13], also occurs in a saltwater environment, and is also therefore minimally impacted by the largely subsurface freshwater withdrawals in the County.

4.2.3. Recreational Significance and State Scenic River Status

The Virginia Scenic Rivers Act, passed in 1970, authorized the designation of scenic rivers. The Scenic Rivers Program was established with the purpose of identifying, designating and protecting streams and rivers of outstanding scenic, recreational, historic, and natural character with a focus in enhancing conservation and wise use of such streams and rivers and adjacent lands. In evaluating permit applications for proposed construction projects within the corridor of a designated stream or river, State agencies must consider the project's potential impacts to the stream and the characteristics leading to its designation. Considerations relevant to scenic rivers may affect project design, siting, and/or withdrawal amounts.

There are currently no recognized State Scenic Rivers in Northampton County; however, Occohannock Creek and Machipongo River have been designated as potential candidates worthy of future study (**Figure 4-12**). Furthermore, as all of the potable water withdrawals in the County are derived directly from groundwater sources, impacts to scenic rivers are usually avoided or relatively simple to mitigate.

Figure 4-12: Candidates for State Scenic River Designation



4.2.4. Sites of Historical or Archeological Significance

The Virginia Landmarks Register (VLR) and the Natural Register of Historic Places (NRHP) are programs of State and National scope, respectively, that seek to identify and preserve important cultural, architectural, and archeological sites. The NRHP has been managed by the National Park Service since 1966 and is the official list of historic resources including structures, sites, objects, and districts that represent the cultural and historical foundations of the nation. The VLR is managed by the Virginia Department of Historic Resources (DHR), is the state's official list of properties important to the history of Virginia. The same criteria are used to evaluate resources for inclusion in both the NRHP and the VLR.

Inclusion in one or both of the Registers encourages the preservation and proper stewardship of the listed property and recognizes its historic value. Numerous incentives exist to encourage stewardship including tax incentives, technical assistance and rehabilitation funding from federal and state agencies; however, property owners accepting these incentives must abide by certain restrictions associated with the relevant program. Property owners in locally designated historic districts are also required to comply with applicable local ordinances.

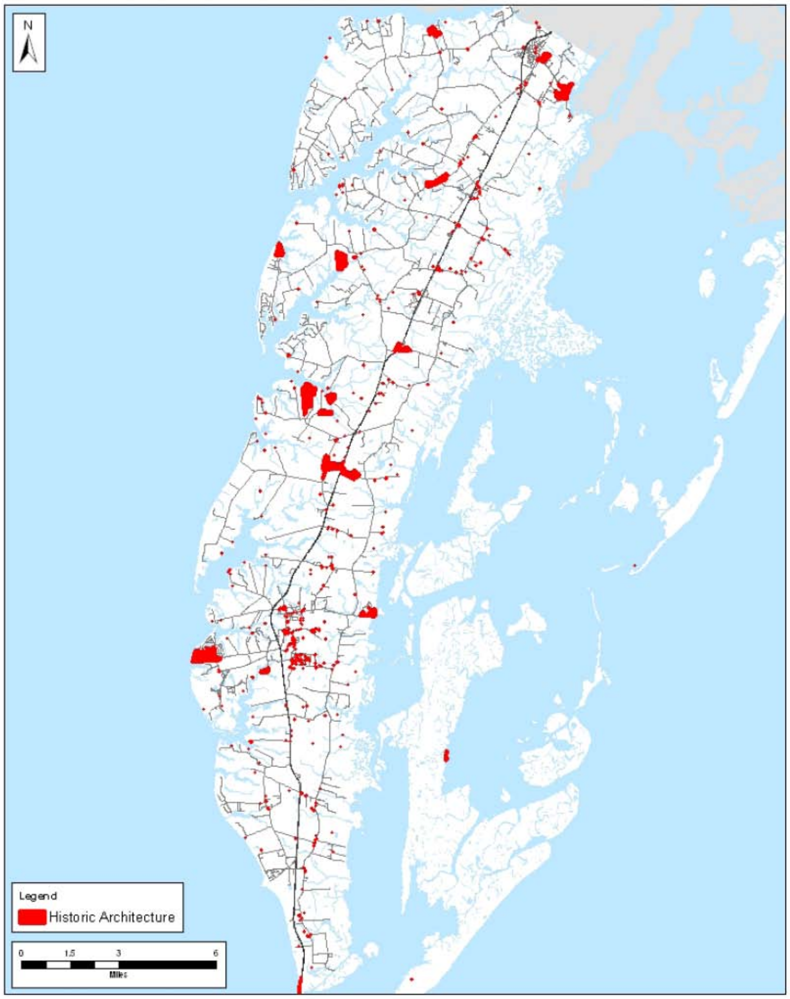
There are a currently twenty-three sites and four districts (Cape Charles, Eastville, and the Northampton County Courthouse and Lumber Company Historic Districts) of historical, architectural, or cultural significance located in Northampton County that are listed in the VLR and NRHP (**Table 4-2** and **Figure 4-13**).

Table 4-2:
National and Virginia Landmark Register Sites in Northampton County

Jurisdiction/Property	USGS Quad Map	VLR	NRHP	DHR File
Almshouse Farm at Machipongo	Franktown	09-12-01	04-01-02	065-0053
Arlington Archaeological Site	Elliott's Creek	03-20-08	05-12-08	065-0001
Benjamin's Department Store	Exmore	03-08-06	05-10-06	065-0528
Brownsville	Nassawadox	12-02-69	02-26-70	065-0003
Cape Charles Historic District	Cape Charles	08-15-89	01-03-91	182-0002
Cape Charles Light Station	Fisherman's Island	12-04-02	06-23-03	065-0071
Cessford	Cheriton	09-10-03	01-16-04	214-0001
Custis Tombs	Elliotts Creek	11-05-68	04-17-70	065-0066
Eastville Historic District	Cheriton	06-18-09	10-01-09	214-0040
Eastville Mercantile	Cheriton	12-01-04	01-20-05	214-5001
Eyre Hall	Cheriton	09-09-69	11-12-69	065-0008
Glebe of Hungar's Parish	Franktown	12-02-69	02-26-70	065-0033
Grapeland	Jamesville	06-21-77	05-06-80	065-0035
Hungars Church	Franktown	07-07-70	10-15-70	065-0012
James Brown's Dry Goods Store	Cheriton	09-12-01	04-01-02	214-0039
John W. Chandler House	Exmore	09-08-04	11-27-04	065-0530
Kendall Grove	Franktown	10-21-80	06-21-82	065-0060
Northampton County Courthouse Historic District	Cheriton	11-16-71	04-13-72	214-0007
Northampton Lumber Company Historic District	Nassawadox	03-20-08	05-29-08	267-5005
Oak Grove	Franktown	12-09-92	02-04-93	065-0019
Pear Valley	Franktown	05-13-69	11-12-69	065-0052
Selma	Cheriton	03-08-06	05-10-06	065-0077
Stratton Manor	Cheriton	09-16-80	11-28-80	065-0024
Upper Ridge Site at Mockhorn Island	Townsend	06-01-05	08-23-05	065-5015
Vaucluse	Franktown	12-02-69	09-15-70	065-0028
Westerhouse House	Franktown	09-17-74	11-19-74	065-0030
Winona	Franktown	11-05-68	10-01-69	065-0032

Source: VDHR, 2010[14]

Figure 4-13: Virginia Landmark Register Sites in Northampton County



Source: Northampton Comprehensive Plan, 2009[1].

Federal and state laws also offer protection to important cultural sites of the indigenous cultures that occupied the area before the Europeans, who settled in Virginia beginning in the fifteenth century. Archeological digs have found evidence of humans on the Shore as early as 8,000 and 10,000 B.C.E. Local Indian tribes were part of either the Powhatan or Algonquian Nations. The Commonwealth of Virginia has extended official recognition to eight tribes, none of which were associated with the Planning Region. There are no federally recognized reservations within the Planning Region. However, there are numerous archaeological sites that are not currently listed but may be eligible ranging in age from a few hundred to several thousand years[15].

Development of new water supply infrastructure must include consideration for historic and cultural resources that may be present in the project footprint. DHR maintains archive documenting historic, archeological and cultural resources which can serve as an initial source of information to determine whether these resources may be impacted by a proposed project. Section 106 of the National Historic Preservation Act requires projects utilizing federal funds to consult with the DHR State Historic Preservation Office and, in most cases, with recognized tribal representatives. Projects with State funding usually have similar requirements. Site investigations including archeological or architectural surveys may be required in order to determine whether sites in the project footprint are eligible for recognition and protection under the federal or state Registers.

As all of the potable water withdrawals in the County are derived directly from groundwater sources, impacts to historic, archeological and cultural resources are usually avoided or relatively simple to mitigate.

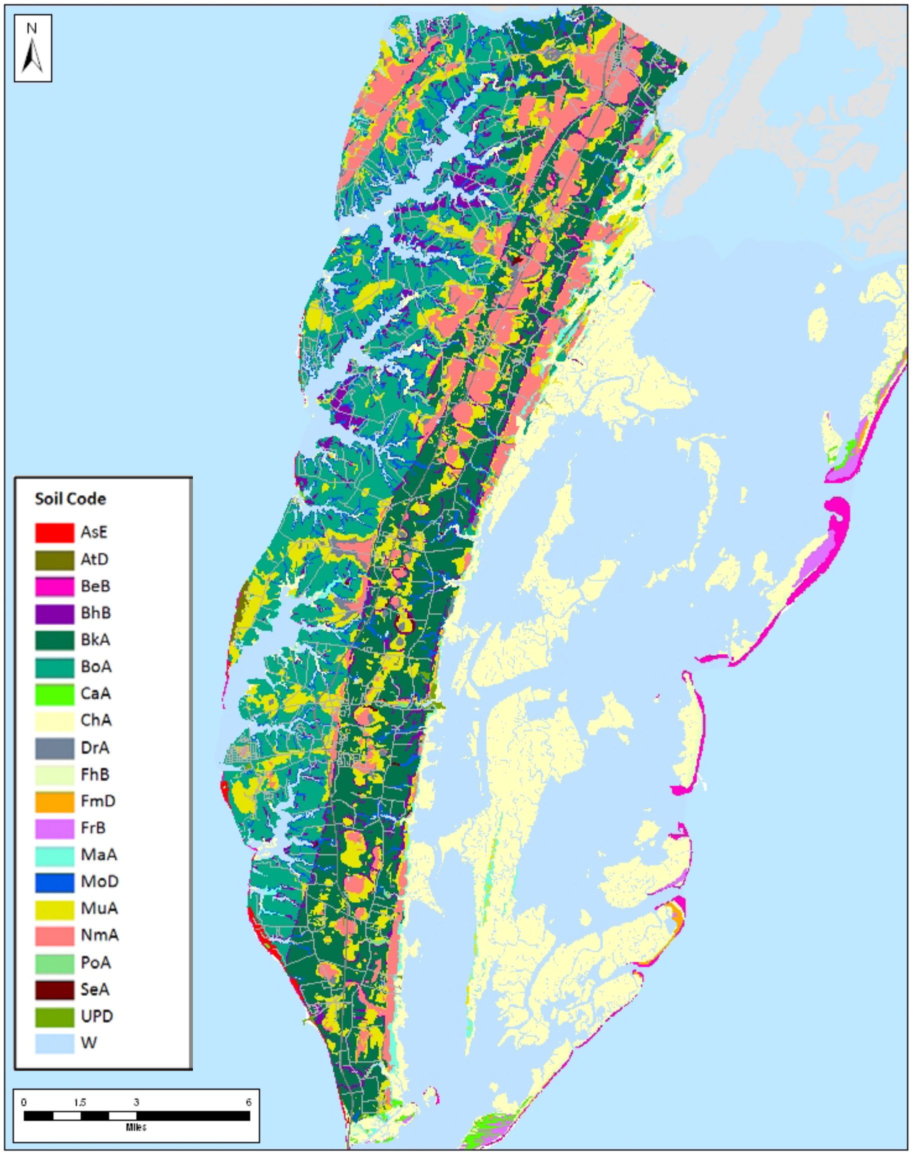
4.2.5. Geology and Soils

The geology of Northampton County consists of unconsolidated sediments on the Virginia Coastal Plain as discussed in Section 4.1.1 above. The type and distribution of soils in Northampton County is an important factor affecting land use and development, particularly for agriculture, construction, and sanitary operation of onsite disposal systems.

The soil profile of Northampton County generally consists of loam to sandy loam. A series of continuous sand strata, commonly identified with the Columbia aquifer, is present below the upper layer of soil. Existing and potential agricultural and development use of the soils is largely determined by the seasonal high elevations of the water table and the ability of the soils to support desired land uses.

A fairly comprehensive soil survey has been completed by the USDA Soil Conservation Service. The survey is useful in identifying the general distribution and types of soils present in the County; however, it does not replace the need for applicable site-specific testing of soil suitability prior to planned changes in land use or development. Soils identified in the survey have been grouped into types, which represent an area or areas of land with soils occurring in a characteristic pattern. The characteristic pattern in each soil type will have a similar soil horizon and other features which give it a distinctive landscape. There are nineteen soil types, not including open water, in Northampton which are described in Table 4-3 and shown in Figure 4-14.

Figure 4-14: Soil Types of Northampton County



Source: Northampton Comprehensive Plan, 2009[1].

Table 4-3:
Soil Types and Occurrence in Northampton County

Symbol	Soil Name	Slope	Drainage	% Occurrence
AsE	Assateague sand	2 to 50		0.3
AtD	Assateague fine sand	2 to 35	rarely flooded	0.1
BeB	Beaches	0 to 10		1.2
BhB	Bojac loamy sand	2 to 6		3.8
BkA	Bojac sandy loam	0 to 2		17.3
BoA	Bojac fine sandy loam	0 to 2		19.1
CaA	Camocca fine sand	0 to 2	frequently flooded	0.8
ChA	Chincoteague silt loam	0 to 1	frequently flooded	24.4
DrA	Dragston fine sandy loam	0 to 2		1.1
FhB	Fisherman fine sand	0 to 6	occasionally flooded	1.2
FmD	Fisherman-Assateague complex	0 to 35	rarely flooded	0.3
FrB	Fisherman-Camocca complex	0 to 6	frequently flooded	1.1
MaA	Magotha fine sandy loam	0 to 2	frequently flooded	1.3
MoD	Molena loamy sand	6 to 35		3
MuA	Munden sandy loam	0 to 2		10.4
NmA	Nimmo sandy loam	0 to 2		9.2
PoA	Polawana loamy sand	0 to 2	occasionally flooded	0.8
SeA	Seabrook loamy sand	0 to 2		0.1
UPD	Udorthents and Udipsamments soils	0 to 30		0.2
W	Water	--		4.3
			TOTAL	**100**

Source: Northampton Comprehensive Plan, 2009[1].

A significant portion of the soils in the county contain hydric component soils (9.2%), defined by the Natural Resources Conservation Service (NRCS) as soils that "formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part". Hydric soils are typically unsuitable for conventional septic systems due to the small or non-existent separation between the septic absorption area and the high water table. The presence of hydric soils is also one of several indications of the presence of regulated wetlands, along with the presence of wetland vegetation and hydrology. The presence of (regulated) wetlands, discussed below in Section 4.2.6, must be considered as part of project planning, design, and construction.

Some soils in the region have demonstrated direct economic value and are being actively quarried. As recently as 2008, there were three quarries in Northampton County covering a total area of 61 acres, two of which were active and removed a total of 30,000 tonnes of sand (Table 4-4).

Table 4-4:
Summary of 2008 Sand Quarry Activity in Northampton County

COMPANY NAME	MINE NAME/NUMBER	PERMIT	DISTURBED ACRES	PERMITTED ACRES	TONS	Active in 2008?
BRANSCOME INC	BROWNSVILLE PIT	06085AC	8.5	10	0	N
GERALD M. MOORE & SON, INC.	#5	13447AA	23	46	29,907	Y
WAGNER BROTHERS	#1	90459AA	5	5	225	Y
		NORTHAMPTON COUNTY	**36.5**	**36.50**	**61.00**	**30,132**

Source: DMM Report PEPR.33 and TNPR.06 (2008)

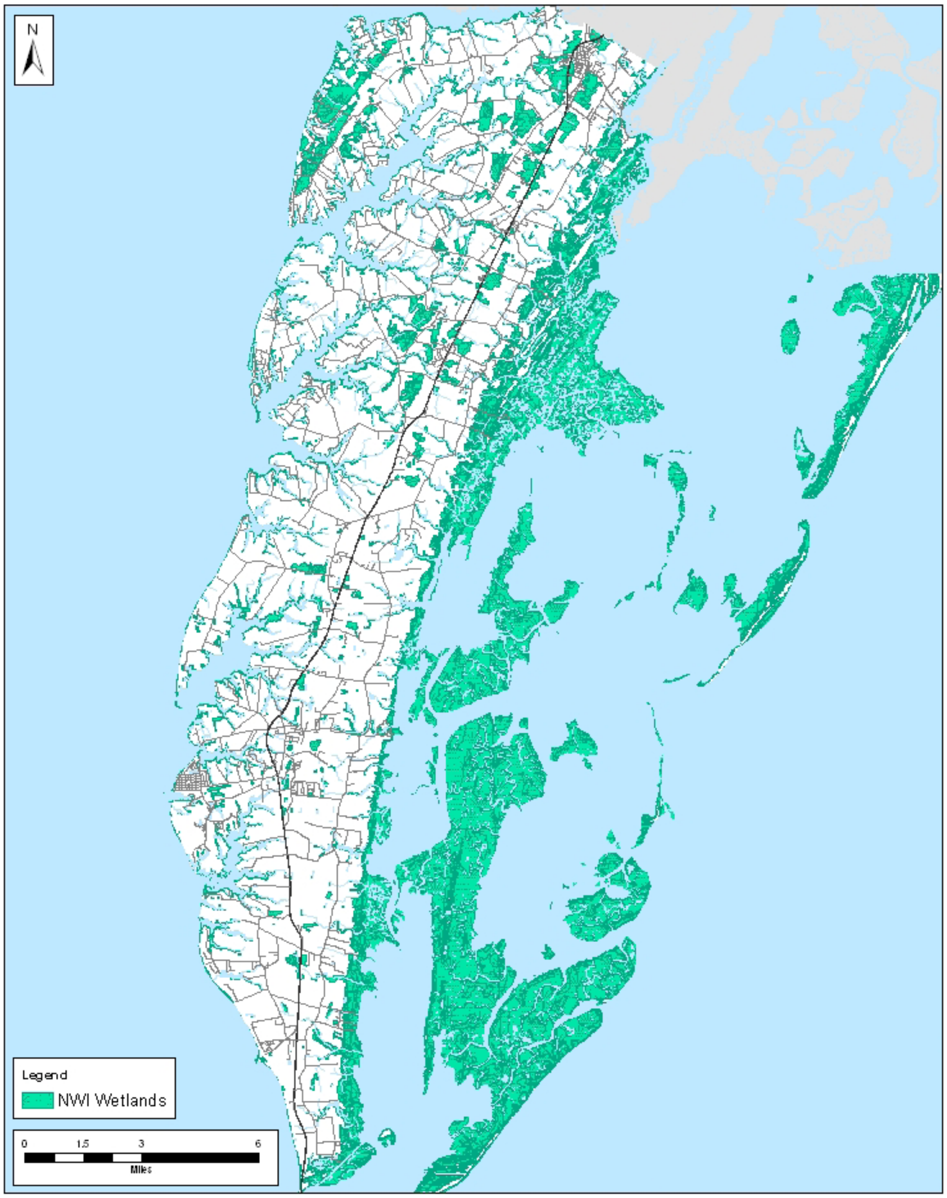
4.2.6. Wetlands

The majority of wetlands present in Northampton County are tidal or tidally influenced. Tidal wetlands have been defined in the Commonwealth of Virginia as part of the Wetlands Act (Title 62.1, Section 13.2, Code of Virginia) as “all land lying between and contiguous to mean low water and an elevation above mean low water equal to the factor 1.5 times the mean tide range at the site”. The area between the seaside shoreline of the peninsula and the barrier islands, lies a maze of pristine and ecologically productive shallow bays, salt marshes, tidal flats and beaches. The area supports a wide variety of marine, avian, and terrestrial species and is considered to be one of the most exemplary ecosystems of its kind. There are also a number of existing upland wetlands in Northampton County. These are associated with areas containing hydric soils. Wetlands in Northampton County are shown in Figure 4-15.

