AMELIA COUNTY, VIRGINIA
WATER SUPPLY PLAN

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Project Number: 21454

October 20, 2010

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EXECUTIVE SUMMARY

This water plan investigates the current and projected groundwater and surface water resources and uses of water in Amelia County, Virginia and fulfills the requirements of 9 VAC 25-780 for the preparation of a comprehensive Water Supply Plan.

Amelia County depends entirely on wells to provide its domestic and commercial/industrial water supplies. Groundwater is crucial to the economic and environmental health of the County and protection is a high priority. Although not a source of drinking water for the County, surface water is interconnected with the groundwater system which may in turn have an effect on the quality and quantity of drinking water in the County. Surface water is also a source of water for agricultural uses (irrigation and livestock watering).

Amelia County is located in the Piedmont Physiographic Province, which is characterized by rolling hills and valleys. The Piedmont Province has a very diverse subsurface geology resulting in wide variations of groundwater quality, well yields and subsequent varying potential for contamination; therefore, well site evaluation and well monitoring is very important in the region. When VDH completed their Source Water Assessment of 14 wells within the County, 8 were ranked highly susceptible to contamination while the remaining 6 were unranked.

Due to the rural environment in Amelia County, the County currently has only one community system; the rest of the County's population obtains their drinking water from private wells. The community water system, operated by the Amelia Courthouse Sanitary District (ACSD), serves approximately 3,000 people and commercial users through 440 connections from water provided by five (5) wells located within Amelia Courthouse. The remainder of the population and a few businesses utilize private wells.

Data from USGS in 1995 indicates that groundwater usage for agricultural purposes for Amelia County was 0.18 million gallons per day (MGD) or about 16% of the total groundwater use in the county. Surface water withdrawal for agricultural purposes was 1.22 MGD, which accounts for all (100%) of the surface water use in Amelia County. 2005 data from the USGS indicated groundwater and surface water was used in Amelia County at the rates of 0.19 MGD and 0.54 MGD respectively. The difference in usage is attributed to approximately 40% less fields irrigated in 2005 than in 1995. To be conservative (and account for drought usage) the 1995 numbers were used for projected future agricultural uses. Groundwater usage for commercial and industrial purposes for Amelia County was 0.18 MGD [1] or about 16% of the total groundwater use in the county.

For the five (5) wells within the Amelia Courthouse area (public water system), the average daily usage for the water system is 0.104 MGD with a daily maximum withdrawal of 0.5 MGD in 2008. The public water system groundwater usage is approximately 37% domestic, 53% industrial/commercial and 8-10% unaccounted for water losses.

There are two aquifers in Amelia County, the Early Mesozoic Basin Aquifer and the Crystalline Rock Aquifer. For both aquifers, groundwater moves primarily along joints, fractures, and bedding planes. The regolith (a layer of loose, heterogeneous material covering solid rock) and fractures in the bedrock provide the principal places for the storage transmission of water. Groundwater within the bedrock aquifer is generally more reliable in water quality and consistent quantity as water storage in the regolith is more susceptible to be affected by surface contamination and droughts.

The amount of water available in an aquifer is dependent on a number of factors including the volume residing in the aquifer at any time and its recharge and discharge rates. Since the current volume and corresponding discharge rates of the two aquifers underlying Amelia County are not known, an estimate of the amount of water potentially available from

aquifer recharge was determined by calculating the amount of recharge that typically occurs on an annual basis over the entire County. Conservatively assuming that only 10% of the annual recharge rate is available to the County and the remaining recharge volume is lost through naturally occurring aquifer discharges (springs, off-site flow, etc.), the annual volume available of groundwater for consumptive use by the County in 2060 is 2,560 million gallons per year (MGY). Recovery of this volume of water will require the location and installation of a suitable number of wells in areas with good groundwater production.

Records indicate that the total annual water use (including water losses) from January to December 2008 for the ACSD water system was 37.8 MG. This averages to approximately 3.2 MG per month and 0.10 MGD.

Currently, self-supplied non-agricultural users (i.e., residential and limited commercial establishments outside of the ACSD service area) are estimated to use 0.99 MGD (359 MGY). Self-supplied agricultural users are estimated to use 1.22 MGD surface water (445 MGY) and 0.18 MGD (66 MGY) groundwater for a total of 1.40 MGD (511 MGY). This estimate is based on 0.18 MGD (66 MGY) groundwater use and 0.26 MGD (94.9 MGY) surface water use for livestock watering with the remainder of surface water use for irrigation.

To determine future water needs of the County, future population growth projections were used. Because growth in the County is expected to continue to follow the same trends in the near future, the County is expected to become less rural and more residential. Based on these projections, the population is expected to quadruple between 1995 and 2060 within the County.

Two methods were then used to project future water needs in the County. The first method used the 1995 total water use rates in the county and assumed that water usage would remain the same per capita as the population increase by approximately 2.61%. The projection did not take into account different rates of growth or changes in per capita water

use based on the possible different users of water (agricultural, domestic, commercial, etc). This simple projection estimated that water use in the County could reach 3,555 MGY by 2060. It is estimated that the water sources would continue to be primarily groundwater with some surface water for agricultural uses. This projection is simplified and likely represents a "worse case" or maximum estimation of future water usage.

The second method used to project water needs based on recent trends specific to the County for each type of water use (such as domestic, industrial, agricultural, etc.). Recent trends indicate these two groups of users (commercial/industrial and agricultural) will not increase as quickly as residential growth and the assumption of water use increasing at the same rate as the population increases may result in a projection that overestimates actual use. A more accurate projection may be obtained by assuming growth and use based on the main user types in the County. This projection indicates a water use of 2,059 MGY by 2060.

Surface water resources are determined to be adequate through 2060 based on limited agricultural use. Based on estimates of groundwater available through annual recharge and projected water demands through 2060, the County has adequate water resources available although additional wells will be required to be drilled in order to utilize this resource.

In order to increase water efficiency, water conservation, and decrease water loss, the County has adopted several programs. In addition, the County has determined the threat of droughts within the County to be low and will monitor drought conditions based on groundwater levels and precipitation monitored by the Virginia Drought Monitoring Task Force (VDMTF) per the Virginia Drought Assessment and Response Plan (VDARP).

The County has several potential alternatives for managing the water supply within the area. These include adopting additional policies and practices regarding low-water use landscaping, increased irrigation efficiency, public education regarding water conservation, and incentive programs to customers to encourage reduced water use. As water demand

increases, the County may need to explore the use of surface water for use as well as continue the groundwater surveys to develop additional wells.