The Virginia Water Protection Permit (VWPP) program is the process for regulating activities in tidal and non-tidal wetlands in the Commonwealth and is run by the Virginia DEQ. Section 401 and Section 404 of the Clean Water Act, also regulate impacts to wetlands under the jurisdiction of the US Army Corps of Engineers (USACE). Typically the placement of fill and/or removal of sediments from regulated wetlands requires a permit from either or both the USACE and the DEQ. The Virginia Marine Resources Commission (VMRC) oversees the Joint Permit Application (JPA) process for projects with potential impacts to sub-aqueous bottoms in the Commonwealth and coordinates the JPA process with DEQ and USACE, in consultation with other relevant federal, state and local agencies.

The US Fish and Wildlife Service (USFWS) collects and maintains extensive data on the distribution and types of wetlands as part of the National Wetland Inventory (NWI) program. Wetlands are inventoried and mapped at a local scale, useful for project planning, as part of the program. However, NWI information must usually be supplemented with field collected, site-specific soil, hydrology, and vegetation data to determine the presence, extent and quality of wetlands in the affected area of a proposed project. The presence of wetlands within a project footprint can significantly impact the siting, design, and sometimes feasibility of some projects. Projects that would alter the wetlands must demonstrate a lack of other suitable alternatives and mitigate impacts to affected wetlands, which can significantly increase project costs.

Figure 4-15: NWI Wetlands in Northampton County



Source: Northampton Comprehensive Plan, 2009[1].

As all of the potable water withdrawals in the County are derived directly from groundwater sources, impacts to wetlands from existing and future water supply projects are usually avoided or are often simpler to mitigate than surface water projects.

4.2.7. Riparian Buffers

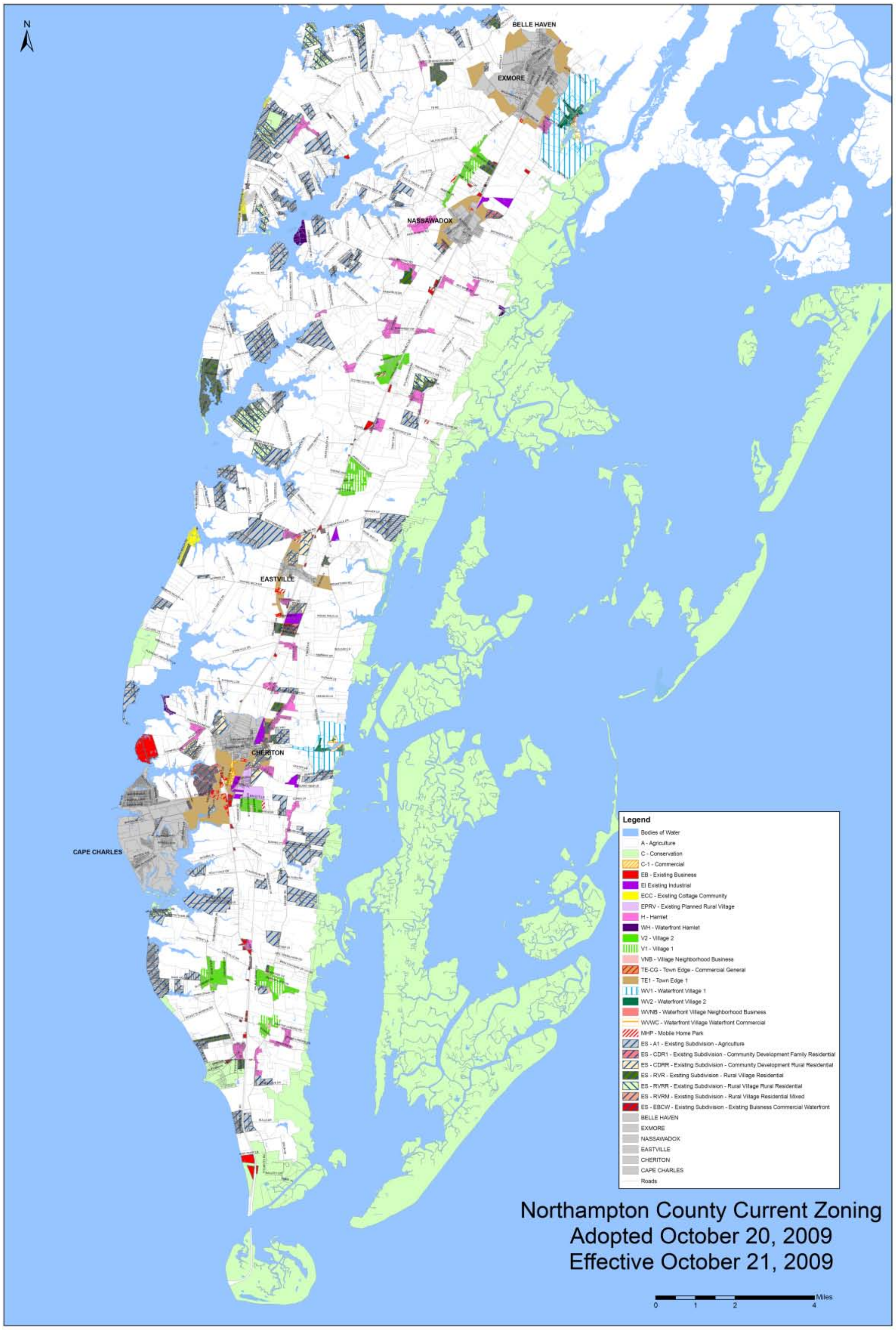
Riparian buffers are lands adjacent to water bodies, left in a natural vegetated state, used to preserve, promote, and protect water quality. Vegetation in the riparian buffers provide water quality protection by absorbing excess nitrogen and phosphorus in the stormwater runoff from adjacent fields and lawns. The level of nutrient removal is dependent on various factors such as buffer, slope, soils, and plant species. The Virginia Department of Forestry has noted that forested buffers up to 100 feet in width can remove up to 80 percent excess phosphorus and 89 percent nitrogen in the stormwater runoff from adjacent agricultural lands. In addition to nutrient removal, the riparian buffers also stabilize soils and decrease stormwater velocity and thereby reduce the amount of sediment runoff.

There are multiple government entities and programs in Virginia that fund or otherwise encourage the establishment of riparian buffers: the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) promotes the riparian buffers adjacent to agricultural lands through a cost sharing program, DCR has numerous programs promoting riparian buffer creation and preservation, the Virginia Department of Forestry (DOF) provides a tax credit in conjunction with the establishment of riparian buffers in Virginia, and the Chesapeake Bay Preservation Act promotes the establishment of riparian buffers in the Chesapeake Bay watershed.

4.2.8. Land Use and Land Coverage

Land use and land cover can have a significant impact on local and regional hydrology and should play an important role in water supply planning. Variations in land use and land cover affect the geospatial variation of water demands and can have an impact on streamflow and groundwater water recharge, both in terms of quantity and quality. Land uses such as urban developments tend to have high proportions of impermeable land cover in the form of pavement and buildings. Without compensating design and planning, these areas will decrease the amount of rainfall percolating into the soil, and runoff rapidly into nearby streams and water bodies. This rapid runoff reduces the amount of water available for groundwater recharge and can impact water supply wells, particularly wells with shallow screens. Rapid runoff can also carry a greater sediment and contaminant load which can impact water quality in adjacent and downstream bodies of water. High sediment loads can also fill in downstream reservoirs and thereby reduce their yield over time. Approved land uses in Northampton County are shown in Figure 4-16.

Figure 4-16: Land Use in Northampton County



Source: Accomack Northampton Department of Planning and Zoning, 2009[16].

This report relies on the land use/land cover data used in Northampton Counties' 2009 Comprehensive Plan. Given its largely rural setting, the County has a relatively very small percentage of impervious surfaces compared to the size of the area. As would be expected, the concentrations of impervious cover in the area are largely concentrated in the County's Towns and along the Route 13 corridor.

The Virginia DCR requires localities to adopt stormwater management regulations and/or controls to minimize the runoff effects of new development. Typically, stormwater management measures may include leaving a portion of a developed property in an undeveloped state, or adding positive controls such as stormwater detention basins when new development occurs. The Chesapeake Bay Act also requires stormwater management measures to be considered in new and re-development projects of minimum size in the Chesapeake Bay watershed, which includes the western half of Northampton County, to control and reduce the nutrient and sediment loads reaching the Bay and its tributaries.

Although the percentage of developed land within Northampton County is relatively small, the County is heavily dependent on groundwater recharge for the continued replenishment of its water supply resources, as discussed above in Section 4.1. Therefore, special care must be taken in the on-going planning, design, and construction of development projects to ensure that the rate and quality of groundwater recharge is adequately protected and promoted. This is particularly important for the County's major groundwater recharge areas which largely coincide with the Route 13 corridor.

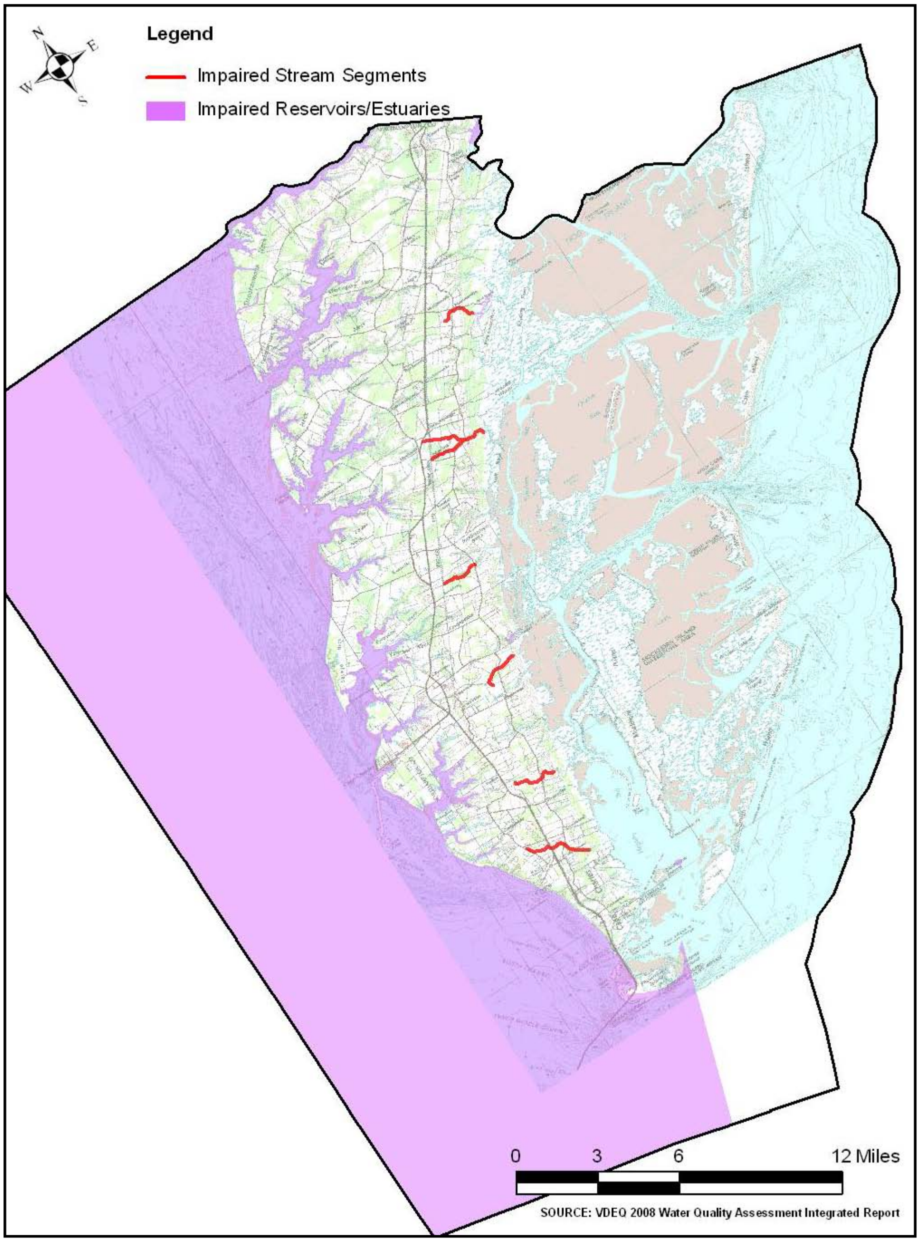
4.2.9. Impaired Streams and Rivers

In order to meet the requirements of Section 305(b) and 303(d) of the U.S. Clean Water Act, the Virginia DEQ compiles information about the Commonwealth's impaired streams, rivers, estuaries, other water bodies, and their watersheds on a biannual basis. The most recent survey of impaired waters is summarized in the 2008 Water Quality Assessment Integrated Report. The goals in the Water Quality Assessment Program are to inventory waters that do not meet water quality standards, and to design and implement a plan to restore water listed as impaired. The standards are based on the water quality required to support one or more of the six designated uses for surface waters, which include: aquatic life, fish consumptions, shellfish consumption, swimming, public water supplies (where applicable), and wildlife. A body of water with one or more parameters that do not meet applicable water quality standards are listed as "impaired" and are not considered to support the body of water's designated use. The primary mechanism for cleanup of impaired waters is to develop a total maximum daily load (TMDL) for those water quality parameters not meeting the standard. A TMDL is the site-specific planned total amount of a given contaminant associated with an impairment that can be assimilated by a 303(d) listed stream and is meant to sufficiently restore water quality to support one or more designated uses.

There are seven stream segments totaling approximately 11 miles in length and 850 square miles of estuaries that are listed as 303(d) impaired for Northampton County as part of the 2008 Integrated Report. It should be noted that the large majority of the estuarine impairments include the portions of the Chesapeake Bay located in Northampton County. Coves, inlets, and other open water areas account for only 17 square miles of the total listed estuarine water impairments in Northampton County. The most common impairments include failure to meet water quality standard for the following parameters: low dissolved oxygen (particularly in the summer months), submerged aquatic vegetation criteria, fecal coliform, enterococcus, benthic-macroinvertebrate bioassessments, PCBs in fish tissue, and pH imbalances. These impairments result in failure to meet one or more of the following designated uses: fish consumption, aquatic life, shellfishing, recreation, and wildlife for listed water bodies.

Although surface water in Northampton County is not utilized for human consumption, fecal coliform can be of concern with respect to surface water if there are high levels in areas used for recreation, shellfish harvesting, and food crop irrigation. State water quality standards require that in all surface waters, except shellfish waters, the fecal coliform bacteria shall not exceed a geometric mean of 2,000 fecal coliform bacteria per liter of water for two or more samples over a calendar month period, or a fecal coliform bacteria level of 74,000 per liter in ten percent of samples in any given month.

Figure 4-17: 303(d) Impaired Waters and NPDES Discharges in Northampton County



4.2.10. Point Source Dischargers

Large discharges to waterways of the Commonwealth are regulated by the Virginia DEQ and DCR and reported to the USEPA. Discharges into surface water are regulated through Virginia Pollutant Discharge Elimination System (VPDES) permits. Permit holders are typically required to adhere to limits on the concentration and quantities of specified pollutants, properly maintain and operate facilities, monitor discharge, keep and submit proper records to DEQ on a monthly basis, and provide open access to inspections. VPDES permits can be granted on a site-specific or general category basis. Facilities with a VPDES permit in Northumberland County are presented in Table 4-5.

Table 4-5:
Permitted Facilities in Northampton County

PERMIT#	FACILITY NAME	LOCATION	EXP. DATE
	Individual Permits, VPDES – Municipal		
VA0021288	CAPE CHARLES WWTP	Cape Charles	9/20/2009
VA0023817	NORTHAMPTON MIDDLE SCHOOL	Marchipongo	8/24/2007
VA0027537	SHORE MEMORIAL HOSPITAL	Nassawadox	11/5/2007
	Individual Permits, VPA		
VPA01058	BEST WESTERN SUNSET BEACH RESORT	Northampton	11/1/2014
VPA01022	CHERRYSTONE CAMPGROUND	Cheriton	--/19/2011
	General Permit – Concrete Ready Mix Plants and Fabricated Products		
VAG110228	BAYSHORE CONCRETE - CAPE CHARLES	Cape Charles	9/30/2008
VAG110038	T & W BLOCK - CAPE CHARLES	Cape Charles	9/30/2008
	General Permit – Nutrient Discharges		
VAN05001	CAPE CHARLES, TOWN OF (WWTP)	Cape Charles	12/31/201
VAN050003	SHORE MEMORIAL HOSPITAL	Nassawadox	12/31/201
	General Permit – Poultry Facility		
VPG250045	PERDUE FARMS, INC. [POULTRY]	Eastville	12/1/2010
	General Permit – Seafood		
VAG523000	BALLARD FISH & OYSTER CO	Cheriton	7/23/2011
VAG523010	J H WEST SEAFOOD	Oyster	7/23/2011
VAG523033	LILLISTON SEAFOOD	Wachapreague	7/23/2011
VAG523011	NANDUA SEAFOOD LLC	Hacksneck	7/23/2011
VAG523008	R & C SEAFOOD COMPANY	Oyster	7/23/2011
VAG523021	TERRY, H. M. COMPANY, INC.	Willis Wharf	7/23/2011
	General Permit - Industrial Storm Water		
VAR050335	EASTERN SHORE RAILROAD	Cape Charles	6/30/2009
VAR051449	NORTHAMPTON COUNTY LANDFILL	Cape Charles	6/30/2009

Source: Virginia DEQ (March 01, 2008)

A Virginia Pollution Abatement (VPA) Permit is required for operations that manage pollution through land application, reuse, or do not otherwise result in a point source discharge to surface waters. VPA permits are required for land application of sewage sludge, animal waste, or industrial waste and for closed systems that reuse and recycle waste water. Exclusions to the VPA permit program are discharges to permitted treatment systems, run-off from fields, return flows from irrigation, storage vessels, and land disposal of pollutants otherwise permitted. Permit requirements typically include the prohibiting of discharge to surface water, requirements regarding waste storage and disposal, best management practices (such as buffer strips, berms, and nutrient management plans) to protect adjacent surface waters, groundwater monitoring to detect possible contamination and sludge monitoring to determine the concentration of pollutants. Facilities with a VPA permit in Northampton are listed in Table 4-5.

5. Projected Water Demand (9 VAC 25-780-100)

This section consists of projections to estimate future water demands. Estimates of populations in the County and the water needed to serve them are made in ten year increments from 2010 to 2040, thirty years into the future. The projections include considerations of both public and private sources of water. As discussed below, some of the projections are based on values and/or methodologies presented in the respective groundwater withdrawal permit applications. The relevant permit applications are presented in Appendix C.

5.1. Population Projections

Population projections for Northampton County were estimated by the Virginia Employment Commission (VEC). Base year data for 1980, 1990, 2000 and population estimates for 2004 through 2006 were compiled by the U.S. Census Bureau. Based on the period between 1980 and 2006 (the most recently available population estimate by the US Census Bureau) there was a population decrease of approximately 0.27% percent per year. However, in the period between 1990 and 2006, the population actually increased by almost the same rate (0.26 percent per year). Projections for 2010 through 2030 were estimated by VEC using the component cohort method. VEC predicted a population decline of 0.16 percent per year (or a net loss of 20 inhabitants per year) until 2030. However, as part of its Comprehensive Plan, the County projected a 0.4 percent per year increase until at least 2016 (or a net increase of 55 inhabitants per year). The VEC data incorporates data going as far back as the 1980's following the relocation of two large industries. Projections for 2040 were not available and the growth rates predicted by the VEC and the County were linear, therefore a straight line interpolation was used to extrapolate the Northampton County population projections to 2040. Population projections for Northampton County are shown in Table 5-1 and in Figure 5-1. Based on the recent growth trend and the fact that the County's estimates will lead to greater water requirements, it is assumed that the County's estimates will be the more prudent estimates to use when prepare for water demands through the 2040 planning horizon. Furthermore, the County's estimates are in line with State-wide projections and represent a small population increase over that of the 1980's.

Figure 5-1: Projected Northampton County Population

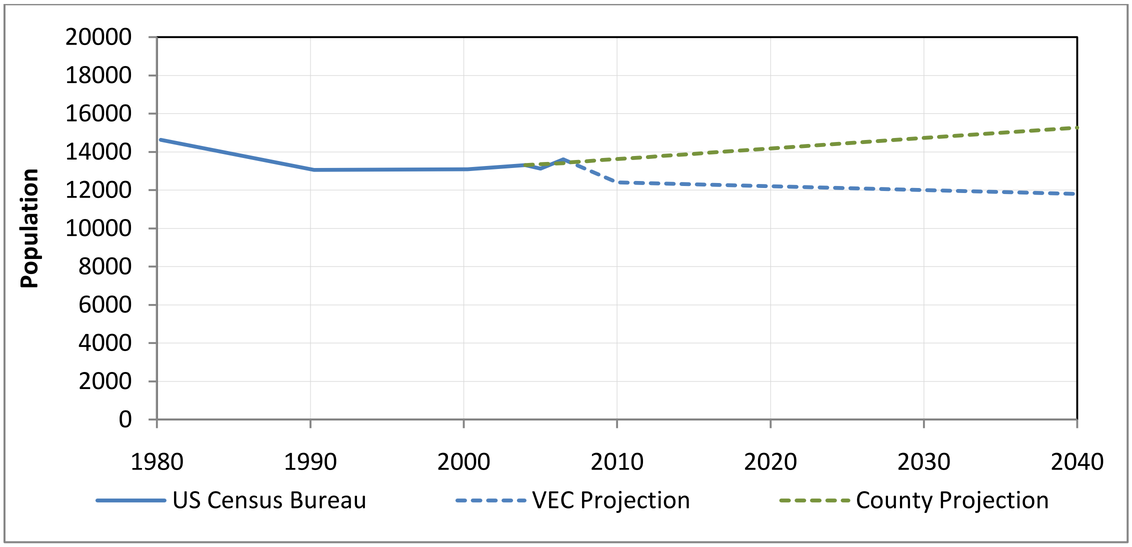


Table 5-1:
Northampton County Population Projections

YEAR \ SOURCE	US CENSUS BUREAU	VEC PROJECTION	COUNTY PROJECTION
1980	14,625		
1990	13,061		
2000	13,093		
2004	13,303		13,303
2005	13,120		13,356
2006	13,609	13,609	13,410
2007		--	13,463
2008		--	13,517
2009		--	13,571
2010		12,400	13,625
2011		--	13,680
2012		--	13,735
2013		--	13,790
2014		--	13,845
2015		--	13,900
2016		--	13,956
2020		12,200	14,174
2030		12,000	14,724
2040†		11,800	15,274
Average Annual Growth Rate	-0.267%* 0.262%**	-0.16%	0.4%

* based on 1980-2006 growth rate
** based on 1990-2006 growth rate
† Malcolm Pirnie, Inc. estimate

5.2. Public Water Sources

Future water demands and service area populations were projected for each of the public water systems in Northampton County based extrapolations of recent historical data.

5.2.1. Arlington Plantation

Arlington Plantation (Figure 5-2) is a 112 acre development that is located south of Cape Charles on the Cheasapeake Bay coast and permitted for 19,600 gpd. Currently, there are 16 homes connected to the service area, according to VDH records. Based on an analysis of available 2010 aerial photography, the constructed homes take up approximately 31 percent of the development, with approximately 6 percent assumed green space and the remaining 63 percent of the development available for new homes. Assuming a similar lot size in future development, 32 new lots could be developed for a total of 48. Assuming the current occupancy of 2 people per home will be accurate at buildout, the total population of Arlington Plantation is projected to be 96 people. The buildout date is uncertain as it is assumed that new homes will be constructed on an as needed/demanded basis.

Water demands at Arlington Plantation are estimated to grow proportionately to the number of connected units and to the average annual and maximum month demands, as shown in Table 5-2and Figure 5-3. Therefore, the reported maximum annual average and maximum month demands (6,230 and 8,996 gpd, respectively) were assumed to be representative of the maximum likely demands over the planning horizon. Demands are assumed to be mostly residential in nature.

Figure 5-2: Arlington Plantation Service Area

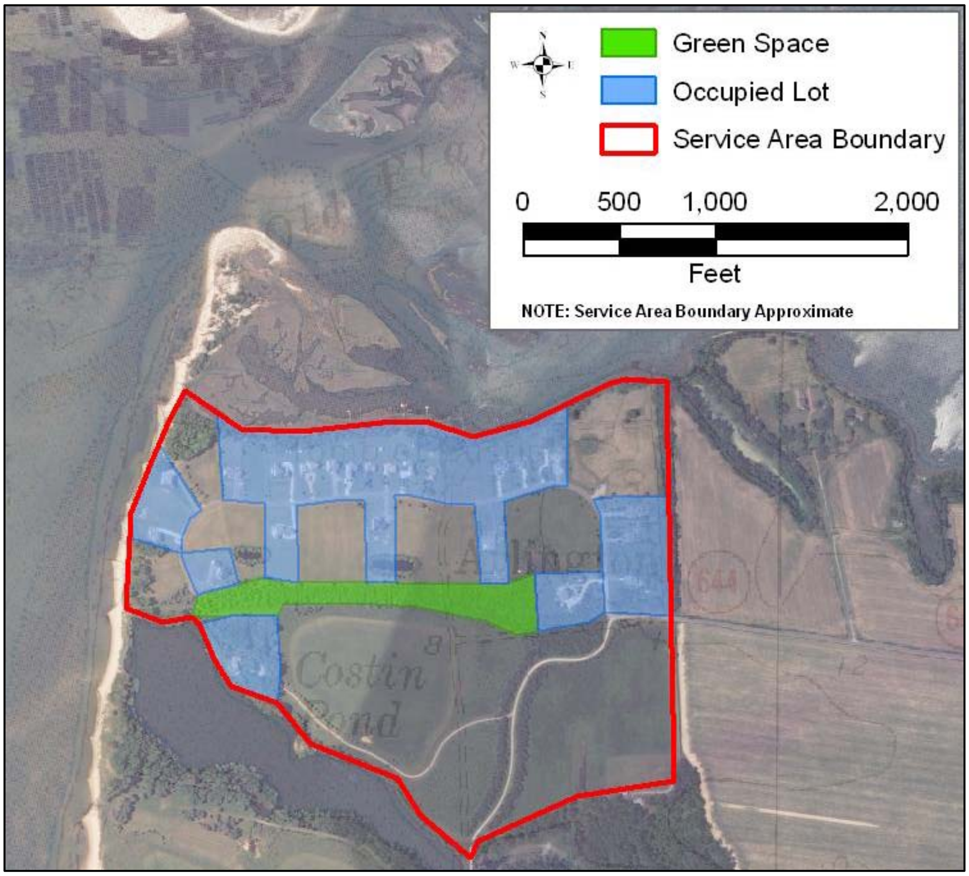


Figure 5-3: Arlington Plantation Population and Demand Projections

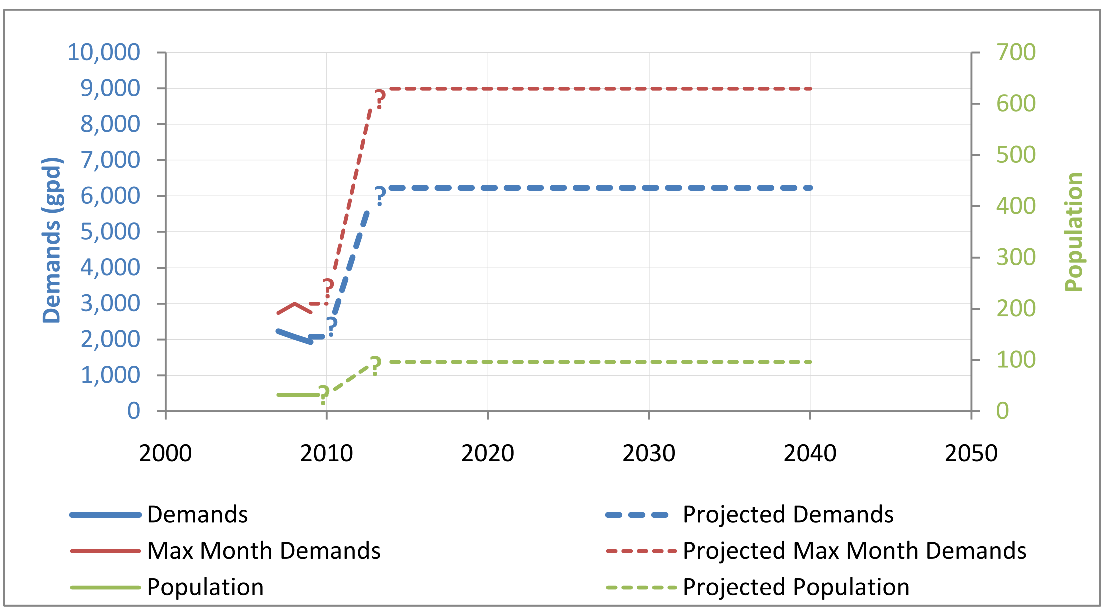


Table 5-2:
Arlington Plantation Population and Demand Projections

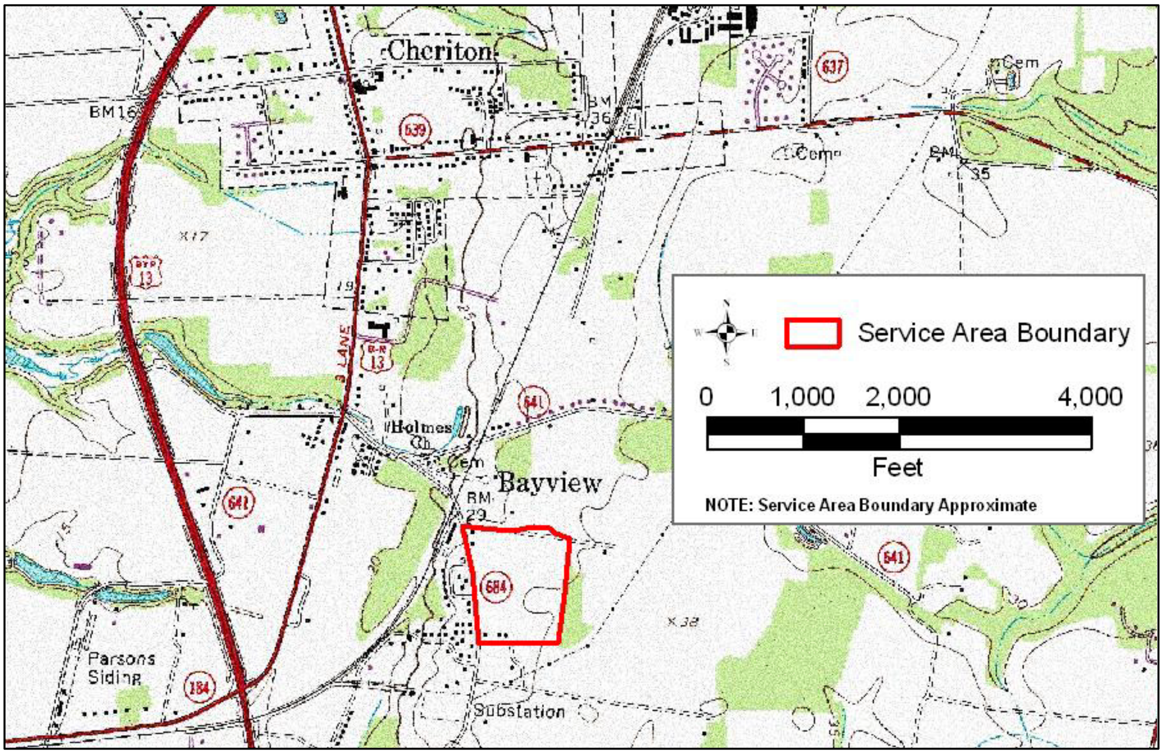
YEAR	POPULATION	CONNECTIONS	AVERAGE DEMANDS (GPD)	PER CAPITA DEMANDS	MAX MONTH DEMANDS (GPD)
VDH Reported Data					
2007	32	16	2,231	69.71	2,738
2008	32	16	2,071	64.71	2,999
2009	32	16	1,928	60.25	2,759
Average	32	16	*2,077	64.89	**2,999
Projected Data					
2010	32	16	2,077	64.89	2,999
2020	96	48	6,230	64.89	8,996
2030	96	48	6,230	64.89	8,996
2040	96	48	6,230	64.89	8,996

* based on 2009 population times average per capita demands
** reported maximum value

5.2.2. Bayview

Bayview (Figure 5-4) is a planned community located south of Cheriton and will consist of 136 dwelling units once completed[17]. According to VDH records, only 65 homes have been constructed and/or connected to the service area as of Oct, 2009. It is expected that all 136 units in the development will be completed within the 2040 planning horizon, however, the date of completion is unknown. Bayview currently has a population of 288 inhabitants which will increase until full buildout. Assuming a proportional increase in population to the current occupancy rate (4.43 occupants per dwelling), the buildout population is estimated to be approximately 603 inhabitants (4.43 occupants per dwelling x 136 dwellings).

Figure 5-4: Bayview Service Area



Water demands at Bayview are estimated to grow proportionately to the number of connected units and to the average annual and maximum month demands, as shown in Table 5-3 and Figure 5-5 . Therefore, the reported maximum annual average and maximum month demands (24,442 and 37,481 gpd, respectively) were assumed to be representative of the maximum likely demands over the planning horizon. Demands are assumed to be mostly residential in nature with a nominal amount of demand associated with Bayview's community center and a few small businesses; however, there is insufficient information to provide an accurate disaggregation of demands.

Figure 5-5: Bayview Population and Demand Projections

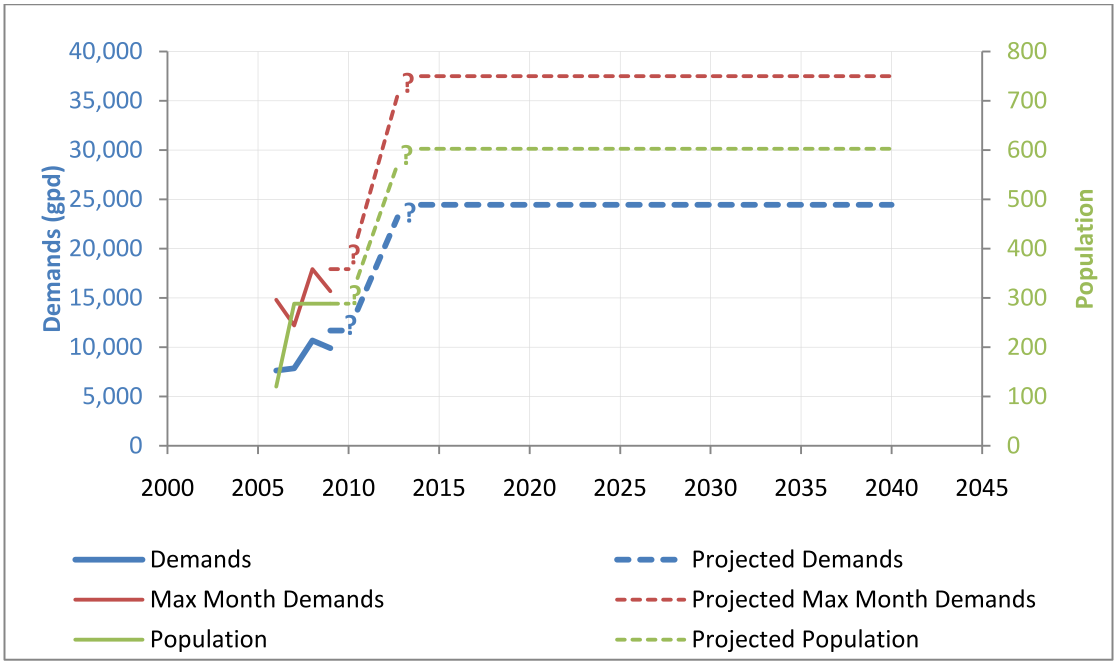


Table 5-3:
Bayview Population and Demand Projections

YEAR	POPULATION	CONNECTIONS	AVERAGE DEMANDS (GPD)	PER CAPITA DEMANDS	MAX MONTH DEMANDS (GPD)
VDH Reported Data					
2006	--	65	7,630	63.58	14,792
2007	288	65	7,862	27.30	12,213
2008	288	65	10,668	37.04	17,914
2009	288	65	9,884	34.32	15,670
Average	288	65	*11,682	40.56	**17,914
Projected Data					
2010	288	65	11,682	40.56	17,914
2020	603	136	24,442	40.56	37,481
2030	603	136	24,442	40.56	37,481
2040	603	136	24,442	40.56	37,481

* based on 2009 population times average per capita demands
** reported maximum value

5.2.3. Town of Cape Charles

The Town of Cape Charles (Figure 5-6)currently has a total of 1,574 residents, 972 of which are full time residents, while 602 are part time residents and occupy dwellings seasonally and on weekends. Over the past two decades, the number of full time residents has declined between 14 and 19 percent, while the number of part time residents has increased significantly over the last decade. The major cause of population growth over the next few decades will most likely be associated with the Bay Creek Resort and Club, a planned unit development to both the north and south of the historic Cape Charles center. Bay Creek has a potential for over 3,000 home sites. Over the past decade, 300 residential dwellings have been constructed in addition to several amenities including two golf courses, a marina, two restaurants, and some commercial space.

Other areas of planned development and service expansion are the South Port Yacht Center and Marine Industrial Park and the Harbor Area. The Harbor Area, immediately south of the historic center of Cape Charles, is expected to have over 360 residential units, restaurants, retail space, a boat storage facility with a capacity of 460, and marina, a hotel with 125 units and 425 condominiums. The anticipated growth in the number of equivalent residential connections (ERC) in the Cape Charles service area is shown in Table 5-4 and Figure 5-7. The estimates are based on projections included in the most recent update to the permit application, dated September 10, 2010 (Appendix C). Average annual demand projections are based on a use of 100 gpd per ERC, which reflects the Service Area’s continuing efforts to improve the efficiency of its system, promote conservation, and the increase in part time residency. Maximum month demand projections were estimated by multiplying the average annual demand by a factor of 1.5, which is higher than the historical ratio due to the continued increase in part time residency, particularly in the summer months.