SECTION 1.0

INTRODUCTION

1.1 Statement of Purpose

This Amelia County Water Supply Plan explores the current and future uses of groundwater and surface water resources in Amelia County, Virginia. The plan acts as a fulfillment of 9 VAC 25-780 which requires water supply planning to:

- Ensure that adequate safe drinking water is available to all citizens of the Commonwealth;
- Encourage, promote, and protect all beneficial uses of the Commonwealth's water resources; and
- Encourage, promote, and develop incentives for alternative water sources.

This Water Supply Plan was developed using information from the County's existing plans and policies including the 2001 *Amelia County Comprehensive Plan 2000-2025 [2]*, the 2007 *Amelia County Emergency Operations Plan [3],* and the 2005 *Amelia County Hazard Mitigation Plan [4].* This plan also incorporated data from the United States Geological Survey (USGS) [1, 5, 6], the United States Census Bureau [7], and two groundwater investigation reports completed by Emery and Garrett Groundwater Incorporated [8,9]. Collectively, the information provided by these and other sources was used to determine current and future water use and to determine the needs and management measures necessary to address local concerns regarding the quantity and quality of drinking water.

The Amelia County Water Supply Plan addresses the following subject areas:

- Existing Community Groundwater Source in the County;
- Existing Water Use in the County;
- Resource Information for the County including County Geological, Hydrological, Meteorological, and Environmental Conditions;
- Population Growth and Projected Future Water Demands;

- Water Demand Management including County Policies for Water Efficiency, Conservation, and Loss Reduction;
- Drought Response and Contingency Planning; and
- Statement of Need and Alternatives.

SECTION 2.0

EXISTING WATER SOURCE INFORMATION

(9 VAC 25-780-70)

2.1 General

Amelia County is located in the heart of Virginia just 35 miles southwest of Richmond. The County is bounded by the Appomattox River along the northern and most of the eastern and western borders, and Nottoway County to the south.

The County is located in the Piedmont Physiographic Province, which is characterized by rolling hills and valleys. The Piedmont Province has a very diverse subsurface geology resulting in wide variations of groundwater quality, well yields and subsequent varying potential for contamination; therefore, well site evaluation and well monitoring is very important in the region [10].

With the exception of limited amounts of surface water used for agricultural purposes, Amelia County depends entirely on wells to provide its domestic, commercial and industrial water supplies. As such, groundwater is crucial to the economic and environmental health of the County and its protection is a high priority. In light of the hydrogeological interconnection between groundwater and surface water, local surface waters may have an effect on the quality and quantity of drinking water in the County.

2.2 Wells and Water Systems

2.2.1 Community Systems

Due to the rural environment in Amelia County, the County currently has only one community system; the rest of the County's population obtains their drinking water from private wells. The community water system, Amelia Courthouse (PWSID 5007135), currently serves approximately 3,000 people and commercial users through 440 connections from water provided by five (5) wells located within Amelia Courthouse. The system capacity permitted

by the Department of Health is 547,000 GPD. General information for these wells is provided in Table 1.

Table 1
Amelia Courthouse Sanitary District Well Information

Well Name	Depth (ft)	Casing Depth (ft)	Well Diameter (inches)	Screen Depths (ft)	Design Capacity Average Daily Withdrawal (MGD)	Design Capacity Maximum Daily Withdrawal (MGD)	Design Capacity Maximum Annual Withdrawal (MGY)*
4CEP001	560	52	6	125-330	0.05	0.07	25.6
4B2004	350	36	8	20-120	0.18	0.24	87.6
4SEP005	500	40	8	70-160	0.07	0.12	43.8
4IEP001	400	40	8	65-200	0.07	0.11	40.2
High School EP002	300	72	6	20-200	0.03	0.04	14.6
				Total	**0.40**	**0.58**	**211.7**

*Extrapolated from Design Capacity Maximum Daily Withdrawal (MGD).

2.2.2 Private Systems

The remainder of the County's population (approximately 9,586 residents in approximately 3,604 residences) utilizes private wells. It is believed that these residences do not withdraw more than 300,000 gallons each of groundwater per month.

Though most of the businesses in Amelia County are located within the Amelia Courthouse limits, there are a few small businesses located in the County that are served by private wells. It is estimated that these small businesses do not withdraw more than 300,000 gallons each of groundwater per month. According to information from the Virginia Department of Health (VDH), there are four (4) businesses in the County that utilize private wells and are permitted by VDH. Two are restaurants, one is a campground, and one is a truck stop [11].

In addition, there were three (3) agricultural users who reported withdrawals from a total of eight (8) withdrawal points that averaged more than 10,000 gallons per day for at least one month during 2008 [12]. Of these, only one uses groundwater; the rest are surface water withdrawals. Additional details regarding these users are provided in Section 3.1.3.

2.2.3 Water Purchases

Amelia County does not currently purchase drinking water from another locality. At this time, the County is not planning to purchase water from other localities.

2.2.4 Source Water Assessment and Wellhead Protection Planning

Virginia's Department of Health Source Water Assessment Information [13]:

> "The Virginia Department of Health (VDH), as the Commonwealth's agency regulating public drinking water, was required by the 1996 Amendments to the Safe Drinking Water Act (SDWA) to develop a Source Water Assessment Program (SWAP).
>
> The goal of the SWAP is to establish procedures and provide a foundation of support for protecting the Commonwealth's drinking water resources from degradation. This degradation can be the result of residential, industrial, commercial, agricultural, waste management, or transportation's: accidental introduction of contaminants; improper land use practices; illegal material handling practices; and other conditions. These conditions and practices can threaten the drinking water resources of the Commonwealth.
>
> The SWAP includes delineating assessment boundaries of a drinking water source, performing an inventory of land use activities, and determining a relative susceptibility of the drinking water source to these activities. The assessment of public drinking water sources is available to waterworks owners and the public.
>
> On November 13, 2008 there were 2,936 active public water systems in Virginia, serving safe drinking water to more than 80% of Virginia's population. Assessments indicate that some drinking water sources have high levels of protection. While other public water systems are not in control of the land use activities in their surrounding areas. The Office of Drinking Water (ODW) encourages public waterworks to purchase land and/or establish conservation easements to increase the protection of vital drinking water resources.
>
> The SWAP has identified future land use development in source water protection areas as a predominant risk to the viability of public waterworks. The ODW has been working with a number of other state agencies to distribute and share SWAP data in an effort to bring more awareness to source water protection areas."

Out of the 14 wells assessed in Amelia County on February 15, 2006, eight were ranked high susceptibility and the other remaining six were unrated.

To further the efforts of the Source Water Assessment Program, the Department of Health developed and funds a voluntary Wellhead Protection Development Program to assist

small community waterworks in central and western Virginia with populations less than 3,300 [13]. The Virginia Department of Health's contractor for the program is Olver Incorporated. Olver Incorporated worked closely with a Local Advisory Committee to identify and evaluate the risks of potential sources of contamination for Amelia Courthouse Sanitary District's (ACSD) five wells. In November 2009, a plan for the ACSD was finalized. The sections below identify the main aspects of the ACSD Wellhead Protection Plan.