Figure 5-6: Town of Cape Charles Service Area

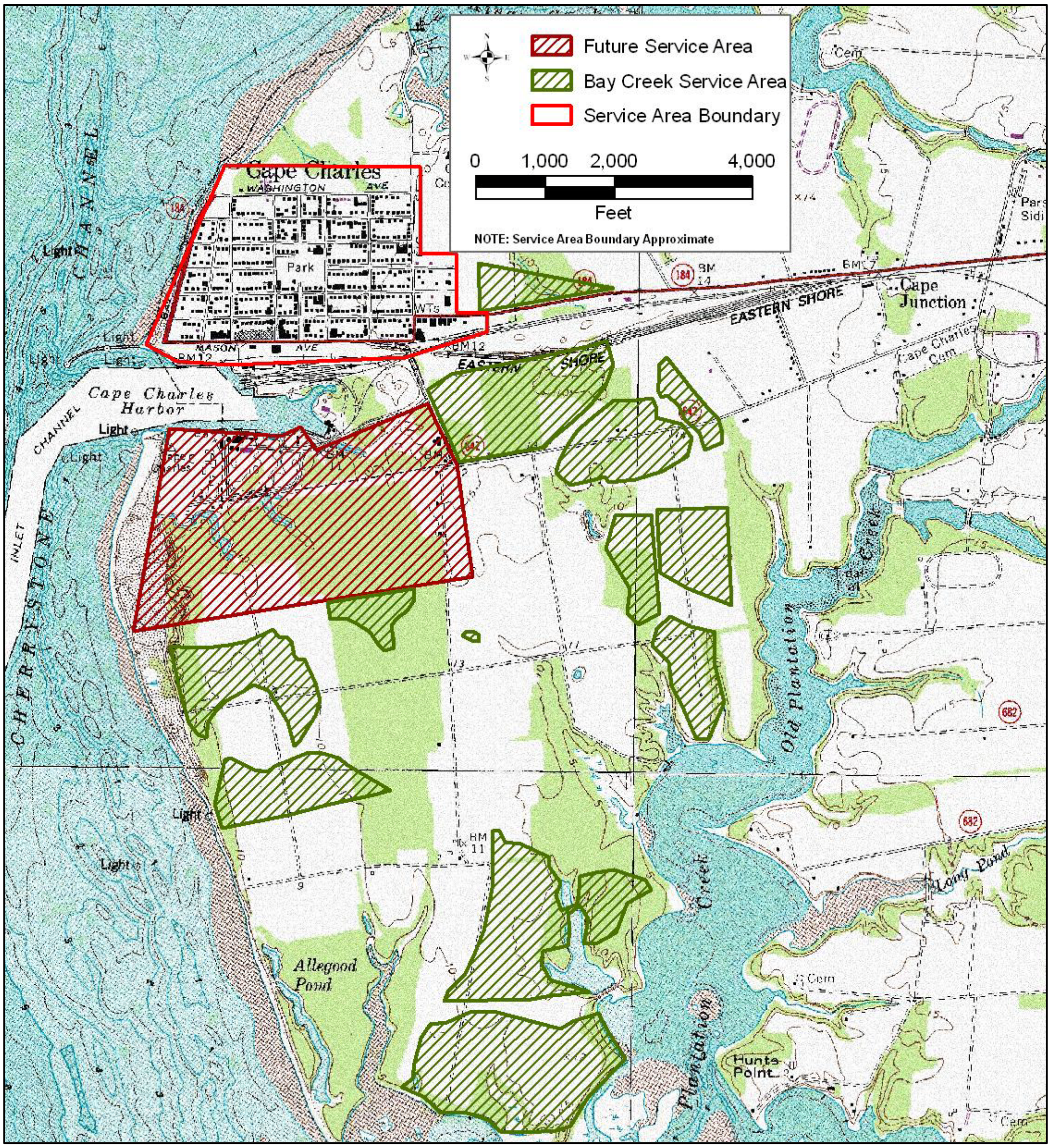


Figure 5-7: Town of Cape Charles Population and Demand Projections

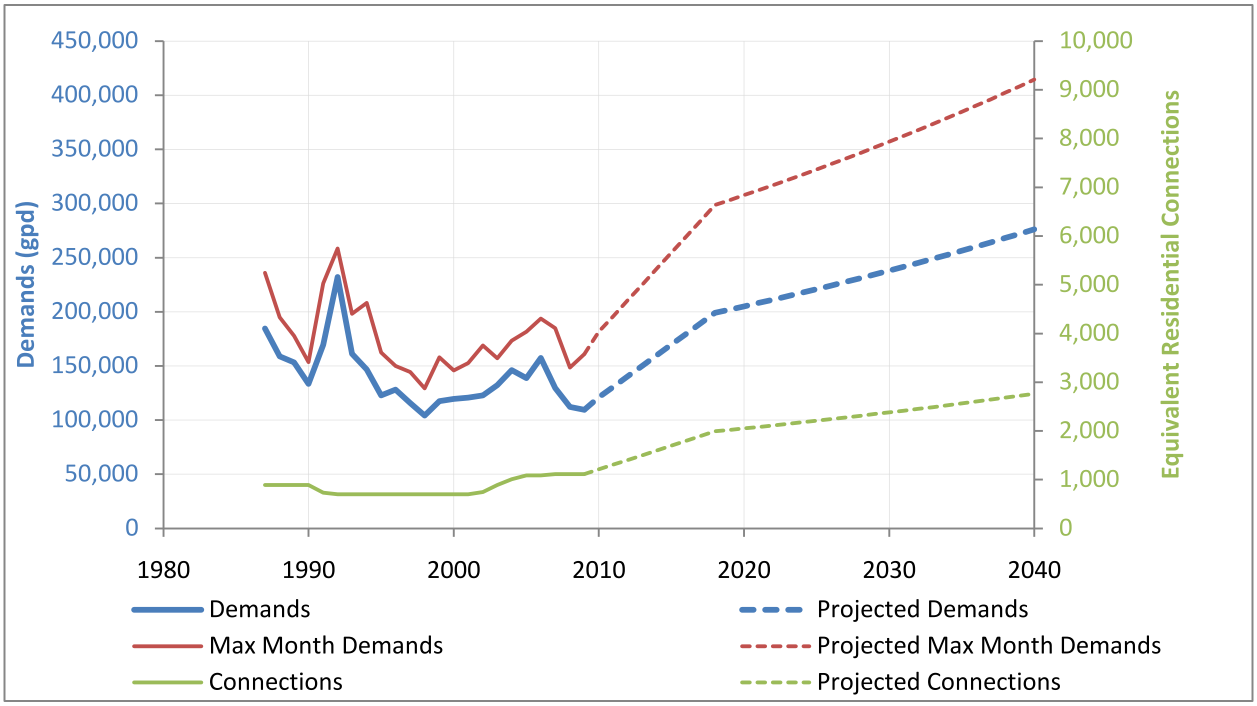


Table 5-4:
Town of Cape Charles Population and Demand Projections

YEAR	ERC	AVERAGE DEMANDS (GPD)	MAX MONTH DEMANDS (GPD)
Projected Data			
2011	1,293	129,300	193,950
2020	2,050	205,000	307,500
2030	2,380	238,000	357,000
2040	2,760	276,000	414,000

Disaggregated demand ratios for Cape Charles are presented in Table 5-5 below and are based on 2007 water usage.

Table 5-5:
Cape Charles Disaggregated Demand Ratios

CATEGORY	PERCENT USE
Well Production	**100.0**
Backwash[1]	**7.6**
Plant Production	**92.4**
Metered Sales[2]	**86.2**
Residential	*71.9*
Condo	*1.2*
Commercial	*10.5*
Municipal	*0.6*
Mixed Use	*1.9*
Unaccounted For[3]	6.1
System Flushing	*0.9*
Fire Protection	*0.2*
VDOT	*0.5*
Leaks/Other	*4.5*

Source:
Town of Cape Charles Condensed Meter Reading Report by Accounty ID for the period between January through December 2007. Some discrepancies exist in the data.
Notes:
1. *Well Production and backwash waste values are metered. Plant production is calculated by subtracting backwater waste from total well withdrawals*
2. *Meter sales provide by the Town of Cape Charles by metered account type. Metered account types include residential, condo, commercial/industrial, municipal, and mixed use.*
3. *Unaccounted for water is the difference between total water produced from the treatment plant and the metered use. Unaccounted for water included unmetered uses, such as fire fighting, flushing pipes, VDOT uses which are estimated, illegal hookups or inaccurate meters; or actual physical losses from leaky pipes.*

5.2.4. Town of Eastville

The Town of Eastville (Figure 5-8) currently has a population of 210 inhabitants. According the VDH records, the population of the Eastville has been effectively flat at 210 residents between 2001 and 2009. In the absence of additional data, it was assumed that the population of Eastville would remain constant through to the 2040 planning horizon. Similarly, average and maximum monthly demands show a level or slight decreasing trend over the same period; therefore, it was assumed that demands would likely remain relatively constant, subject to annual variations in climate. Therefore, the reported maximum annual average and maximum month demands (62,367 and 97,853 gpd, respectively) were assumed to be representative of the maximum likely demands over the planning horizon (Table 5-6 and Figure 5-9). Demands are assumed to be entirely residential in nature.

Figure 5-8: Town of Eastville Service Area

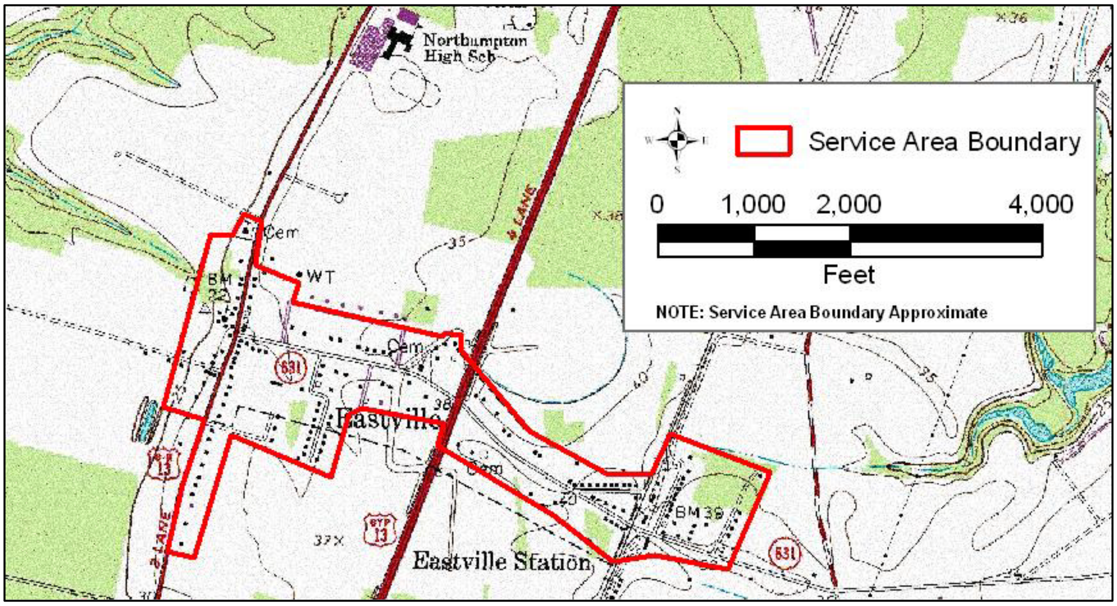


Figure 5-9: Town of Eastville Population and Demand Projections

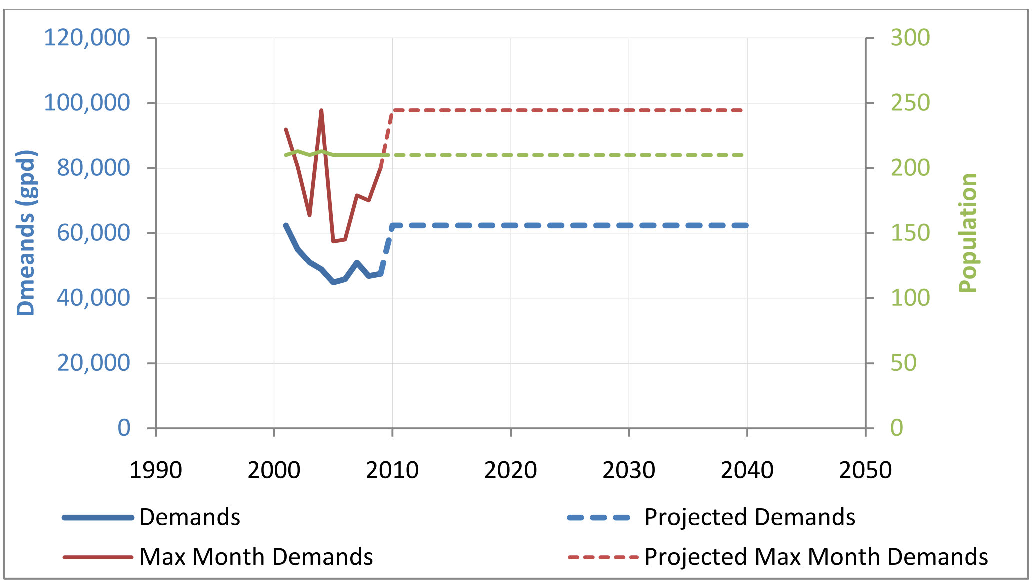


Table 5-6:
Town of Eastville Population and Demand Projections

YEAR	POPULATION	AVERAGE DEMANDS (GPD)	MAX MONTH DEMANDS (GPD)
Projected Data			
2010	210	62,367	97,853
2020	210	62,367	97,853
2030	210	62,367	97,853
2040	210	62,367	97,853

5.2.5. Town of Exmore

The Town of Exmore (Figure 5-10) currently has a population of approximately 1,355 inhabitants. According to U.S. Census Bureau, as cited in the most recent groundwater withdrawal permit application dated July 2009 (Appendix C), the population of Exmore grew by 2 percent per year in the period between 2000 and 2009. The majority of this growth occurred over the period between 2007 and 2009, when the population increased by 8 percent per year. Moving forward, growth is expected to slow over the short term (2009 to 2011) due to current economic conditions, and increase thereafter by approximately 5 percent assuming an improved economy, the addition of broadband access, and an increase in wastewater treatment plant capacity. Based on a continued growth rate of 5 percent through to 2040, the total population of Exmore is projected to be approximately, 3,374 inhabitants (Table 5-7 and Figure 5-11).

Water demands in Exmore are expected to grow with the increase in population, particularly associated with a planned 300 lot subdivision as well as with the planned addition of a new hotel and a biodiesel facility. Detailed projections to 2019 can be found in the permit application (Appendix C). Beyond 2019, annual average water demand projections were estimated by using a straight line extrapolation to a value of approximately 474,000 gpd by 2040. Maximum day demands were projected using the historical ratio of maximum month demand to average annual demand (1.42), resulting in an estimated maximum month demand of approximately 671,000 gpd by 2040.

Table 5-7:
Town of Exmore Population and Demand Projections

YEAR	POPULATION	AVERAGE DEMANDS (GPD)	MAX MONTH DEMANDS (GPD)
Projected Data			
2010	1,382	156,167	220,994
2020	2,019	266,498	377,124
2030	2,696	370,402	524,159

2040	3,374	474,306	671,195

Figure 5-10: Town of Exmore Service Area

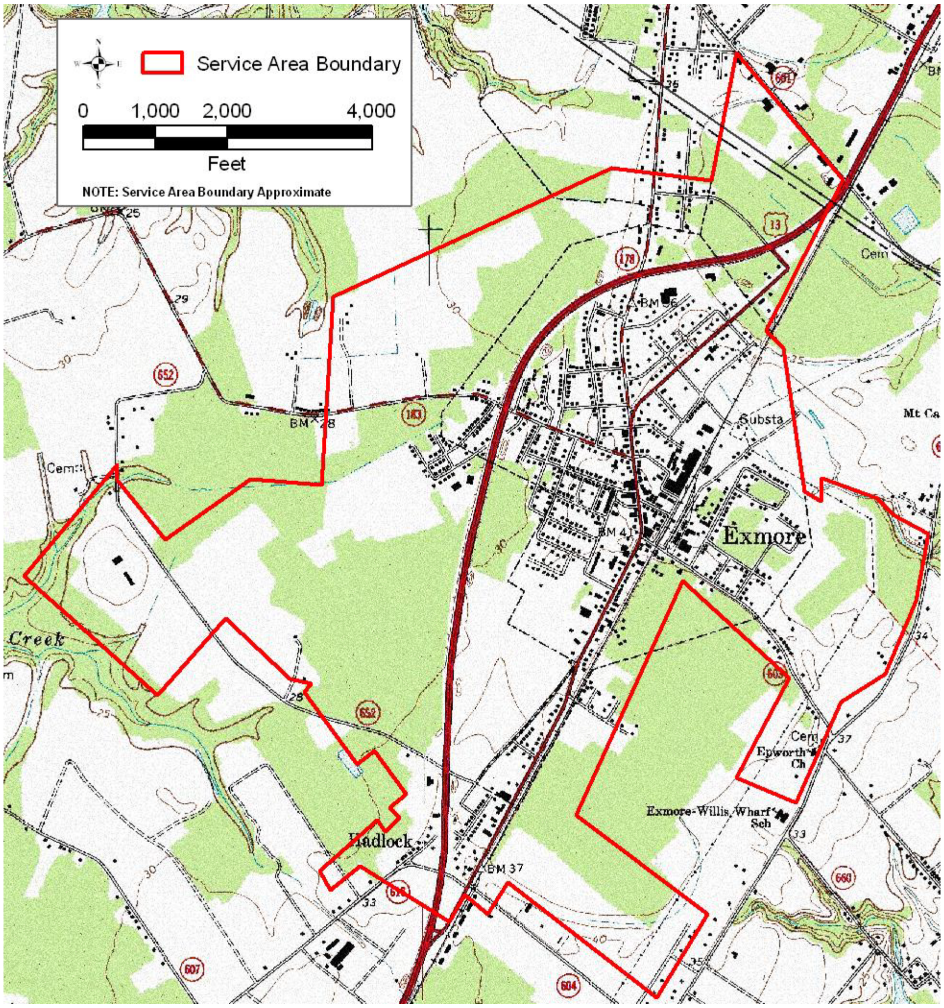
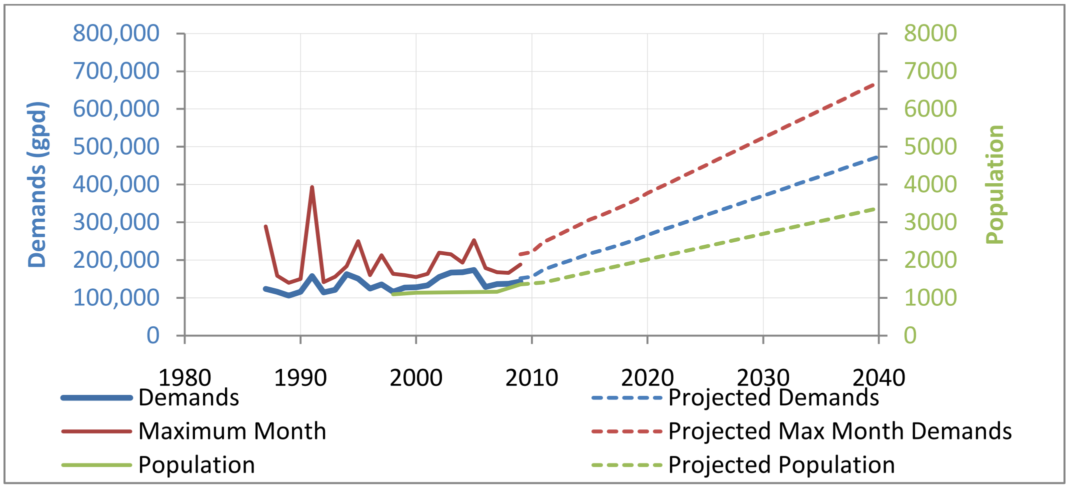


Figure 5-11: Town of Exmore Population and Demand Projections



Disaggregated demand ratios for Exmore are presented in Table 5-5 below and are based on July and August 2008 meter readings reported in the July 2009 Exmore groundwater withdrawal permit application.

Table 5-8:
Exmore Disaggregated Demand Ratios

CATEGORY	JUL 2008		AUG 2008		JUL-AUG 2008 AVERAGE	
	Demands	Percent	Demands	Percent	Demands	Percent
Metered						
Residential	922,897	18.2	989,089	19.2	955,993	**18.7**
Business	2,749,314	54.3	2,330,088	45.3	2,539,701	**49.8**
Other	1,388,689	27.4	1,828,923	35.5	1,608,806	**31.5**
Total	5,060,900	100.0	5,148,100	100.0	5,104,500	**100.0**

Source: Exmore Groundwater Withdrawal Permit Application (July 2009)
Notes: Other category estimated by subtracting total VDH reported withdrawal from metered residential and commercial uses. Other uses are assumed to include unmetered uses, such as fire fighting, flushing pipes, illegal hookups or inaccurate meters; or actual physical losses from leaky pipes.

5.2.6. Holiday Acres Mobile Home Park

Holiday Acres Mobile Home Park is located approximately two miles south of Nassawadox on Route 13 (Figure 5-12). There were an average of 84 residents at the park in 2009 and a historical maximum of 94 people in September 2001. In the absence of additional information, it was assumed that the historical maximum is representative of the maximum likely occupancy of the facility through to the 2040 planning horizon. Since 1998, average annual demands at the park have varied between 4,993 gpd (59 gallons per capita, per day) and 9,401 gpd (129 gallons per capita, per day) and averaged

6,943 gpd), according to VDH reported values. Average annual and maximum month demands have shown a level or decreasing trend over the same period; therefore, it was assumed that demands would likely remain relatively constant, subject to annual variations in climate. Therefore, the reported maximum annual average and maximum month demands (9,854 and 15,999* gpd, respectively) were assumed to be representative of the maximum likely demands over the planning horizon (Table 5-9 and

Figure 5-13). Demands are assumed to be entirely residential in nature.

Figure 5-12: Holiday Acres Mobile Home Park Service Area

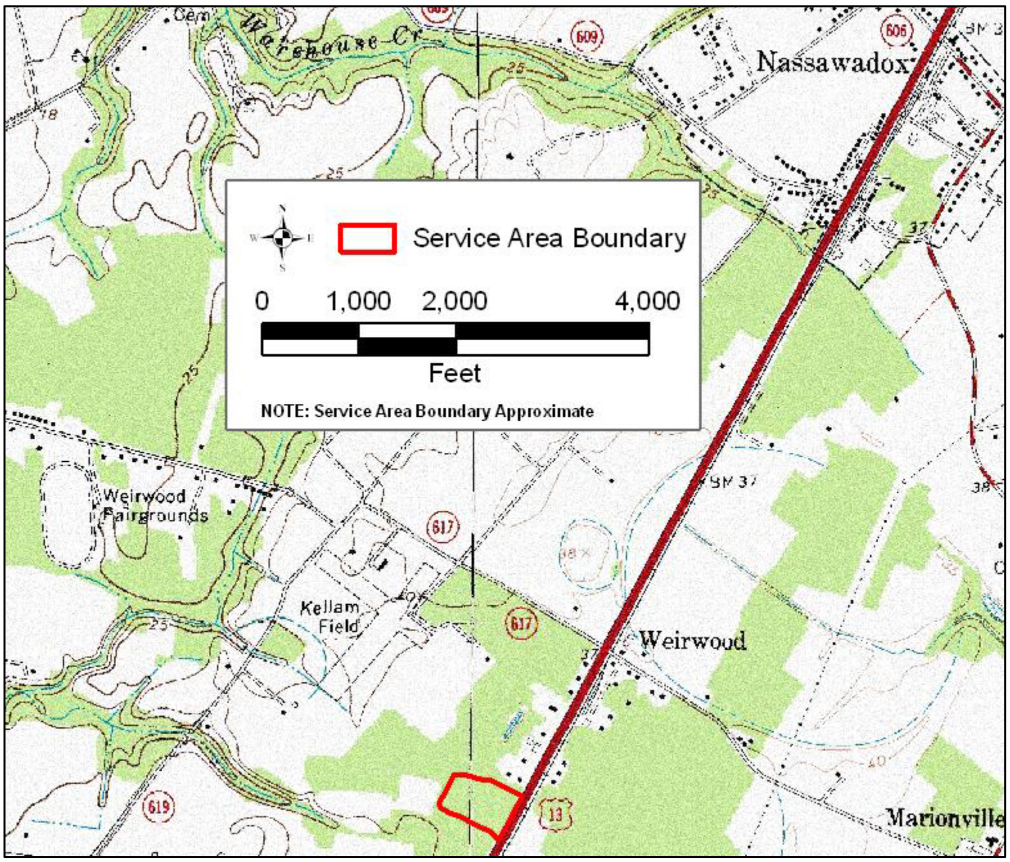


Figure 5-13: Holiday Acres Mobile Home Park Population and Demand Projections

* The estimated maximum month estimate excludes the actual reported historical maximum month demand of 21,716 gpd (239 gallons per capita per day) under the assumption that this demand includes a pipe leak or other unintended use as the next highest demand of 15,999 gpd (the maximum month assumed) was only 150 gallons per capita per day.

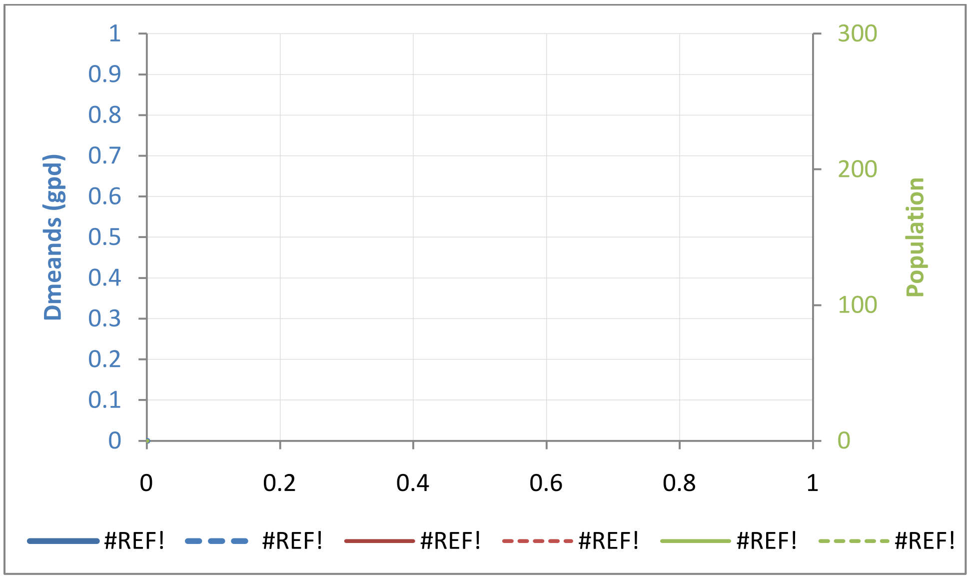


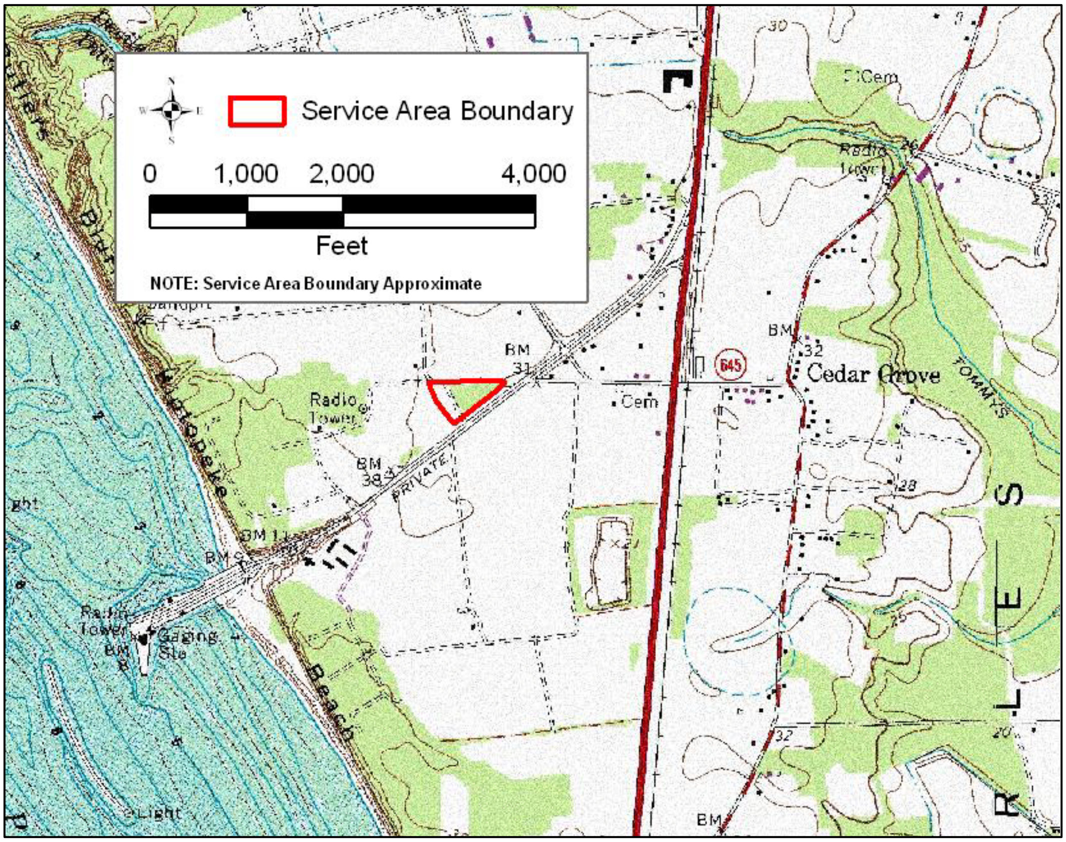
Table 5-9:
Holiday Acres Mobile Home Park Population and Demand Projections

YEAR	POPULATION	AVERAGE DEMANDS (GPD)	MAX MONTH DEMANDS (GPD)
Projected Data			
2010	94	9,854	15,999
2020	94	9,854	15,999
2030	94	9,854	15,999
2040	94	9,854	15,999

5.2.7. Kiptopeake Condominiums

The Kiptopeake Condominiums are located immediately north of Kiptopeake State Park (Figure 5-14). Water usage data for Kiptopeake Condominiums was not available at the time of writing of this report.

Figure 5-14: Kiptopeake Condominiums Service Area



5.2.8. Northampton County Buildings Complex

The Northampton County Buildings Complex is a collection of buildings located in Eastville, including a 325 inmate regional jail facility, a social services building (55 employees and approximately 70 clients per day), a Court Building, a Sheriff's Office with 24 officers, and ancillary offices (Registrar, Commonwealth's Attorney, Juvenile Probation, Court Clerk, Clerk of the Works, Public Services Director, ect.).

Water demand projections were prepared for the Complex as part of its groundwater permit application in 2005 and based on similar facilities in the state. The projections represent the completed facility and are currently expected to represent water demands for the indefinite future, therefore the average annual and maximum month demands at 2040 are anticipated to reach 44,440 gpd and 67,525 gpd, respectively (Table 5-10).

Table 5-10:
Northampton County Buildings Demand Projections

	STAFF			VISITOR			STAFF + VISITOR
Building/Office	# people	Unit demand (gpd)	Demand (gpd)	# people	Unit demand (gpd)	Demand (gpd)	Demand (gpd)
County Administration	48	35	1,680	30	5	150	1,830
Dept. of Social Services	55	15	825	70	3	210	1,035
Clerk of Court	7	15	105	3	3	9	114
Circuit Court	4	15	60	100	3	300	360
Gereral District Court	8	15	120	100	3	300	420
J&DR Court	4	15	60	80	3	240	300
Juvenile Probation	10	15	150	5	3	15	165
Commonwealth's Attorney	4	15	60	0	3	0	60
Registrar	4	15	60	5	3	15	75
Sheriff's Office	24	15	360	5	3	15	375
Jail	40	15	600	20	3	60	660
Jail (inmates)	325	120	39,000			0	39,000
TOTAL			43,080			1,314	**44,394**

Average daily demand =	**44,400**	**gal/day**
Average monthly demand =	**1,350,500**	**gal/month**
Average yearly demand =	**16,206,000**	**gal/year**
Peak monthly demand =	**2,025,750**	**gal/month**
Yearly demand w/ 2 months peak =	**17,556,500**	**gal/year**
Domestic Storage =	**22,200**	**gallons**
Fire reserve storage =	**48,000**	**gallons**
Total Storage Required =	**70,200**	**gallons**
Elevated Storage Provided =	**75,000**	**gallons**

Fire reserve storage is for onsite fire hydrants and sprinkler systems and routine use is not anticipated.

Water Demand Projections

Construction of the Northampton County Government Complex will be phased over the next few years. The demand calculations are for the complex at full buildout and no further expansion is planned.

5.2.9. Shore Memorial Hospital

Shore Memorial Hospital (Figure 5-15) is located in Nassawaddox and currently is licensed for 143 beds[18]. According to VDH records, the facility has an average population of 615, which includes in-patients, out-patients, staff and visitors. Currently, there are no know plans to expand the facility, therefore, in the absence of additional data, it was assumed that the historical maximum annual average and maximum monthly usage rates of 103,222 gpd and 117,378 gpd, respectively are representative of future demands through the 2040 planning horizon (Table 5-11 and Figure 5-16).

Figure 5-15: Shore Memorial Hospital Service Area

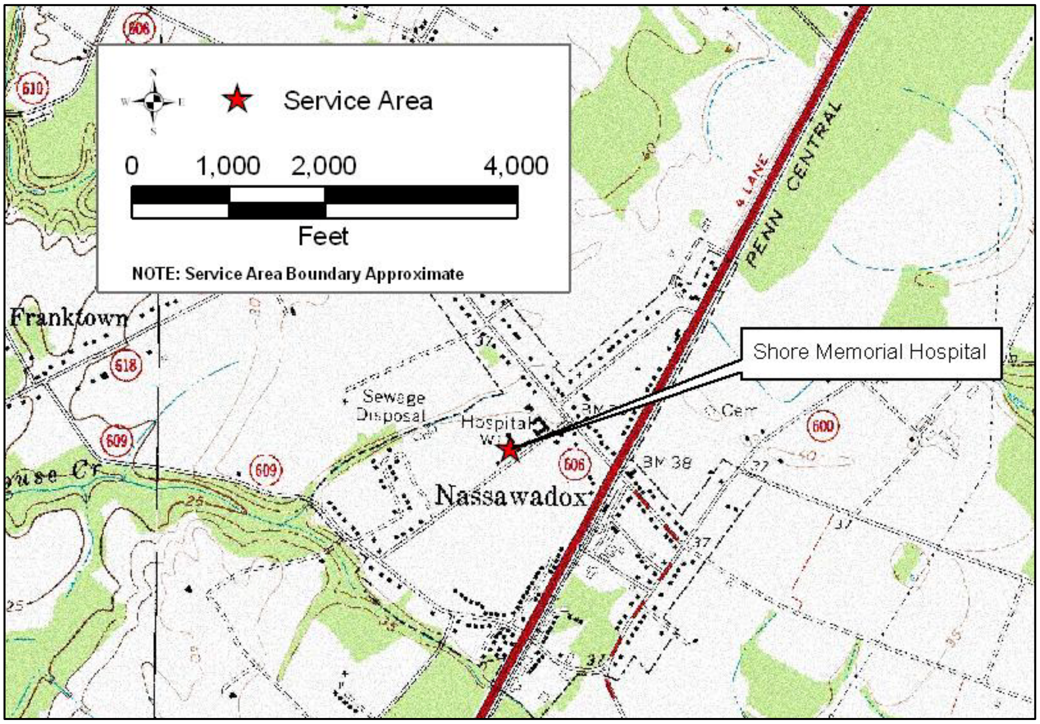


Figure 5-16: Shore Memorial Hospital Population and Demand Projections

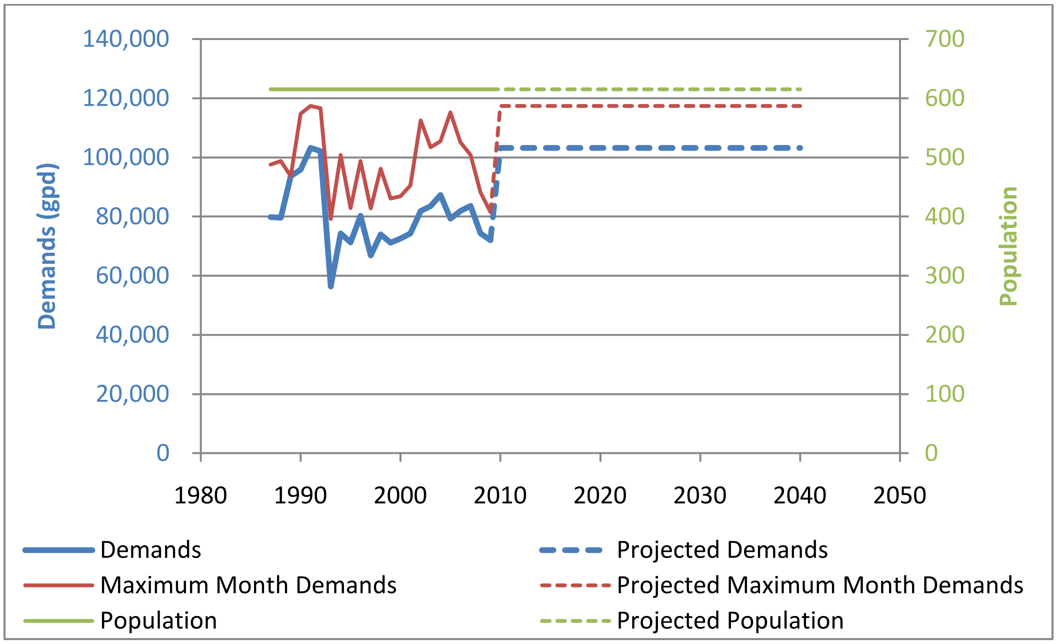


Table 5-11:
Shore Memorial Hospital Population and Demand Projections

YEAR	POPULATION	AVERAGE DEMANDS (GPD)	MAX MONTH DEMANDS (GPD)
Projected Data			
2010	615	72,088	81,567
2020	615	103,222	117,378
2030	615	103,222	117,378
2040	615	103,222	117,378

5.3. Large Self-Supplied Non-Agricultural Users

5.3.1. Bayshore Concrete Products of Cape Charles

Bayshore Concrete produces a variable amount of concrete per year, which has caused water demands to range between 11.5 million gallons in 2002 and 18.5 million gallons. According to the most recent groundwater withdrawal permit, the facility is first and foremost limited by its Air Permit, which limits production to 270,000 tons of concrete per year, consequently, the facility is not currently likely to expand beyond its permitted annual and maximum month withdrawal volumes of 27 million gallons per year and 3.0 million gallons per month for the foreseeable future (Bayshore Concrete groundwater water withdrawal permit application, Appendix C).

5.3.2. Best Western Sunset Beach Resort

The Best Western Sunset Beach Resort consists of an RV park, motel, restaurant and pub. Water demand projections were prepared as part of the facility groundwater withdrawal permit (Appendix C) and were based on usage from the period between 2003 and 2005. Using recorded water withdrawals for the period, an average usage rate for the motel and RV park was determined by subtracting estimated restaurant and pub related water demands based on ticket sales, an assumed $17.5/patron, and a 5 gpd per patron use rate. The average use rates were found to be 224 gpd per RV connection and 290 gpd per motel room. Assuming complete occupancy at the facility, the maximum month demands were projected to be 1,077,560 gallons per month. The ten year goal for the facility was set at annual occupancy rates of 65 percent for the motel and 55 percent for the RV park and ticket sales of $325,000 for the restaurant and pub, resulting in an average annual use of 7,646,624 million gallons per year. There are currently no known plans to expand the facility and as such, it is assumed that the existing ten year targets will be representative of future water demands through the 2040 planning horizon.

5.3.3. Cherrystone Family Camping Resort

According to the most recent groundwater withdrawal permit (Appendix C), the Cherrystone Family Camping Resort had 732 campsites as of 2002 and was anticipating the addition of 200 additional sites in the following years. The 2002 projection reflected anticipated demands for 2012 as presented in Table 5-12.

Table 5-12:
Cherrystone Family Camping Resort Demand Projections

CATEGORY	AVERAGE ANNUAL USAGE (gallons per year)	MAX MONTH DEMANDS (gallons per month)
Projected Data		
Historic Usage	8,057,000	2,347,000
Unmetered Usage	169,000	68,000
Assumed 5 percent occupancy increase	402,850	117,350
200 new campsites	2,130,000	673,200
New Swimming Pool	100,000	100,000
Total	11,038,850	3,505,550

In the absence of updated information and no known plans for expansion, it is assumed that the projection is representative of demands for the foreseeable future, up to and including, the 2040 planning horizon.

5.3.4. YMCA Silver Beach Family Campground

The YMCA Silver Beach Family Campground, opened in 2001 was designed, staffed and equipped to handle up to 450 total persons every day during the months of June through August. During the off-peak season months of September through May, the facility plans occupancy up to 450 person per weekend or approximately 2.5 days per week. The off-peak occupancy rates also reflect retreats and conferences that also occur during these months. Based on the historical usage at the facility, water demands average 77 gallons per person per day. Given historical average usage and the facility's current capacity, the average annual and maximum month demands at full occupancy are estimated to be 17,434 gpd and 32,382 gpd, respectively. The facility's occupancy rates are anticipated to grow linearly until maximum capacity is reached around 2016 and, assuming no expansion of the facility, level off at capacity until the 2040 planning horizon (Table 5-13 and Figure 5-17).

Figure 5-17: YMCA Silver Beach Campground Demand Projections

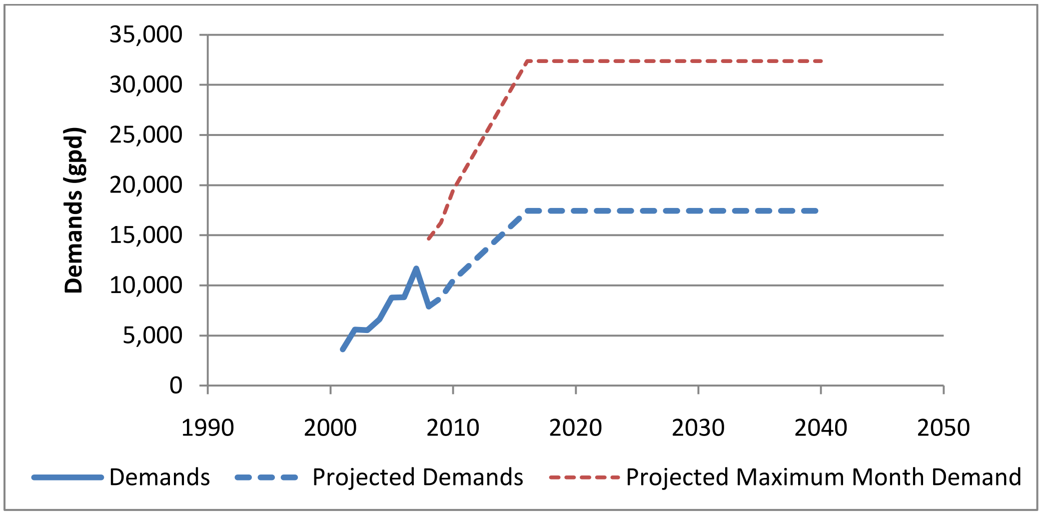


Table 5-13:
YMCA Silver Beach Demand Projections

YEAR	AVERAGE DEMANDS (GPD)	MAX MONTH DEMANDS (GPD)
Projected Data		
2010	10,482	19,469
2020	17,434	32,382
2030	17,434	32,382
2040	17,434	32,382

5.4. Large Self-Supplied Agricultural Users

No detailed historical usage was available upon which to base a series of projections for large agricultural demands at individual facilities and available groundwater permit applications indicated that requested amounts would be sufficient for the foreseeable future. Furthermore, the USGS estimates of water usage for the County for the period between 1985 and 2005 indicate a level or declining trend in agricultural demands (Figure 5-18)[19]. Therefore, it was assumed that, on average, the current permitted amounts for each facility will likely be sufficient to meet demands within the 2040 planning horizon (Table 5-14 and Table 5-15).