2.2.4.1 General

Wellhead protection is a process of:

- Identifying the area's public water supply wells;
- Assessing the potential risks to groundwater in areas around these wells; and
- Implementing measures to manage these risks and reduce the potential for groundwater contamination.

The objectives of the ACSD Wellhead Protection Plan are:

- To promote public health, economic development and community infrastructure by maintaining an adequate drinking water supply for all residents of the community and region, both now and into the future;
- To protect groundwater from the threat of contamination as a result of accidents or unwise practices from nearby residential, industrial, commercial, agricultural, waste management, or transportation activities; and
- To cooperate with the Virginia Department of Health in carrying out the Safe Drinking Water Act purposes and provisions.

2.2.4.2 Potential Sources of Contamination

The fixed radius approach to delineating the recharge zone was used as a reasonable first approximation for the District's wells.

- Zone 1 is a 1000-foot radius around the well and is a priority zone for managing potential sources of contamination; and
- Zone 2 is a one-mile (5,280-foot) radius which represents an estimate of the total recharge zone for the well.

Based on sources of contamination found within these two zones, primary concerns for the ACSD wells include on-site septic systems, abandoned wells, gas stations, fuel storage, underground storage tanks, chemical spills along roadways and railways, residential activities, surface waters (including flooding as a result of a well located down gradient of a pond), and industrial activities.

2.2.4.3 Implementation Actions

As part of the plan several implementation actions were developed. These include:

- Develop a brochure specifically for the ACSD's use to educate and promote general wellhead protection.
- Mail the ACSD brochure to each residence in the Wellhead Protection Area (WHPA) and to each water customer coincident with the distribution of the annual Consumer Confidence Report.
- Promote continued community education on wellhead protection by preparing and distributing additional educational materials on drinking water protection, private well maintenance and the importance of proper well abandonment.
- Add wellhead protection information to the ACSD web page.
- Install signs along the roadway in high visibility locations near the designated boundary of the wellhead protection area that state "Entering a Wellhead Protection Area".
- Annually review with pertinent emergency response personnel the designated WHPA zone and appropriate response procedures.
- Develop with the County the option of designating a Wellhead Protection Overlay District for public water systems in the county and include this District in the Comprehensive Plan.
- Continue annual petroleum contamination testing for the monitoring well located between the known area of contamination and public water supply wells 4B2, 4C, and 4I.
- Implement a program to assist in sealing or abandoning wells that are no longer in use in the wellhead protection area. Prioritize those wells that are deeper and/or closer in proximity to the public wells.

- Include standards for wellhead protection in specifications for Town projects.

- Annually review and update the Wellhead Protection Plan.

SECTION 3.0

EXISTING WATER USE INFORMATION

(9 VAC 25 780-80)

3.1 Water Use

Land use patterns influence the quality and quantity of groundwater supplies in different ways. According to data from the USGS [1], 1995 water withdrawals for Amelia County totaled 2.31 MGD. Agricultural use constituted a majority of the water withdrawn, accounting for 61% of the usage with 1.22 MGD coming from surface water and 0.18 MGD coming from groundwater. Domestic use accounted for 31% (0.72 MGD) while commercial/industrial use accounted for 8%. Projections for future use are described in Section 5.2.

3.1.1 Community Water Systems

Amelia County only has one small community groundwater system that serves approximately 3,000 people and commercial users through 440 connections from water provided by five (5) wells located within Amelia Courthouse. The Amelia Courthouse Sanitary District (ACSD) water operators monitor and record usage data. In 2008, the average daily usage for the water system is approximately 0.10 MGD with a daily maximum withdrawal of 0.5 MGD. There is no military water use, agricultural water use, water used in water production processes, heavy industrial water use, or sale of water to other community systems. Table 2 provides a typical breakdown of the distribution of water to the community water system customers.

Table 2
Typical Water System Water Use by Category in September 2009

Category	Number of Connections	Water Use (MGD) (September 2009)[1]	Percent Water Use
Residential	290	0.039	37
Commercial/Industrial	150	0.055	53
Unaccounted Water Loss	N/A	0.010[2]	10
Total	**440**	**0.104**	**100**

1. This month's data is considered typical of water use for the ACSD (2.82 GPM).

2. Estimated system water loss (Daryl Gough, Maintenance Supervisor, Amelia Courthouse Sanitary District, personal communication, May 26, 2010).

Most of the commercial/industrial water users are located within the Amelia Courthouse district and thus receive their water from the ACSD community system. The Amelia County Industrial Development Authority has been established to oversee economic development in the County and is currently responsible for the Amelia County Industrial Park. Currently four major industries are located in the park, and additional tracts are still available for development. The park was developed to include water and sewer service [14]. Data from the USGS [1] indicates that groundwater usage for commercial and industrial purposes for Amelia County was 0.18 MGD or about 16% of the total groundwater use in the county.

Information from the ACSD records indicates that the total annual water use from January to December 2008 was 37.8 MG. This averages to approximately 3.2 MG per month and 0.10 MGD. While some variations in monthly water use are apparent, there does not appear to be a significant seasonal influence in water use. The breakdown of Calendar Year 2008 monthly water usage is depicted in Table 3.

Table 3
2008 Water Production for ACSD

Month	Total Monthly Use (MG)	Average Daily Use (MGD)
January	3.1	0.100
February	2.7	0.093
March	3.1	0.100
April	3.0	0.100
May	4.0	0.129
June	2.9	0.097
July	2.8	0.090
August	3.2	0.103
September	3.6	0.120
October	3.2	0.103
November	3.0	0.100
December	3.2	0.103
Annual	**Total = 37.8**	**Average = 0.104**

The ACSD maintains monthly well withdrawal records but does not maintain daily logs. As such, the peak flow days for each month and the corresponding peak days in each week are not recorded. However, the ACSD operators observed that in general Monday is the peak day during most weeks, while Saturdays and Sundays usually have lower water withdrawals due to schools not being in session. Three schools and a nursing home are the greatest individual users of water in the ACSD system. Information from September 2009 indicated that the schools and nursing homes accounted for 31% of the commercial water use and 18% of the total water use for the month (Buddy Webster, Chief Water Operator, personal communication, October 21, 2009). Although daily log information is not currently recorded, if it becomes available in the future, this information will be incorporated into the plan.

The ACSD does not currently use nor has future plans to use stream intakes to supply water to County water users. Stream intakes could have an effect on such in-stream beneficial uses such as boating, fishing, other recreational activities, and transportation. In addition, there could be environmental consequences as well. If the County decides to utilize stream intakes in the future, such affects will be analyzed prior to stream intake use.

3.1.2 Self-supplied Non-agricultural Users

There are approximately 9,586 residents in approximately 3,604 residences that utilize private wells within the County. Seven (7) of these private wells serving individual residential homes and one (1) private well serving a mobile home park (currently with seven (7) mobile homes), are located within the Amelia County Sanitary District (ACSD). There are plans to connect three (3) of these homes and the mobile home park to the ACSD system within the next few years. The other residential homes cannot be served by the ACSD due to their location in regards to the existing water lines (Daryl Gough, Maintenance Supervisor, Amelia Courthouse Sanitary District, personal communication, September 28, 2010). There are an additional four (4) small businesses utilizing private wells within the County. All of the

businesses are located outside of the current ACSD service area. None of these self-supplied residential or commercial/industrial users are believed to use more than 300,000 gallons each of water per month.

According to the *Virginia Green* website, the average person uses approximately 100 gallons of water a day for drinking, washing, and cooking [15]. Table 4 indicates the estimated amount of water used on a daily and annual basis by non-agricultural users of private wells.

Table 4
Self-supplied Non-agricultural Water Use by Category

Category	Number	Average Water Use per Day Each	Total Daily Use	Total Annual Use
Residential	9,586	~100 gallons[1]	~0.96 MGD	~350 MGY
Commercial/Industrial	4[2]	~6,300 gallons[3]	~0.025 MGD[3]	~9.1 MGY[3]
		Total	**~0.99 MGD**	**~359 MGY**

1. Information from the Virginia Green website, 2009 (http://www.deq.state.va.us/p2/virginiagreen/water) [15].
2. Two restaurants, one campground, and one truck stop. From the VDH Office of Drinking Water, Listing of Waterworks and Associated Owners and Administrative Contacts, June 2009 [11].
3. Extrapolated from water use estimates from NC DENR Division of Pollution Prevention and Environmental Assistance indicating 35 gallons/day/restaurant seat and 120 gallons/day/campsite with hookups [16]. Number for campgrounds user was divided by two to give conservative estimate based on seasonal use of 6 months of each year.

3.1.3 Self-supplied Agricultural Users

According to the 2001 Amelia County Comprehensive Plan [2], agriculture accounts for over 33% of the land use in Amelia County. All of the farms in the county obtain their water from private wells and surface water withdrawals. From livestock watering to irrigation purposes, water is used for a number of different applications on these farms.

Data from the USGS [1] regarding the amount of water withdrawn by agricultural users in Amelia County in 1995 is summarized in Table 5. The data includes water withdrawn for irrigation and for livestock watering and indicates that total groundwater usage for agricultural purposes for Amelia County accounted for about 16% of the total groundwater use in the County. More recent USGS data from 2005 indicated lower withdrawals by agricultural users than in 1995. 2005 data from the USGS indicated groundwater and surface water was used in Amelia County at the rates of 0.19 MGD and 0.54 MGD, respectively [6]. Information

from the 2007 USDA Agricultural Census indicated that total irrigated acres in the County had decreased from 2002 to 2007 by about 40%. The amount of harvested acres of some crop types had changed during this period with crops such as corn, wheat, and winter wheat showing an increase in harvested acres and other crops such as barley, soybeans, and tobacco showing a decrease in harvested acres. Changes in crops grown in the County during this period may result in changes in water use since different crop types require different amounts of irrigation. In addition, the number of cattle farms in the County had decreased from 2002 to 2007 although the number of cattle and calves had increased slightly [17]. To be conservative (and account for drought usage), the higher withdrawals from 1995 numbers were used for projected future agricultural uses. All of the groundwater utilized for agricultural purposes within the County is from the private wells. Surface water withdrawal for agricultural purposes accounts for all (100%) of the surface water use in Amelia County.

Table 5
Agricultural Withdrawals for Amelia County, Virginia in 1995*

Agricultural Users Source	Irrigation	Livestock Watering	Total Withdrawals (MGD)	Total Withdrawals (MGY)
Surface Water	0.95	0.26	1.22	445
Groundwater	0.0	0.18	0.18	66
Total	**0.95**	**0.45**	**1.40**	**511**

*This includes both reporting and non-reporting agricultural withdrawals.

The Groundwater Management Act of 1992 requires withdrawal permits for all users located in designated groundwater management areas that use more than 300,000 gallons of water per month, including agricultural users. Amelia County is not located within a designated groundwater management area and as such, there are no permitted agricultural users in the county. However, annual reporting of water withdrawals is required for any user that withdraws more than 10,000 gallons a day on average for any single month for general agricultural purposes or for users who withdrawal over one million gallons in any single month for crop irrigation (9 VAC 25-200). Records provided by DEQ indicate that in Calendar Year 2008 there were a total of three (3) agricultural users who make use of eight (8) withdrawal

points that reported withdrawals of more than 300,000 gallons for at least one month. The water usage from these three (3) agricultural users is already accounted for in Table 5.

The total 2008 withdrawals of these self-supplied agricultural water users are summarized in Table 6. As shown in the table, seven (7) of the withdrawal points utilized are surface water sources and one (1) is a groundwater source. This data is believed to be typical for reportable withdrawals during a relatively dry year.

Table 6
2008 Summary of Reportable Water Use by Self-Supplied Agricultural Users

Agricultural Users Source	Number of Reporting Users	2008 Water Use (MGD)[1]	2008 Water Use (MGY)
Surface Water	7	0.0236	8.63[2]
Groundwater	1	0.0105	3.84
Total	**8**	**0.0341**	**12.47**

1. Calculated based on MGY data provided by DEQ [12].
2. This includes two month's reports of less than 300,000 gallons.

A list of reporting self-supplied agricultural users for 2008 and other pertinent information is summarized in Table 7.

Table 7
2008 Reporting Self-supplied Agricultural Users Summary

Water User Name	Water Utilized	Water Type	Use	No. Months with Withdrawals Exceeding 0.3 MG	Daily Withdrawal (MGD)[1]	Annual Withdrawal (MGY)
Hard Acres Farm	Farm Pond # 3	Surface	Irrigation	2	0.00540	1.97
Hard Acres Farm	Farm Pond # 2	Surface	Irrigation	1	0.00178	0.65[2]
Hard Acres Farm	Farm Pond #1	Surface	Irrigation	2	0.00222	0.81
Hard Acres Farm	North Buckskin Creek	Surface	Irrigation	1	0.00164	0.60*
Oakmulgee Dairy	Well	Ground-water	Non – Irrigation (livestock watering)	12	0.01052	3.84
Oakmulgee Dairy	Appomattox River	Surface	Irrigation	3	0.00685	2.5
Oakmulgee Dairy	Runoff Pond	Surface	Irrigation	3	0.00575	2.1
Green Hill Dairy	Appomattox River	Surface	Irrigation	1	0.00274	1.0
				Total	**0.03690**	**12.47**

1. Calculated based on MGY data provided by DEQ [12].
2. Includes one month withdrawal less than 300,000 gallons.

The total of 12.47 MG used in 2008 for self-supplied agricultural irrigation and livestock watering for the eight withdrawal points indicated in Table 7 represents only a small fraction of the total agricultural county-wide water use estimated by USGS and depicted in Table 5. All of these agricultural users are located outside of the Amelia County Sanitary District with no plans to incorporate them into the system in the future (Daryl Gough, Maintenance Supervisor, Amelia Courthouse Sanitary District, personal communication, September 28, 2010).