Table 5-14.
Projected Large Self-Supplied Agricultural Groundwater Demands

FACILITY/SYSTEM NAME	Annual Permitted Withdrawal (gallons) *Assumed 2010-2040 Demands*	Monthly Permitted Withdrawal (gallons) *Assumed 2010-2040 Demands*
AL Mathews	41,904,000	14,142,000
Ames Farm	65,000,000	16,250,000
Bethel Church	32,400,000	16,200,000
Bobtown Nursery	10,900,000	4,000,000
Bowen Farm	42,620,000	16,000,000
Broadleaf Farms	3,700,000	1,000,000
Byrd Farm	22,650,000	9,910,000
Christian/Ames Farm	56,091,000	21,034,125
David Van Dessel Farm	4,500,000	1,200,000
Dennis Azaleas	2,700,000	500,000
Dennis Nursery	5,000,000	900,000
Drummond Farm	31,000,000	11,000,000
East Coast Brokers and Packers	13,500,000	2,400,000
Ed Goin	34,320,000	11,583,000
Evans or Oaks Farm	120,072,000	26,568,000
Gillespe Farm	28,000,000	12,500,000
Gunter Farm	12,500,000	6,300,000
Hagan Farm	17,000,000	5,700,000
Hickory Hill	34,560,000	17,280,000
Hogneck Farm	13,000,000	5,500,000
Home Farm	8,400,000	6,500,000
James Farm	54,000,000	7,900,000
Kelley Farm	30,124,000	14,300,000
Lang	51,840,000	12,960,000
Lewis Farm	24,300,000	11,500,000
Liberty Hall Farm	4,400,000	1,000,000
Mathews Farm	10,900,000	3,114,290
Melfa Farm	30,360,000	11,400,000
Middleton Farm	185,000,000	37,000,000
Mutton Hunk Fen Natural Area Preserve	40,340,000	19,100,000
Northam Somers	37,800,000	11,812,500
Painter Farm	18,400,000	8,520,000
Peach Orchard	42,600,000	8,520,000
Rew Farm	49,000,000	16,300,000
Robert Van Dessel Farm	3,400,000	900,000
Simpson Farm	21,517,000	10,193,000
Sommers Farm	24,300,000	11,500,000
Sterling	93,060,000	44,080,000
Tidewater Growers	1,800,000	600,000
Weaver Farm	32,900,000	11,000,000
Wes Powers	20,160,000	5,040,000
Wessells Farm	21,517,000	10,193,000
Wessells/ Watkinson Farm	13,500,000	3,375,000
Total Permitted Withdrawals (MG)	**1,411.04**	**466.77**

Figure 5-18: USGS Historical Trend in Agricultural Water Demands in Northampton

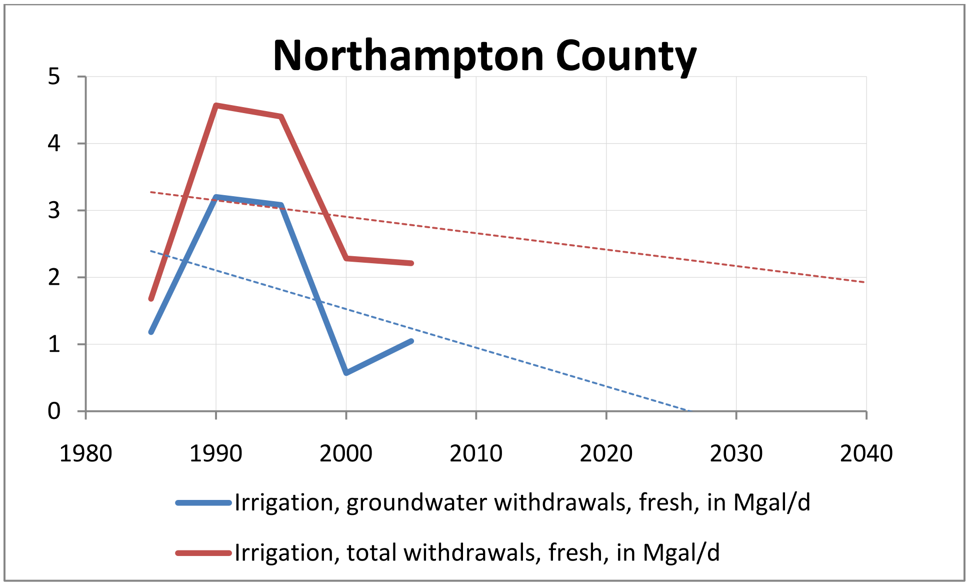


Table 5-15.
Projected Large Self-Supplied Agricultural Surface Water Demands

	Average Annual Use (MG)
User Name	*Assumed 2010-2040 Demands*
BLACK FARMS	35.20
CHERITON FARMS	2.85
CHEROKEE POINT FARMS	4.32
DAVIDS NURSERY	7.03
HERMITAGE FARMS NURSERY	16.69
KELLAM FARM	12.00
MIDWOOD FARM	4.99
NOTTINGHAM ENTERPRISES INC	16.50
WAYNE T HEATH FARMS INC	16.20
YAROS FARMS INC	289.83

5.5. Small Self-Supplied Use Outside of the Community Service Areas

Based on USGS estimates of small self-supplied population and water demands outside of the community service area, the County-wide trends for the period between 1985 and 2005 are decreasing[19]. The USGS data were extrapolated to 2040 using a linear interpolation for population and water demands (Table 5-16 and Figure 5-19).

Figure 5-19: Small Self-Supplied Water Demands Outside of the Community Service Areas

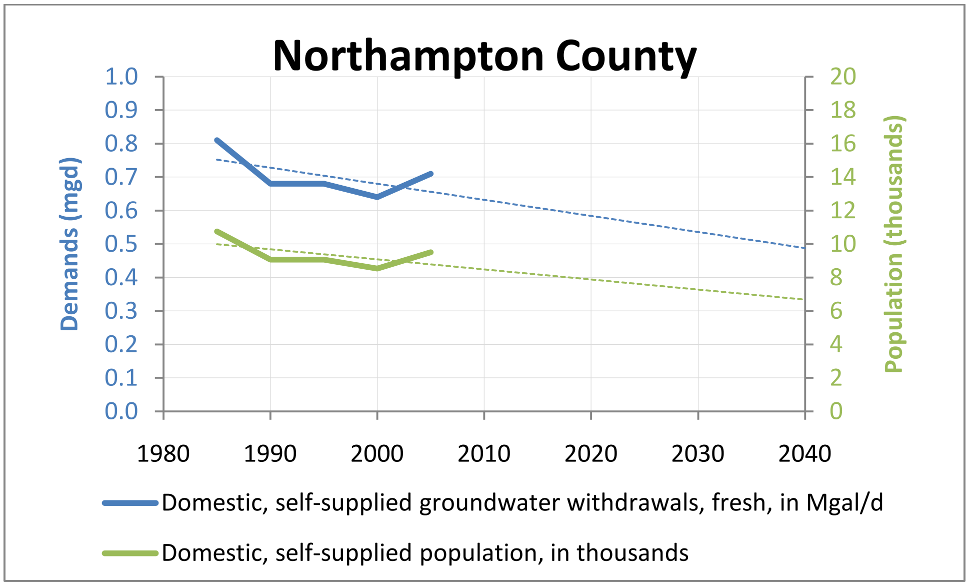


Table 5-16:
Small Self-Supplied Water Demand Projections

YEAR	POPULATION	AVERAGE DEMAND (GPD)
Projected Data		
2010	8,487	632,000
2020	7,883	584,000
2030	7,278	536,000
2040	6,674	488,000

6. Water Demand Management (9 VAC 25-780-110)

Water demand management involves both an increase in efficiency of water use and a reduction of water losses. The net result is a decrease in demand for treated water that can defer development of new resources and reduce the cost of future water service. Each gallon of water conserved is one less requiring storage, treatment, and distribution. It may also represent one less gallon that has to be heated for washing or bathing, thus saving energy costs, or that must pass through a wastewater conveyance system and treatment before it is returned to the environment.

Conservation is an important complement to new supply sources. In some cases, conservation may eliminate the need for new sources of supply. Fresh water, like other natural resources, is a limited commodity which must be managed wisely to preserve the well-being of future generations. Efforts to conserve existing supplies and efficient allocation of water resources are important during each stage of the water supply planning process.

The Groundwater Management Act of 1992 requires a Groundwater Withdrawal Permit for all groundwater withdrawals greater than or equal to 300,000 gallons per month within declared Groundwater Management Areas, including the Eastern Shore Groundwater Management Area (ESGWMA). The Groundwater Withdrawal Regulations require that applications for new Groundwater Withdrawal Permits within the ESGWMA include a Water Conservation and Management Plan (WCMP) approved by the Virginia Department of Environmental Quality, Water Resources Division. The WCMP is included as an enforceable part of the permit to withdraw groundwater. Because groundwater is the sole source of water for public, commercial, and a majority of the industrial water supplies in Northampton County, the WCMPs that are part of the Groundwater Withdrawal Permit fulfill the Water Demand Management requirement under this section. Most agricultural uses that require irrigation also withdrawal groundwater at quantities requiring a permit, and will require a WCMP as part of the permit.

An approved WCMP must include:

- Use of water-saving plumbing and processes including, where appropriate, the use of water-saving fixtures in new and renovated plumbing as provided under the Uniform Statewide Building Code (USBC).
- A water loss reduction program.
- A water use education program.

- An evaluation of potential water reuse options.

There are also requirements for mandatory use reductions during water shortage emergencies, including, where appropriate, ordinances prohibiting the waste of water generally.

6.1. Public Water Supplies

The following are components associated with Water Demand Management common to public water supplies. Individual water systems will have their own WCMPs as part of their Groundwater Withdrawal Permits. These plans are provided in Appendix C.

6.1.1. Water Saving Equipment and Processes

The Building Officials and Code Administrators (BOCA) organization is a nonprofit organization which develops a series of performance-oriented model codes (BOCA, 1990). These codes were adopted by the Commonwealth of Virginia as part of the Virginia Uniform Statewide Building Code (USBC, 2006). These codes directly specify the use of water conservation fixtures in commercial and residential applications.

The USBC applies to all new construction and some remodeling of existing structures. The USBC requires that:

> *When reconstruction, renovation, or repair of existing buildings is undertaken, existing materials and equipment may be replaced with materials and equipment of similar kind or replaced with greater capacity equipment in the same location when not considered a hazard; however, when new systems, materials, and equipment that were not part of the original existing building are added, the new systems, materials, and equipment shall be subject to the edition of the USBC in effect at the time of their installation. Existing parts of such buildings not being reconstructed, renovated, or repaired need not be brought into compliance with the current edition of the USBC.*

The International Plumbing Code (IPC) sets maximum flow standards (Section 605.4) for a variety of fixtures and appliances. These standards are presented in the following table.

Plumbing Fixture or Fixture Setting	Maximum Flow Rate or Quantity [1]
Water Closet	1.6 gallons per flushing cycle
Urinal	1.0 gallon per flushing cycle

Shower head	2.5 gpm at 80 psi
Lavatory, private	2.2 gpm at 60 psi
Lavatory, public	0.5 gpm at 80 psi
Lavatory, public, metering or self-closing	0.25 gallon per metering cycle
Sink faucet	2.2 gpm at 60 psi

1 gpm - gallons per minute

The current standards set a maximum limit of 2.2 gallons per minute (gpm) at 80 pounds per square inch (psi) for showers and private lavatories. Water closets are limited to 1.6 gallons per flushing cycle, and urinals are limited to 1.0 gallons per cycle. In addition, lavatories in public facilities are limited to 0.5 gpm for those with standard valve or spring faucets and 0.25 gallons per cycle for self-closing metering valves (IPC, 2006).

The USBC in Virginia was adopted from the International Plumbing Code. States are permitted to develop plumbing codes that implement stricter measures than those imposed by the National Plumbing Code. However, localities in Virginia must obtain State authorization to develop a stricter code.

6.1.2. Water Loss Reduction Program

6.1.2.1. Water Loss Audit

Annually a water loss audit will be conducted to determine the volume and nature of lost and unaccounted-for water within the water supply system. The purpose of this audit is to identify sources of demand that would normally escape detection by the metering system. This type of demand includes:

1. Fire Fighting. The Fire Department will submit an estimate of all water used on a monthly basis including water used for fire-fighting and for hydrant flushing.

2. Main Flushing. All main flushing performed by the PWS will require the submittal of a water consumption estimate.

3. Theft. Any observed theft will be reported to the PWS and the appropriate action will be taken. An estimate of the volume of water stolen will be submitted as part of the annual water loss audit.

4. Main Breaks. All main breaks will require the reporting by PWS personnel of the estimated volume of water lost.

5. Tank Drainage. All draining of storage tanks in the main distribution system will be reported.

6. Unmetered Services. Every effort will be made to install meters on any portion of the system that is not yet metered as soon as funding becomes available. Grants will be solicited to provide funding.

7. Leaks. Upon completion of the first water loss audit, the PWS will develop a leak detection program which will have as its goal the complete survey of all distribution pipes and mains within the system, to be phased in over the next five years.

8. Meter Errors. The PWS will replace meters at a rate such that a complete system-wide meter turnover takes place every fifteen years, which is the typical warranty period for water meters. The size of meters requested by commercial and industrial customers will be evaluated and the developer will be consulted to help in determining the appropriate meter size for a particular site based on water use and the anticipated demand. Preventing the installation of oversized meters minimizes unwarranted waste of water.

9. Equipment Calibration. All meters at the well heads will be calibrated on an annual basis. There will be service to check and replace inaccurate meters. Large customer meters that are accessible will be field calibrated yearly. An on-going maintenance program will be implemented to locate and repair plant pipe leaks at the water treatment facilities.

All forms for reporting leaks and unaccounted-for water loss will be maintained by the PWS. These forms will be reviewed by PWS personnel on a daily basis so that measures can be taken to reduce unaccounted-for water loss.

6.1.2.2. Leak Repair Program

The owner of any residential unit, commercial establishment, or industrial establishment who is found, based on the water loss audit or by other methods, to be an excessive user of water due to leakage from water lines or plumbing fixtures on the premises will be notified by the PWS. These owners will be required to repair and stop such leakage within a reasonable period of time or will be subject to financial penalties.

6.1.3. Water Use Education Program

Public education concerning the importance of water conservation is a key factor in reducing excessive water use. Education programs should include information about how drinking water is produced and why it is important to conserve. Providing consumers with a better understanding of the reasons conservation is necessary allows them to better appreciate and participate in conservation activities.

The public education program planned by the PWS will include the following components:

1. Billing Inserts. Inserts will be included with water bills. The inserts will include information concerning water conservation techniques and leak detection strategies.

2. Brochures. Water conservation brochures and pamphlets will be made available to the public and at exhibits set up during public events.

3. Video Tapes. A variety of water conservation video tapes will be available from the PWS free of charge. They will be available to the general public, to schools for classroom instruction, and for public meetings. The videos will also be provided to cable television companies for showing on government channels.

4. Water Conservation Hot Line. A telephone number will be available through which residents can have their conservation questions answered by a knowledgeable Town employee. In addition, requests for information on various water conservation topics, speakers, or other personal contacts will be coordinated through this telephone line.

5. News Releases. News releases to the print media, radio, and television will keep the public informed. This process will be used not only during emergencies but also on a regular basis to keep the public informed about conservation-related issues.

6. School Education. Programs will be available for presentation by PWS staff at local schools. Programs will be targeted to specific age groups. Assistance will be made available for teachers who wish to develop their own water awareness programs.

7. Speakers. PWS staff will be available for speaking engagements or personal contacts. These individuals will work with local clubs and organizations to develop public awareness concerning the need to conserve water along with other topics related to the water supply industry.

8. Support of water table groundwater wells for irrigation of lawns and landscaping by residents, businesses and industries within the service area. The use of wells screened in the water table aquifer for these activities helps to minimize the use of the confined Yorktown-Eastover aquifer.

6.1.4. Economic Incentives

Block rate schedules provide a mechanism for his schedule encourages conservation by not providing a lower rate to high volume water users. By charging large and small water users the same rate, large users have a greater incentive to conserve.

The Town will analyze its water rates annually. Rate setting goals will be as follows:

- Perpetuating Public Utilities self-sufficiency while maintaining the highest water quality standards.
- Recommending appropriate rates for water usage and special service charges that are equitable to all customers.
- Continuing a comprehensive water conservation policy by using public information and charges which will discourage nonessential use of water.

6.1.5. Water Reuse

Water reuse may be either direct or indirect and for potable or non-potable uses. Direct reuse involves introducing highly treated, reclaimed water directly to a potable water distribution system, while indirect reuse involves returning treated wastewater to the environment for dilution and natural purification, and subsequent withdrawal for water supply. Potable reuse (which is referred to as recycle by the Virginia Department of Health (VDH)) is the specific use of treated wastewater as a drinking water source.

Indirect potable reuse occurs widely in the United States, each time treated wastewater effluent is discharged to a natural waterway upstream of a water supply intake. In most cases, it is unintentional. Past experience indicates that indirect reuse was acceptable because the application of water and wastewater treatment techniques, the near-universal use of some form of disinfectant, and the natural dilution and purification that occurs in natural waterways adequately treated the water. However, in recent years the effectiveness of these measures in protecting against viral and trace organic contaminants has come under increasing scrutiny.

Unplanned and unintentional reuse of this type is classified as uncontrolled potable reuse, and represents the overwhelming majority of cases of indirect potable reuse.

6.1.5.1. Potable Reuse

The Virginia Department of Health has prepared a Recycle Issues paper dated November 24, 1992. The VDH stated its opposition to both direct and indirect potable reuse projects when naturally occurring sources of water are available. The VDH insists that the highest quality, best source of water be selected when alternatives are available. The VDH also listed several other requirements which would apply to a potable reuse project, pertaining to independent monitoring, dilution, liability, removal of biological hazards and toxics, and utilization of natural purification processes. Given the current position of the VDH, reuse of wastewater treatment plant effluent for potable purposes is not deemed a practicable reuse alternative to conserve water.

6.1.5.2. Non-Potable Reuse

Many industrial water demands are for non-potable uses. One method of reducing demands on potable water sources is to supply non-potable demands using treated wastewater plant effluent. Detailed regulations for implementation of a water reuse project do not exist in the Commonwealth of Virginia. Permitting of a water reuse project would most likely involve both the VDH and the Virginia Department of Environmental Quality (VDEQ). In addition, a Virginia Pollution Discharge Elimination System (VPDES) Permit would be required for discharge to State waters if the flow is not contaminated during its use; if it is contaminated, the approval of VDH and/or VDEQ would be required.

Several states including California, Arizona, Texas, Utah, and Florida have developed regulations and state statutes that specify the required minimum quality of reclaimed water, depending on the intended use of the water. In general, the requirements become more stringent as the likelihood of public contact increases. In California, if treated reclaimed water for industrial use meets the state’s standards for full body contact recreation, workers are not required to avoid contact with the water or to wear protective clothing. However, precautions are required should the treated reclaimed water fail to meet these criteria. With the approval of State and local health departments, reclaimed water can be used for soil compaction, dust control, and other construction purposes.

As mentioned previously, recycling will be required in all new car washes and existing car washes will be required to be retrofitted. In addition, required recycling systems are being considered for all new construction and all repair or replacement of continuous flow devices, including any water connector, device, or appliance which requires a continuous flow of 5 gallons per minute or more.

Typically, non-potable markets for reused water include irrigation uses, industrial uses, and creation of recreational lakes. Many factors affect the market for reused water, including:

- Size and location of demand.
- Water quality requirements.
- Degree of treatment required for discharge.
- Cost of reclaimed water.
- Cost and availability of alternative supplies.

It is likely that additional reuse methodologies will be evaluated in the future. Industries within the service area that use large quantities of water are continually evaluating their processes and looking for ways to lower production costs. For these industries, water represents one of their greatest operating expenses. It is in the best interest of these industries to stay abreast of the latest reuse technologies and employ them whenever feasible.

6.2. Commercial and Industrial Supplies

The following are components associated with Water Demand Management common to commercial and industrial water supplies. Individual water systems will have their own WCMPs as part of their Groundwater Withdrawal Permits. These plans are provided in Appendix C.

6.2.1. Water Saving Equipment and Processes

The Building Officials and Code Administrators (BOCA) organization is a nonprofit organization which develops a series of performance-oriented model codes (BOCA, 1990). These codes were adopted by the Commonwealth of Virginia as part of the Virginia Uniform Statewide Building Code (USBC, 2006). These codes directly specify the use of water conservation fixtures in commercial and residential applications.