Agricultural users of less than 300,000 gallons per month can be estimated by subtracting the 2008 self-supplied agricultural users data provided by DEQ by the USGS data (1995). The results are summarized in Table 8.

Table 8
Non-reporting Self-supplied Agricultural Users

Water Type	Estimated Daily Water Use by Non-reporting (<300,000 gallons) Self-supplied Agricultural Users (MGD)		Estimated Annual Water Use by Non-reporting (<300,000 gallons) Self-supplied Agricultural Users (MGY)		Total Annual Water Use (Irrigation and Livestock Watering) (MGY)
	Irrigation	Livestock Watering	Irrigation	Livestock Watering	
Surface Water	0.926	0.26	338.0	94.9	432.9
Groundwater	0.0	0.169	0.0	61.7	61.7
Totals	0.926	0.429	338.0	156.6	494.6

SECTION 4.0

EXISTING RESOURCE INFORMATION

(9 VAC 25-780-90)

4.1 Groundwater Sources

Groundwater is a highly useful and seemingly abundant resource. According to data gathered by the USGS [18] in 2000, groundwater provides 37% of the public-supply withdrawals, 24% of industrial and mining water, and 42% of agricultural water (mostly used for irrigation) in the United States. In Virginia, 80% of the total population relies on groundwater for their drinking water; this includes those that use private wells and as well as public water systems. Similarly, 79% of public water supply systems in Virginia use groundwater as the source of the drinking water provided to their service populations. In addition, in 10 of Virginia's 95 counties, greater than 85% of the population is served by private wells [19]. These data show that over half of the country's population relies on groundwater as the primary source of drinking water and in Virginia over three-quarters of the population depends on groundwater as their drinking water source. All of the residents in Amelia County rely on groundwater as the primary source of drinking water.

4.1.1 Geology

Amelia County lies in the Piedmont Physiographic province of Virginia including both eastern and central piedmont formations and is underlain primarily by igneous and metamorphic rocks. While the Piedmont province is generally considered to have an abundant supply of groundwater, such supplies are not uniform over the entire region due to the regions diverse subgeology. Much of the underlying rock in Amelia County consists of granites and metamorphosed sedimentary rocks with bedrock that generally has low permeability and thus relatively limited amounts of groundwater [2].

As depicted in Figure 1, Amelia County encompasses four geologic terranes: Goochland, Richmond Mesozoic Basin, Raleigh, and Eastern Slate Belt [12]. In addition, there are several mylonitic fault zones within the County. The typical production for wells located within these geologic terranes is addressed in more detail in Section 4.1.2.

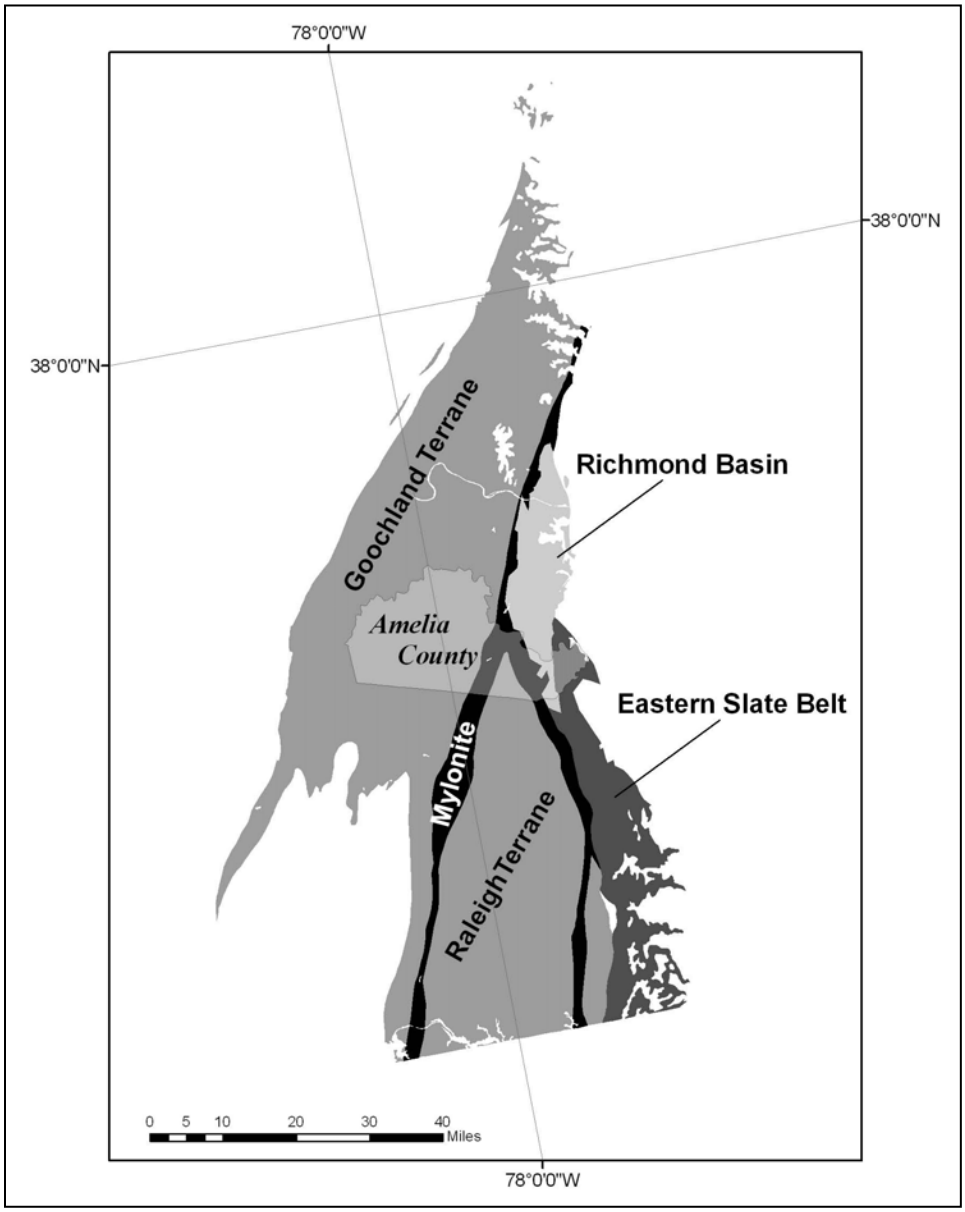


Figure 1 - Geologic Terranes in Amelia County, VA [12]

4.1.1.1 Hydrogeology

According to the United States Geological Survey's Groundwater Atlas of the United States Publication HA-730-L [20], there are two (2) aquifers in Amelia County, the Early Mesozoic Basin Aquifer and the Crystalline Rock Aquifer. The location of the two aquifers is shown on Figure 2.

- Early Mesozoic Basin Aquifer (Richmond Basin) - The early Mesozoic basins formed by downfaulting that accompanied rifting of the Earth's crust in the Triassic and Jurassic Periods are filled mostly with thick sequences of sedimentary rocks. The groundwater in the Early Mesozoic rocks moves primarily along joints, fractures, and bedding planes.

- Crystalline Rock Aquifer (Goochland Terrane, Mylonite, Raleigh Terrane, and Eastern Slate Belt) - Most of the rocks that compose the crystalline-rock and undifferentiated sedimentary-rock aquifers are crystalline metamorphic and igneous rocks of many types. The main types of crystalline rocks are coarse-grained gneisses and schists of various mineral compositions; however, fine-grained rocks, such as phyllite and metamorphosed volcanic rocks, are common in places. In crystalline-rock aquifers, the regolith and fractures in the bedrock provide the principal places for the storage and transmission of water.

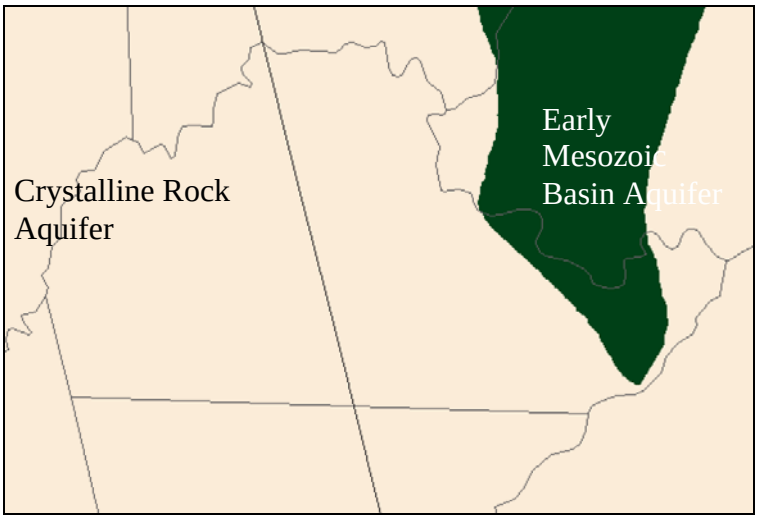


Figure 2 - Aquifers underlying Amelia County [20]

4.1.2 Aquifer Capacity and Production

The capacity of an aquifer depends on the porosity of the rock or soil in the geologic deposit. For the aquifer to be useful as drinking water it must be pumpable to the surface at

a reasonable rate and cost. An ideal aquifer for a water supply is one that has high capacity, high specific yield, high hydraulic conductivity, and good water quality [21]. The actual capacities of the two aquifers underlying Amelia County are not known. The County worked with consultants from Emery & Garrett Groundwater Inc. in 2007 and 2008 to explore further groundwater development in the area [8, 9]. As a result of these studies, several potential Groundwater Development Zones were identified and preliminary studies were completed. Further studies on these and other sites could provide preliminary well yields and water quality information.

Using public drinking water well information reported to the Virginia Department of Health (VDH), DEQ estimated the sustained well yield for all available non-residential wells within the geologic terranes found in the eastern piedmont area of Virginia. This includes data from wells located within and outside of Amelia County and within the same rock types. As such, this information may be considered a good estimate of the typical groundwater production rates for well located in the County's aquifers. For this analysis, DEQ combined the Raleigh and Goochland terranes since both are composed of mainly crystalline rocks; these constitute the majority of the area of Amelia County. The mylonitic zones within the Goochland terrane were separated for the analysis due to distinctions in the faults and the Goochland terrane that may result in differences in aquifer yields. The Richmond Mesozoic Basin is composed of sedimentary rocks, and the Eastern slate belt from metamorphosed volcanic and sedimentary rocks. Both of these terranes constitute smaller areas of the eastern part of the County.

Figure 3 shows the estimated sustained yields for the geologic terranes of which Amelia County is included. As depicted, the highest median well yields are located in the Goochland and Raleigh Terranes, followed by the Mylonite Zones, the Richmond Mesozoic Basin, and the Eastern Slate Belt with the lowest yields [20].