The USBC applies to all new construction and some remodeling of existing structures. The USBC requires that:

> *When reconstruction, renovation, or repair of existing buildings is undertaken, existing materials and equipment may be replaced with materials and equipment of similar kind or replaced with greater capacity equipment in the same location when not considered a hazard; however, when new systems, materials, and equipment that were not part of the original existing building are added, the new systems, materials, and equipment shall be subject to the edition of the USBC in effect at the time of their installation. Existing parts of such buildings not being reconstructed, renovated, or repaired need not be brought into compliance with the current edition of the USBC.*

The International Plumbing Code (IPC) sets maximum flow standards (Section 605.4) for a variety of fixtures and appliances. These standards are presented in the following table.

Plumbing Fixture or Fixture Setting	Maximum Flow Rate or Quantity [1]
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Urinal	1.0 gallon per flushing cycle

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Lavatory, private	2.5 gpm at 80 psi
Lavatory, public	0.5 gpm at 80 psi
Lavatory, public, metering or self-closing	0.25 gallon per metering cycle
Sink faucet	2.5 gpm at 60 psi

1 gpm - gallons per minute

The current standards set a maximum limit of 2.5 gallons per minute (gpm) at 80 pounds per square inch (psi) for showers and private lavatories. Water closets are limited to 1.6 gallons per flushing cycle, and urinals are limited to 1.0 gallons per cycle. In addition, lavatories in public facilities are limited to 0.5 gpm for those with standard valve or spring faucets and 0.25 gallons per cycle for self-closing metering valves (IPC, 1996).

The USBC in Virginia was adopted from the International Plumbing Code. States are permitted to develop plumbing codes that implement stricter measures than those imposed by the National Plumbing Code. However, localities in Virginia must obtain State authorization to develop a stricter code.

6.2.2. Water Loss Reduction Program

There are a wide variety of commercial and industrial uses of water and water loss reduction programs specific to that enterprise are included in the WCMPs provided in Appendix C. However, there are common components that apply to most commercial and industrial uses:

- Routinely record water meter readings. Review use to identify changes that might indicate a leak. Use of historical tables, time-trend graphs, and/or process limits as applicable will be used to identify abnormal use patterns.
- Routinely inspect piping and tanks for any indication of leaks.
- Implement written procedures to address leaks that will include means for a rapid repair and/or leak bypass to minimize water loss.
- Replace meters at a rate such that a complete system-wide meter turnover takes place every fifteen years, which is the typical warranty period for water meters.
- All meters at the well heads will be calibrated on an annual basis. There will be service to check and replace inaccurate meters.

6.2.3. Water Use Education Program

Water use education is highly specific to the commercial and/or industrial use. Education programs for individual commercial and industrial users are described in the WCMPs included in Appendix C.

6.2.4. Water Reuse

Water reuse may be either direct or indirect and for potable or non-potable uses. Direct reuse involves introducing highly treated, reclaimed water directly to a potable water distribution system, while indirect reuse involves returning treated wastewater to the environment for dilution and natural purification, and subsequent withdrawal for water supply. Potable reuse (which is referred to as recycle by the Virginia Department of Health (VDH)) is the specific use of treated wastewater as a drinking water source.

Indirect potable reuse occurs widely in the United States, each time treated wastewater effluent is discharged to a natural waterway upstream of a water supply intake. In most cases, it is unintentional. Past experience indicates that indirect reuse was acceptable because the application of water and wastewater treatment techniques, the near-universal use of some form of disinfectant, and the natural dilution and purification that occurs in natural waterways adequately treated the water. However, in recent years the effectiveness of these measures in protecting against viral and trace organic contaminants has come under increasing scrutiny.

Unplanned and unintentional reuse of this type is classified as uncontrolled potable reuse, and represents the overwhelming majority of cases of indirect potable reuse.

6.2.4.1. Potable Reuse

The Virginia Department of Health has prepared a Recycle Issues paper dated November 24, 1992. The VDH stated its opposition to both direct and indirect potable reuse projects when naturally occurring sources of water are available. The VDH insists that the highest quality, best source of water be selected when alternatives are available. The VDH also listed several other requirements which would apply to a potable reuse project, pertaining to independent monitoring, dilution, liability, removal of biological hazards and toxics, and utilization of natural purification processes. Given the current position of the VDH, reuse of wastewater treatment plant effluent for potable purposes is not deemed a practicable reuse alternative to conserve water.

6.2.4.2. Non-Potable Reuse

Many industrial water demands are for non-potable uses. One method of reducing demands on potable water sources is to supply non-potable demands using treated wastewater plant effluent. Detailed regulations for implementation of a water reuse project do not exist in the Commonwealth of Virginia. Permitting of a water reuse project would most likely involve both the VDH and the Virginia Department of

Environmental Quality (VDEQ). In addition, a Virginia Pollution Discharge Elimination System (VPDES) Permit would be required for discharge to State waters if the flow is not contaminated during its use; if it is contaminated, the approval of VDH and/or VDEQ would be required.

Several states including California, Arizona, Texas, Utah, and Florida have developed regulations and state statutes that specify the required minimum quality of reclaimed water, depending on the intended use of the water. In general, the requirements become more stringent as the likelihood of public contact increases. In California, if treated reclaimed water for industrial use meets the state's standards for full body contact recreation, workers are not required to avoid contact with the water or to wear protective clothing. However, precautions are required should the treated reclaimed water fail to meet these criteria. With the approval of State and local health departments, reclaimed water can be used for soil compaction, dust control, and other construction purposes.

As mentioned previously, recycling will be required in all new car washes and existing car washes will be required to be retrofitted. In addition, required recycling systems are being considered for all new construction and all repair or replacement of continuous flow devices, including any water connector, device, or appliance which requires a continuous flow of 5 gallons per minute or more.

Typically, non-potable markets for reused water include irrigation uses, industrial uses, and creation of recreational lakes. Many factors affect the market for reused water, including:

- Size and location of demand.
- Water quality requirements.
- Degree of treatment required for discharge.
- Cost of reclaimed water.
- Cost and availability of alternative supplies.

It is likely that additional reuse methodologies will be evaluated in the future. Industries within the service area that use large quantities of water are continually evaluating their processes and looking for ways to lower production costs. For these industries, water represents one of their greatest operating expenses. It is in the best interest of these industries to stay abreast of the latest reuse technologies and employ them whenever feasible.

6.3. Agricultural Supplies

The following are components associated with Water Demand Management common to agricultural irrigation systems. Agricultural irrigation systems that use greater or equal to 300,000 gallons per month will have their own WCMPs as part of their Groundwater Withdrawal Permits. These plans are provided in Appendix C. In addition to the WCMPs, the Natural Resources Conservation Service (NRCS) provides significant technical and financial assistance to the agricultural community in implementing measures that directly conserves water. The program that has the greatest impact is the Environmental Quality Incentive Program (EQIP) that provides irrigation efficiency upgrades, irrigation pond and pond expansions, Irrigation Water Management Plans, and tailwater recovery systems.

6.3.1. Water Saving Equipment and Processes

The primary water savings for agricultural supplies rely on methods for irrigation scheduling and use of high efficiency irrigation systems, including use of computerized irrigation systems. Irrigation scheduling includes:

- Assessing soil moisture levels (e.g.; tensiometers)
- Morning and evening irrigation
- Low wind conditions

High efficiency irrigation systems generally refer to systems that achieve 80% or better efficiency. While the most efficient systems are drip irrigation systems, and micro-irrigation systems, there are some overhead systems such as center-pivot that, if equipped with high efficiency heads (low pressure sprinklers and end guns) and operated at times to minimize loss, can achieve high levels of efficiency. The NRCS, through the EQIP program assists the agricultural community in implementing irrigation efficiency upgrades to the systems. Some of the significant system upgrades funded through the EQIP program include:

- Converting overhead impact sprinklers to drops
- Converting overhead sprays to drops
- Updating nozzles and pressure regulators on existing drops
- Updating nozzles and pressure regulators on existing overhead
- Providing end guns, valves, shut-off devices, and booster pumps

Continued support for the EQIP program is critical for continued improvement in these systems.

6.3.2. Water Loss Reduction Program

Water and water loss reduction programs specific to a agricultural user are included in the individual WCMPs provided in Appendix C. However, there are common components that apply to most agricultural uses:

- Routinely record use. Review use to identify changes that might indicate a leak. Use of historical tables, time-trend graphs, and/or process limits as applicable will be used to identify abnormal use patterns.
- Routinely inspect piping and tanks for any indication of leaks.
- Implement written procedures to address leaks that will include means for a rapid repair and/or leak bypass to minimize water loss.

While also directly related to re-use, irrigation ponds, and expansion of irrigation ponds assist in reducing water loss by capturing storm water runoff. When an irrigation pond is sited, and when agricultural land is re-graded, directing storm water to the irrigation pond significantly increases the storage capacity of these systems.

6.3.3. Water Use Education Program

Water use education is accomplished primarily through NRCS programs, such as the EQIP programs and agricultural extension programs through the local co-op agencies and Farm Bureau.

6.3.4. Water Reuse

Reuse consists principally of recapturing two types of flow:

- Tailwater Recovery
- Wastewater Reuse

Tailwater recovery systems have the potential to significantly capture any excess irrigation water and storm water for reuse as irrigation water. These systems are widely promoted by the NRCS as a conservation practice standard and, through the EQIP program have implemented several tailwater recovery systems on the Eastern Shore. Expansion of these systems should be encouraged.

Wastewater reuse somewhat restricted by FDA requirements for certain agricultural products. However, reuse has been implemented for number agricultural systems, most noticeably for some nursery operations.

7. Drought Response and Contingency Plan (9 VAC 25-780-120)

In accordance with Water Supply Planning Regulations, Section 9 VAC 25-780-120, the following discussion presents a Drought Response and Contingency Plan (DRCP) as a component of the WSP.

A drought is a period of unusually dry weather, including lower than normal levels of precipitation, which persists long enough to cause serious problems such as water supply shortages and/or crop damage. The present DRCP is focused on identifying drought conditions and implementing appropriate responses in order to maintain adequate water supplies in Northampton County. The successful response to drought conditions in the Planning Region largely depends upon public education and involvement.

The DRCP outlines a regional approach to responding to drought, while recognizing that drought conditions will vary across the County, and specific response and contingency actions will be made based on local conditions. The plan recognizes the unique characteristics of water sources within the region, as well as the beneficial uses of the water.

The DRCP includes four graduated stages of responses to the onset of drought conditions within the Planning Area:

DRCP STAGE	VDEQ DROUGHT MONITOR CONDITIONS	CONDITIONS	MAJOR RESPONSE
■ Normal Conditions	--	Normal Conditions	--
	D0	Abnormally dry (short-term)	
■ Drought Watch	D1	Moderate Drought	Public awareness campaign
■ Drought Warning	D2	Severe Drought	Voluntary restrictions
■ Drought Emergency	D3	Extreme Drought	Mandatory restrictions
	D4	Exceptional Drought	

The plan is based on procedures for the implementation and enforcement of the plan, in accordance with 9 VAC 25-780-120.3. Furthermore, the DRCP acknowledges the role of the Commonwealth in monitoring and responding to drought conditions as outlined in the Virginia Drought Assessment and Response Plan, dated March 28, 2003 (Appendix D), while reserving the right to respond to those conditions and enforce the actions presented in this plan based on local conditions and local procedures.

7.1. Purpose

The purpose of this DRCP is to provide a contingency plan to:

- Manage the use of water resources in Northampton County in the event of drought conditions or other water supply emergencies,
- Establish an enforceable programmed response for each drought stage that will reduce water consumption with the least adverse impact on the residents and businesses of Northampton County
- Respond to non-climate related water supply emergencies, such as contamination or equipment failure, which may result in the need to restrict water use until water service can be restored.

7.2. Drought Indicators

The process of determining the presence or severity of a drought is complex and can be based on numerous indicators. In the Commonwealth of Virginia, drought evaluations are made by the Virginia Drought Monitoring Task Force (VDMTF), an interagency group of technical representatives from state and federal agencies responsible for monitoring natural resource conditions and the effects of drought on various segments of society. During periods of normal moisture conditions, the VDEQ monitors the NOAA U.S. Drought Monitor and prepares a monthly report and drought map specific to Virginia. The VDMTF is activated following an occurrence of moderate drought conditions (D1) as reported by the U.S. Drought Monitor program. The VDMTF may also active following the occurrence of smaller scale drought conditions that occur below the resolution of the Drought Monitor. The VDMTF monitors the progression of drought conditions (using typical drought indicators including precipitation deficits, groundwater levels, streamflows, and reservoir storage) and their effects on various sectors of society including water supply, agriculture, forestry and recreation. The VDMTF remains active until drought conditions have receded to unusually dry levels (D0) as reported by the U.S. Drought Monitor on a state wide level and may remain active longer if small areas beneath the resolution of the Drought Monitor continue to experience drought impacts. The VDMTF also provides recommendations for the declaration of the various drought stages. Virginia is currently divided into thirteen drought evaluation regions, including the Eastern Shore Drought Evaluation Region to which Northampton County belongs.

7.2.1. Precipitation Deficits

Precipitation deficits are monitored by the VDMTF which compares current local precipitation amounts (compiled by the Office of the State Climatologist) with 30-year local precipitation normals (developed by NOAA). Deficits are evaluated as running averages from the start of a water year (which begins on October 1), or on a trailing 12-month average for more extended events (Table 7-1 and Figure 7-1).

Figure 7-1: Seasonal drought triggers relative to precipitation normals

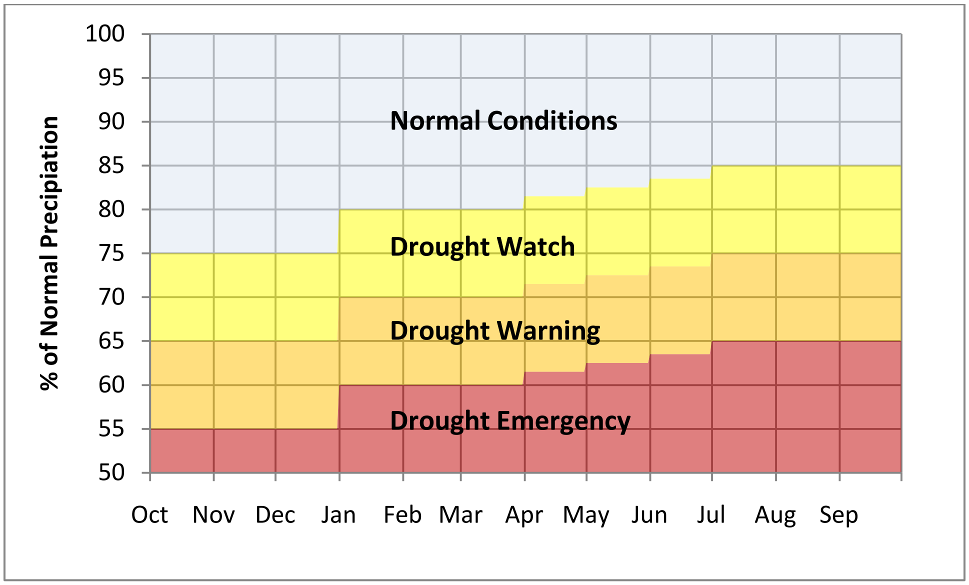


Table 7-1:
Seasonal drought triggers relative to precipitation normals

	DROUGHT STAGE			
Months Analyzed	**Normal Conditions**	**Drought Watch**	**Drought Warning**	**Drought Emergency**
	(% of Normal Precipitation)			
October-December	>75.0	<75.0	<65.0	<55.0
October-January	>80.0	<80.0	<70.0	<60.0
October-February	>80.0	<80.0	<70.0	<60.0
October-March	>80.0	<80.0	<70.0	<60.0
October-April	>81.5	<81.5	<71.5	<61.5
October-May	>82.5	<82.5	<72.5	<62.5
October-June	>83.5	<83.5	<73.5	<63.5
October-July	>85.0	<85.0	<75.0	<65.0
October-August	>85.0	<85.0	<75.0	<65.0
October – September (and previous 12 months)	>85.0	<85.0	<75.0	<65.0

7.2.2. Groundwater Levels

Groundwater monitoring wells located in the water table aquifer representing drought evaluation regions are used by the VDMTF to monitor shallow groundwater responses to drought conditions. Measured water levels are compared to the historic water level statistics for the entire period of record of a given monitoring well. Measured groundwater levels within the ranges shown in Table 7-2 have been recommended by the Drought Response Technical Advisory Committee to be indicative one of the four drought conditions.

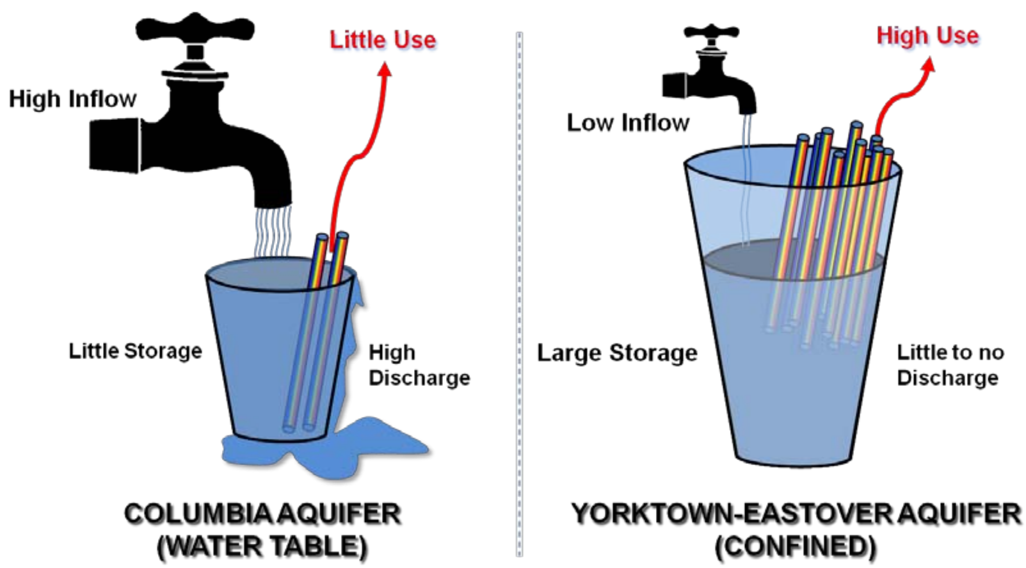
Table 7-2:
Measured groundwater level relative to statistical occurrence

	DROUGHT STAGE			
	Normal Conditions	**Drought Watch**	**Drought Warning**	**Drought Emergency**
	(% occurrence relative to all historical measured groundwater levels)			
Measured Groundwater Level	>25 %	10-25 %	5-10 %	<5 %

Representative monitoring wells were selected by the Drought Response Technical Advisory Committee as part of the Drought Assessment and Response Plan process on the basis of period of record and relative location within the drought evaluation region. The P.C. Kellam Observation Well (USGS local number 63H 6 SOW 103A) was selected as the monitoring well most representative of conditions in Northampton County.

Information from the USGS well wells will be used only to provide general insights into regional conditions, which will then be shared with the public, but will not represent a primary criterion for drought evaluation in Northampton County. This is because despite the Northampton County's nearly complete reliance on groundwater, at current usage rates, the effects of droughts occurring over time frames of less than a few years have little *direct* impact on the availability of water, provided water usage does not significantly increase during the drought. In the water table aquifer, the average recharge rate typically far exceeds water usage (625 MGD vs. less than 1 MGD, respectively) and the large majority of recharge is returned to the hypergean environment through evapotranspiration and discharge to surface water bodies. In the confined aquifers, the recharge rate is much lower and is on the same order of magnitude as withdrawals (9 MGD, vs. approximately 10 MGD) with little discharge to overlying aquifers and surface water bodies; however the storage in the confined aquifers is far greater than in the water table aquifer and temporary recharge deficits have a small impact on the total storage. Furthermore, increased usage in the confined aquifer(s) will be somewhat offset by a lesser yet proportional increase in leakage from the overlying aquifer(s). A conceptual representation of the relative differences in water budgets between the water table and confined aquifers is shown in Figure 7-2. Furthermore, variations in water availability occur on a scale that can be fairly localized and measured water levels in a single well are not likely to be representative may not representative of conditions across the entire County.