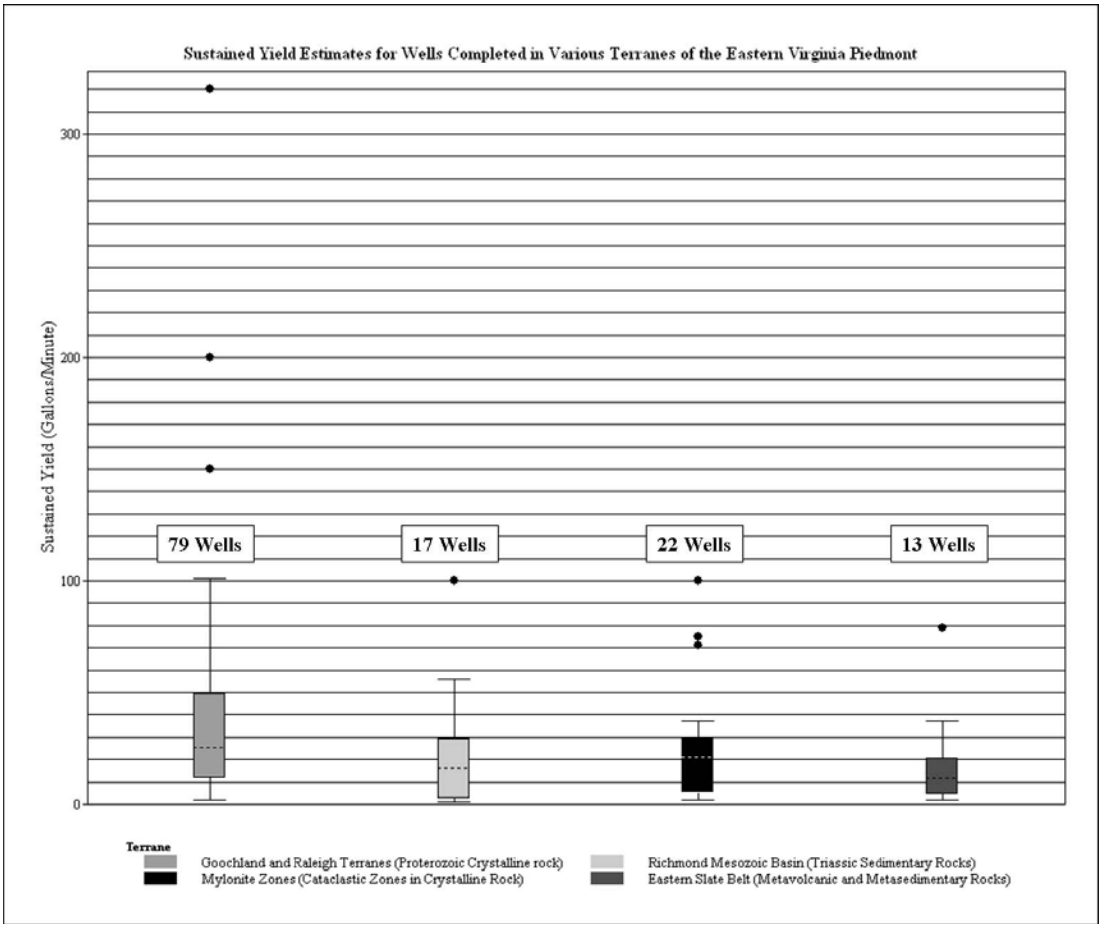


Figure 3 – Sustained Yield Estimates for Wells Completed in Various Terranes of the Eastern Virginia Piedmont

The median well yield estimates provided in Figure 3 for each terrane can be extrapolated to provide annual median production values. As depicted in Table 9, the Goochland and Raleigh terranes that comprise most of the County have the greatest sustained yield.

Table 9
Median Sustained Wells Yields for Geologic Terranes in the Eastern Virginia Piedmont

Geologic Terrane	Median Sustained Yield (gallons/minute)	Annual Median Sustained Yield (MGY)
Goochland and Raleigh	25	13.1
Mylonite Zone	21	11.0
Richmond Mesozoic Basin	16	8.4
Eastern Slate Belt	11	5.8

In addition, DEQ compiled information regarding actual annual water production of wells reported to DEQ in millions of gallons per year for 2007 as shown on Figure 4. Five of the wells shown on the figure are located in Amelia County. Of these, three of the wells reported production in the 0.00-0.67 MG range during 2007 while the remaining two wells reported 2007 annual production in the 0.68-3.20 MG range [12].

On average the five ACSD wells are currently producing more than the wells included in the 2007 DEQ information. The total Calendar Year 2008 production was 37.8 MG, for an average of approximately 7.6 MG for each well. This is well above the DEQ production values and indicates that there is significant variation of the production rates of groundwater wells within Amelia County. In some locations, production is limited while in other areas, good production has been achieved. This degree of variability in groundwater production is not uncommon in some terranes and aquifers. If placed in productive locations, additional wells within these aquifer(s) can provide significant water volume to support future water needs.

4.1.3 Flow and Recharge

Groundwater flow is very slow compared to surface water. Only in limestone caverns, open lava tubes, or large rock fracture can the flow rate resemble surface water [21]. The flow of groundwater is governed by pressure gradients. Discharged water has water behind it that is driving it out of the system and moving it from the highest pressure in the flow system to the lowest pressure in the flow system. In general, the underground topography (or water table surface) is similar to the landscape above which could be a reasonable indicator of the regional groundwater flow.

The rate of groundwater flow varies widely and is dependent on the geology of the area. Within unconsolidated geologic deposits groundwater flow is low, maybe only a few inches a day and travels in a smooth pathway. In consolidated geologic deposits, the flow is faster, more turbulent, and with more mixing. The aquifers below the Piedmont

Physiographic province of Virginia which includes Amelia County are composed largely of igneous and metamorphic rock, with some areas of sedimentary rock. There are no extensive unconsolidated geologic deposits overlying the bedrock of the Piedmont. Groundwater is stored and transmitted in fractures and faults in the bedrock. Water supplies are generally located within a few hundred feet of the surface since water-bearing fractures decrease in size and number as depth increases. Due to the diversity of the geology of the region, water quantity and quality is varied making well site evaluation important [12].

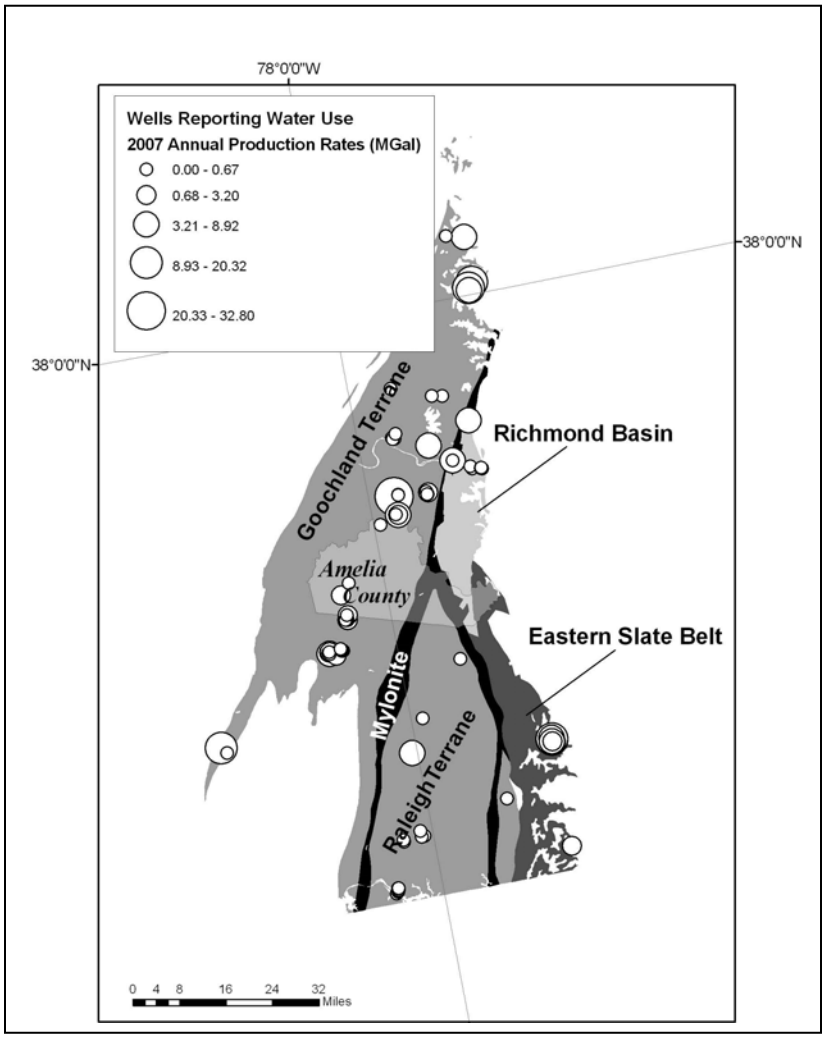


Figure 4 - 2007 Annual Production Rates for Wells Reporting Water [12]

Recharge refers to the rate at which groundwater is replenished by precipitation or other sources. Some precipitation is intercepted by vegetation, some runs off as overland flow into surface water bodies and the remainder penetrates the ground and recharges the aquifer.