Figure 7-2: Conceptual differences in water budgets between the water table and confined aquifers on the Eastern Shore of Virginia



However, significant drought events are typically associated with increased water demands, particularly for agricultural and landscaping irrigation and other seasonal water uses. *Indirect* impacts to groundwater availability during drought events on the Eastern Shore are typically associated with local water level declines due to increased usage. Therefore, for a given drought to be based on groundwater indicators alone, it may be preferable to provide the flexibility to discrete water supply systems (community, agricultural and other self-supplied systems) such that local groundwater water levels may be used as indicators of local drought conditions and severity for each system or portions of the County. The recommended indicator of a drought emergency for a (community or individual) groundwater water supply system is either a water level less than 5 ft above the intake or 80 percent of available drawdown in a production well. For systems where production well water level measurements are impracticable, a nearby observation well may also be used.

7.2.3. Streamflow and Reservoir Storage

As discussed in previous sections of the present WSP, Northampton County does not have any significant fresh surface water features and derives all of its water supply from groundwater, with the exception of a few irrigation ponds. Therefore, the use of streamflow and reservoir storage as an indicator of drought is not particularly pertinent in Northampton County.

7.2.4. Other Indicators

The DMTF also evaluates other available indicators including the VDOF Cumulative Severity and Keech-Byrum Drought Indeces and other data for forest impacts and information compiled by the Virginia Agricultural Statistics Service and the Virginia Cooperative Extension Service to assess the impacts of drought on agricultural interests, in addition to the number of requests for federal drought disaster designation reported by the Virginia Department of Agriculture and Consumer Services. Furthermore, the VDMTF also considers operating conditions at public waterworks in the determination of drought recommendations.

7.3. Drought Stage Declarations

The DMTF and individual water system managers may use the indicators described above to assess drought conditions across the County and at individual systems, respectively. The following general descriptions will be used to guide drought stage declarations locally and to make recommendations to the Virginia Drought Coordinator for County-wide declarations:

- **Normal Conditions**
  - Precipitation exceeds the percent of normal precipitation threshold specified for normal conditions and the relevant time period shown in Table 7-1 and
  - Groundwater levels are above the 25th percentile for all historic levels

- **Drought Watch**

- Precipitation at or below the percent of normal precipitation threshold specified for drought watch conditions and the relevant time period shown in Table 7-1 or
- Groundwater levels are between the 25th and 10th percentile for all historic levels

Drought Warning

- Precipitation at or below the percent of normal precipitation threshold specified for drought warning conditions and the relevant time period or
- Groundwater levels are between the 25th and 10th percentile for all historic levels

Drought Emergency

- Precipitation at or below the percent of normal precipitation threshold specified for drought emergency conditions and the relevant time period,
- Groundwater levels measured in production wells levels are less than 5 ft above the pump intake, or
- Groundwater level measured in production or nearby observation wells show drawdown greater than 80 percent relative to non-pumping water levels.

The process of determining the presence or severity of a drought is complex and requires a certain level of professional judgment, therefore, the preceding descriptions should not be viewed as absolute requirements for drought designation, but rather as a mechanism to be used to reach consensus on the appropriate drought recommendations at the County-wide and local levels.

Drought Stages conditions may be declared for the entire county or portions of the county by the Virginia Drought Coordinator and for individual community and self-supplied water supply systems by their respective management. The more stringent of differing declarations should apply in the case of a discrepancy, subject to spatial jurisdiction.

7.4. Drought Stage Responses

As discussed above, the DRCP includes the use of four graduated drought stages: normal conditions, drought watch, drought warning, and drought emergency. Normal conditions represent status quo operating conditions.

The drought watch stage responses are generally responses intended to raise awareness of water users in the jurisdiction to climatic conditions that are likely to precede the occurrence of a significant drought event. Public outreach activities to raise this awareness are identified as well as conservation activities that may be used to reduce demand.

Drought warning stage responses are generally responses that are required when the onset of a significant drought event is imminent. Voluntary water conservation activities are identified with the goal of reducing water use by 5 – 10%, in accordance with 9 VAC 25-780-120.A.2.b.

Drought emergency stage responses are generally responses that are required during the height of a significant drought event. Mandatory water conservation activities are identified with the goal of reducing water use by 10 – 15%, in accordance with 9 VAC 25-780-120.A.2.c.

The subsections below represent guidelines and language that may be used to develop local or county wide Drought Management and Contingency Planning ordinances.

7.4.1. Normal Operation

Community water supply systems servicing incorporated towns in Northampton County shall be operated by a qualified operator and division supervisor under the purview of the director of public works and town manager. The supply system operator and/or supervisor shall report routine operations and monthly water usage to the director of public works and town manager. The town manager shall further advise the town council and the mayor. Other community water supply systems shall be operated by a qualified operator coordinating with relevant County and State agencies. Normal operation of community water systems will include at least monthly water level measurements in production wells or nearby observation wells and the collection or review of local precipitation data to monitor the potential for drought conditions to occur. More frequent data collection may be required during dry conditions.

7.4.2. Drought Watch

Following the declaration of a countywide, regional or local drought watch, the town manager, system operator/supervisor, and/or director of public works for affected individual public water supply systems and the administrators of affected large self-supplied water withdrawals exceeding 10,000 gpd will:

- Review existing drought water conservation and contingency plans and
- Make reasonable efforts to pursue leak detection and repair programs.

Furthermore, where an individual public water supply system unilaterally declares a drought watch for their service area, the system operator/supervisor will:

- Inform the VDH of their self-declared drought watch and
- Issue a press release indicating the reasons for the declaration.

If a major water leak or water supply equipment failure occurs in a community water supply system, repairs shall be immediately initiated by the relevant department and the town manager shall be immediately notified of such. In conjunction with the town manager, the waterworks supervisor/operator and director of public works shall determine if a water shortage will occur as a result of the leak or equipment failure.

7.4.3. Drought Warning

Following the declaration of a Countywide, regional or local drought warning or serious water shortage due to a major leak, equipment failure non-climate related water supply disruption, the town manager, system operator/supervisor, and/or director of public works for affected public water supply systems will:

- Issue public announcements encouraging the voluntary reduction or elimination of non-essential water uses including car washing, lawn watering, garden watering, and water usage by swimming pools and other recreational facilities after consultations with the mayor and public works committee chair and
- Voluntarily reduce or eliminate non-essential flushing of water lines and other operational water uses.

The goal of the voluntary water use restrictions shall be to reduce total water consumption by 5 to 10 percent. If the drought warning is self-declared, the town manager, system operator/supervisor, and/or director of public works for individual community water supply systems will also notify the VDH.

Following the declaration of a Countywide or regional the administrators of large self-supplied water withdrawals exceeding 10,000 gpd will voluntarily reduce or eliminate non-essential flushing of water lines and other operational water uses.

7.4.4. Drought Emergency

Following the declaration of a Statewide, Countywide, or regional drought emergency by the Governor by executive order, the town manager, system operator/supervisor, and/or director of public works for affected public water supply systems will:

- Issue public announcements declaring the mandatory reduction or elimination of non-essential water uses including car washing, lawn and garden watering, and water usage by swimming pools and other recreational facilities. The following specific prohibitions will apply:

  Unrestricted irrigation of lawns, gardens and other landscaped areas is prohibited

  - Newly sodded and seeded areas may be irrigated to establish cover on bare ground at the minimum rate necessary for no more than a period of 60 days, irrigation rate may not exceed a total of one inch of applied water in any seven day period.
  - Gardens, bedding plants, trees, shrubs and other landscape materials may be water with hand held containers, hand-held hoses equipped with an automatic shutoff device, sprinklers, or other automated water devices at the minimum rate necessary but in no case more frequently than twice per week.
  - All allowed lawn irrigation must be applied in a manner to assure that no runoff, puddling or excessive watering occurs.
  - Irrigation systems may be tested after installation, routine maintenance or repair for no more than ten minutes per zone.

  Unrestricted irrigation of golf courses is prohibited

  - Tees and greens may be irrigated between the hours of 9:00PM and 10 AM a the minimum rate necessary
  - Localized dry areas may be irrigated with a hand held container or hand held hose equipped with an automatic shutoff device at the minimum rate necessary.
  - Greens may be cooled by syringing or by the application of water with a hand held hose equipped with an automatic shutoff device at the minimum rate necessary.
  - Fairways may be irrigated between the hours of 9:00 PM and 10:00 AM at the minimum rate necessary not to exceed one inch of applied water in any ten-day period.
  - Fairways, tees and greens may be irrigated during necessary overseeding or resodding operations in September and October at the minimum rate necessary. Irrigation rates during this restorations period may not exceed one inch of applied water in any seven-day period.

- Newly constructed fairways, tees and greens and areas that are re-established by sprigging or sodding may be irrigated at the minimum rate necessary not to exceed one inch of applied water in any seven-day period for a total period that does not exceed 60 days.
- Fairways, tees and greens may be irrigated without regard to the restrictions listed above so long as:
  - The only water sources utilized are water features whose primary purpose is stormwater management,
  - Any water features utilized do not impound permanent streams,
  - During declared Drought Emergencies these water features receive no recharge from other water sources such as ground water wells, surface water intakes, or sources of public water supply, and,
  - All irrigation occurs between 9:00 p.m. and 10:00 a.m.
- All allowed golf course irrigation must be applied in a manner to assure that no runoff, puddling or excessive watering occurs.
- Rough areas may not be irrigated.

Unrestricted irrigation of athletic fields is prohibited.

- Athletic fields may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. at a rate not to exceed one inch per application or more than a total of one inch in multiple applications during any ten-day period. All irrigation water must fall on playing surfaces with no outlying areas receiving irrigation water directly from irrigation heads.
- Localized dry areas that show signs of drought stress and wilt (curled leaves, foot-printing, purpling) may be syringed by the application of water for a cumulative time not to exceed fifteen minutes during any twenty four hour period. Syringing may be accomplished with an automated irrigation system or with a hand held hose equipped with an automatic shutoff device at the minimum rate necessary.
- Athletic fields may be irrigated between the hours of 9:00 p.m. and 10:00 a.m. during necessary overseeding, sprigging or resodding operations at the minimum rate necessary for a period that does not exceed 60 days. Irrigation rates during this restoration period may not exceed one inch of applied water in any seven-day period. Syringing is permitted during signs of drought stress and wilt (curled leaves, foot-printing, purpling).
- All allowed athletic field irrigation must be applied in a manner to assure that no runoff, puddling or excessive watering occurs.

- Irrigation is prohibited on athletic fields that are not scheduled for use within the next 120-day period.
- Water may be used for the daily maintenance of pitching mounds, home plate areas and base areas with the use of hand held containers or hand held hoses equipped with an automatic shutoff device at the minimum rate necessary.
- Skinned infield areas may utilize water to control dust and improve playing surface conditions utilizing hand held containers or hand held hoses equipped with an automatic shutoff device at the minimum rate necessary no earlier than two hours prior to official game time.

Washing paved surfaces such as streets, roads, sidewalks, driveways, garages, parking areas, tennis courts, and patios is prohibited.

- Driveways and roadways may be pre-washed in preparation for recoating and sealing.
- Tennis courts composed of clay or similar materials may be wetted by means of a hand-held hose equipped with an automatic shutoff device at the minimum rate necessary for maintenance. Automatic wetting systems may be used between the hours of 9:00 p.m. and 10:00 a.m. at the minimum rate necessary.
- Public eating and drinking areas may be washed using the minimum amount of water required to assure sanitation and public health.
- Water may be used at the minimum rate necessary to maintain effective dust control during the construction of highways and roads.

Use of water for washing or cleaning of mobile equipment including automobiles, trucks, trailers and boats is prohibited.

- Mobile equipment may be washed using hand held containers or hand held hoses equipped with automatic shutoff devices provided that no mobile equipment is washed more than once per calendar month and the minimum amount of water is utilized.
- Construction, emergency or public transportation vehicles may be washed as necessary to preserve the proper functioning and safe operation of the vehicle.
- Mobile equipment may be washed at car washes that utilize reclaimed water as part of the wash process or reduce water consumption by at least 10% when compared to a similar period when water use restrictions were not in effect.
- Automobile dealers may wash cars that are in inventory no more than once per week utilizing hand held containers and hoses equipped with automatic shutoff devices, automated equipment that utilizes reclaimed water as part of the wash

process, or automated equipment where water consumption is reduced by at least 10% when compared to a similar period when water use restrictions were not in effect.

- Automobile rental agencies may wash cars no more than once per week utilizing hand held containers and hoses equipped with automatic shutoff devices, automated equipment that utilizes reclaimed water as part of the wash process, or automated equipment where water consumption is reduced by at least 10% when compared to a similar period when water use restrictions were not in effect.
- Marine engines may be flushed with water for a period that does not exceed 5 minutes after each use.

Use of water for the operation of ornamental fountains, artificial waterfalls, misting machines, and reflecting pools is prohibited.

- Fountains and other means of aeration necessary to support aquatic life are permitted.
- Use of water to fill and top off outdoor swimming pools is prohibited.
- Newly built or repaired pools may be filled to protect their structural integrity.
- Outdoor pools operated by commercial ventures, community associations, recreation associations, and similar institutions open to the public may be refilled as long as:
    - Levels are maintained at mid-skimmer depth or lower,
    - Any visible leaks are immediately repaired
    - Backwashing occurs only when necessary to assure proper filter operation,
    - Deck areas are washed no more than once per calendar month (except where chemical spills or other health hazards occur),
    - All water features (other than slides) that increase losses due to evaporation are eliminated, and
    - Slides are turned off when the pool is not in operation.
- Swimming pools operated by health care facilities used in relation to patient care and rehabilitation may be filled or topped off.
- Indoor pools may be filled or topped off.
- Residential swimming pools may be filled only to protect structural integrity, public welfare, safety and health and may not be filled to allow the continued operation of such pools.

- Declare mandatory water use restrictions for hotels, motels, tourist homes, campgrounds, trailer parks, and all other commercial establishments. Such establishments shall be required to notify their patrons and restrict water usage for bathing and other purposes to a bare minimum. Restaurants and food service establishments will provide water to customers only when requested, and
- Place a moratorium on all new water service connections.
- Coordinate with law enforcement officials who shall issue tickets to violators of mandatory use restrictions. Upon conviction, a violator shall be guilty of a class 4 misdemeanor, and each incident shall be considered a separate offence.

The goal of the water use restrictions shall be to reduce total water consumption between 10 and 15 percent, or higher depending on the severity of the drought or critical water supply emergency. All residential, business and industrial water users; whether supplied by public water supplies, self-supplied sources, or private water wells; who do not normally utilize water for any of the listed prohibited uses are requested to voluntarily reduce water consumption by at least 10%. This reduction may be the result of elimination of other non-essential water uses, application of water conservation practices, or reduction in essential water uses.

If the drought emergency or water supply emergency is self-declared, the town manager, system operator/supervisor, and/or director of public works for individual community water supply systems will also notify the VDH and the Virginia Emergency Operations Center.

Water Rationing

In some cases, the mandatory non-essential water use restrictions may not be sufficient to protect the supplies of an individual public waterworks. When an individual waterworks' sources are so depleted as to threaten public health and safety, it may become necessary to ration water within that system in order to assure that water is available to support essential uses. Rationing water is a more severe measure than merely banning nonessential uses of water. Under rationing, each customer is allotted a given amount of water, based on a method of allotment developed by the waterworks or local government. Generally, it will be based on a percentage of previous usage or on a specific daily quantity per household. Rationing is more likely to have some effect on welfare than mandatory non-essential use restrictions, because industrial and commercial water uses may be curtailed or eliminated to assure an adequate supply is available for human consumptive uses.

The decision to ration water will typically be made by the local government or waterworks operator. The Virginia Drought Coordinator will work closely with any entity where water rationing is required to assure that all available State resources are effectively used to support these highly stressed water supply systems. The Virginia Department of Emergency Management (VDEM) is the first point of contact for waterworks or local governments who decide to ration water. VDEM will coordinate the Commonwealth's response and assistance to such entities.

8. Statement of Need and Alternatives (9 VAC 25-780-130)

This Section describes the adequacy of the existing water sources and whether they meet the current and projected demands. In addition, potential alternatives to increase current supplies or develop new water supplies are discussed.

8.1. Adequacy of Existing Water Sources

The Columbia and Yorktown-Eastover multi-aquifer system within Northampton County and the Eastern Shore of Virginia has been designated a Sole Source Aquifer by the USEPA. As such, availability of fresh water supply in Northampton County is limited. However, given the current and projected demands, there is sufficient water supply to meet the overall needs of Northampton County. The challenge for the County in the future is to manage the resource in a manner that will avoid local degradation of the water supply that can occur even under the current demands. The greatest risk is from local saltwater intrusion in the confined Yorktown-Eastover aquifer due to over pumping and contamination of the Columbia aquifer from various land use activities. The following alternatives help to avoid or mitigate these impacts.

8.2. Alternatives Analysis

Available alternatives to reduce potential impacts from saltwater intrusion in the Yorktown-Eastover aquifer and land use derived contamination to the Columbia aquifer can be divided into two general categories:

- Potential new or expansion of underutilized sources
- Use of new or emerging technologies that improve availability or provides access to previously unavailable sources

8.2.1. Alternatives Analysis: Potential New or Expanded Water Supply Sources

8.2.1.1. Water table withdrawals

Recharge to the water table aquifer is several orders of magnitude greater than the confined aquifer. As such, this groundwater resource is far more renewable. Benefits of encouraging use of the water table aquifer are:

- Encourage, proactively, use of the water table aquifer over the confined aquifers.

- Avoid retroactively waiting until all of the confined aquifers are “critical” before using the water table.
- The significantly higher recharge to the water table greatly reduces impacts of a withdrawal from the aquifer. A withdrawal from the water table system is far more sustainable than from the confined aquifers.
- Increased use of the water table aquifer helps to preserve the confined aquifers.

For water supply development, the water table aquifer is not targeted as a preferred source in large part due to:

- Individual well yields are typically lower: the water table aquifer is shallower than confined aquifers and is not under pressure.
- Because the aquifer is not under pressure, the wells are often more difficult to develop following construction.
- The aquifer is more susceptible to contamination from land use activities.
- Cost to develop a water table supply is often greater than for a confined aquifer. Additional field investigation and multiple wells are often required to provide the same yield.

To encourage use of the water table aquifer, funding through programs such as the NRCS EQIP have the potential to significantly increase the number of water table withdrawals for agricultural uses. Additionally, changes to the DEQ Groundwater Withdrawal Regulations to recognize the lesser impact from using this aquifer would encourage use of the Columbia aquifer over the confined Yorktown-Eastover aquifer for all withdrawals, including some for public water supply.

8.2.1.2. Dug ponds

Similar to groundwater withdrawals from the water table aquifer, this alternative focuses on maximizing use of the water table aquifer. Unlike water table withdrawals, dug ponds are used exclusively for agricultural irrigation and industrial cooling water supply. Currently, dug ponds are not a source of water for public water supplies in Northampton County.

The primary impediment to use of dug ponds as a source of water supply is the area required to create the pond. To avoid impacts to wetlands, upland areas that are also often prime agricultural lands must be used for the ponds. Increased funding through the NRCS EQIP program for new ponds or existing pond expansion could significantly improve the capacity and use of these ponds.

8.2.2. Alternatives Analysis: Potential New and Emerging Technologies

8.2.2.1. Aquifer Storage and Recovery (ASR)

Aquifer Storage and Recovery is a technology that uses confined aquifers as a reservoir to store water that will later be withdrawn for use. ASR can be used as a direct source of water or it can be used to impede saltwater intrusion, thereby increasing availability of fresh groundwater in the Yorktown-Eastover aquifer. The principal benefits of ASR are:

- Encourages use of a technology that can significantly increase recharge to the aquifer.
- Can result in a no-net-loss operation.
- Reduces impacts of withdrawals for all groundwater users.
- Reduces the potential for saltwater intrusion to occur

While there are significant technological costs associated with operation of an ASR system, this method of water management has been successfully used throughout the United States. The most significant impediment to expanded use of ASR within the Virginia Groundwater Management Areas, including Northampton County is the lack of specific criteria that clearly differentiates ASR as a system that uses the aquifer as a reservoir from conventional groundwater withdrawals.

8.2.2.2. Desalinization

Use of brackish groundwater through reverse osmosis is a technology that has been used in the Coastal Plain of Virginia since 1989, with the operation of the Suffolk EDR facility. Subsequently, reverse osmosis has been used by a large number of communities in the Coastal Plain of Virginia, including most of the major municipal systems, such as James City County, Newport News Waterworks, and Chesapeake. Additionally, over the past 10-years, cost of constructing new or retrofitting old systems has decreased on average 10% per-year.

For areas of Northampton County where there is a significant brackish water source, particularly along the coastal areas, desalinization has significant potential for providing a source of high quality potable water. Additionally, membrane treatment is a viable technology for areas where the quality of water in the Columbia aquifer is impaired. As cost for reverse osmosis or membrane treatment continues decline and as efficiency of these systems continue to improve, this technology has significant potential for providing additional water supply to N County.

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