For the 2007 study performed by Emery & Garrett Groundwater Inc. for the County, the consultants applied a recharge value of ten (10) inches per year over the study area to estimate available recharge. According to this report, this recharge value is equal to 477,000 gallons per day per square mile. The groundwater development zone study areas addressed in the report were approximately 4.38 square miles providing a potential recharge of 2,090,000 gpd (763 MGY). When applied to the entire County, this could represent a substantial amount of water available for future use [8].

The recharge value indicated in the study above was based on recharge values in other areas of the region and in Maryland. More site specific data indicates that the recharge may be much lower. Baseflow data available though the USGS indicates the average recharge for the County's watersheds is closer to 6.66 inches per year equaling 317,800 gallons per day per square mile [5].

4.1.4 Estimated Available Groundwater

The amount of water available in an aquifer is dependent on a number of factors including the volume residing in the aquifer at any time and its recharge and discharge rates. Since the current volume and corresponding discharge rates of the two aquifers underlying Amelia County are not known, an estimate of the amount of water potentially available from aquifer recharge was determined by calculating the amount of recharge that typically occurs on an annual basis over the entire County. This was performed using the 6.6 inches per year (317,800 gallons per day per square mile) recharge rate. The estimate also assumes that the area of pervious surfaces in the County will be able to accommodate the full recharge value

while impervious surfaces within the County will act as precipitation runoffs to surface waters instead of allowing infiltration into the ground. Therefore, all residential and commercial/industrial land use areas were considered impervious and all agricultural and undeveloped lands pervious for the purposes of these calculations.

Amelia County is ~357 square miles [7]. Conservative estimates of pervious and impervious surfaces in the County for the present recharge area and available recharge area in the future (2060 - timeframe of water planning) were calculated. As described in more detail in Section 4.4, currently less than 10% of the County land use is residential and commercial/industrial and greater than 90% land use is agricultural or undeveloped.

For projected pervious and impervious surface areas, an assumption was made that the conversion of agricultural and undeveloped land (pervious surfaces) to residential and commercial/industrial land use (impervious surfaces) occurs at the same rate as population growth. Based on population projections (Section 5.2), the population in Amelia County is expected to quadruple from 2000-2060 and as such, the conversion of land use is projected to result in approximately 40% impervious surface area in the County by 2060. The estimated areas of pervious and impervious surfaces presently and in the future (2060) are summarized in the Table 10.

Table 10
Estimated Pervious and Impervious Surface Areas in Amelia County

Surface Type	Present (square miles)	Projected (2060) (square miles)
Pervious Surface Area	321	214
Impervious Surface Area	36	143
Total Area	**357**	**357**

The corresponding volumes of groundwater potentially available for present and future use in the County based on the average recharge projection of 6.66 inches per year are shown in Table 11.

Table 11
Current and Projected Daily and Annual Available Groundwater through Recharge in Amelia County

Potentially Available Volume of Groundwater Through Recharge	Daily (MGD)	Annually (MGY)
Present	105	38,404
Projected Future (2060)	70	25,602

Conservatively assuming that only 10% of the annual recharge rate is available to the County and the remaining recharge volume is lost through naturally occurring aquifer discharges (springs, off-site flow, etc.), the annual volume available for consumptive use by the County in 2060 is 2,560 MGY. Recovery of this volume of water will require the location and installation of a suitable number of wells in areas with good groundwater production.

4.2 Surface Water Sources

Surface water in the County ranges from small ponds to large rivers; however, some of these resources are impractical for use as drinking water sources. Surface water is extremely vulnerable to contamination and treatment of drinking water from these sources is typically more costly than using groundwater wells. Consequently, Amelia County derives its drinking water exclusively from groundwater wells while some surface water is used for agricultural purposes. In addition surface water plays an important role in the ecology of the County.

4.2.1 Rivers

Amelia County is located primarily within the Appomattox River watershed. The Appomattox River bounds Amelia County to the north and most of the eastern and western borders of the County. Other major surface waters include Beaverpond Creek, Flat Creek, Namozine Creek, Nibbs Creek, Smacks Creek, Deep Creek, and Winticomac Creek. According to the Department of Natural Sciences, the Nibbs Creek watershed has been identified by Virginia's Department of Conservation and Recreation and the Department of Environmental Quality as having water quality impairments [22]. Additional watersheds within the County are shown on Table 12.

Table 12
Major Watersheds in Amelia County [1]

Watershed	Approximate % of County
1. Appomattox River (and other smaller tributaries)	**40%**
2. Flat Creek	**25%**
3. Nibbs Creek	**10%**
4. Deep Creek	**20%**
5. Namozine Creek	**5%**
Total	**100%**

The Appomattox River has been recognized as having the potential for the development of a large regional water supply and some studies were carried out to evaluate that potential. The studies completed in the 1980s evaluated a potential impoundment known as Lake Genito and recommended that Amelia, Cumberland, Powhatan, and Chesterfield Counties enter into a combined effort to foster the development of a small-scale regional water supply [2]. Until recently, no action was made to implement this recommendation. Over the past several years, a group of counties agreed to move forward with the permitting phase of developing the Lake Genito reservoir although Amelia County decided not to participate in this effort. To date, the formation of a regional water supply and the creation of the Lake Genito impoundment have not been completed.

4.2.2 Reservoirs

There are a number of reservoirs in Amelia County; however, none are currently used as a source of drinking water. The reservoirs include Big Pond, Beaver Pond, Jones Lake, Davenport Pond, Bardens Pond, Owenbys Lake, Whites Pond, Andersons Lake and Andersons Pond [23]. There are 275 lakes and ponds in the County for a total of approximately 8,295 acres [3].

Amelia Lake is a 100-acre impoundment located within the Amelia Wildlife Management Area and is owned and managed by the Virginia Department of Game and Inland Fisheries [24]. Like the other reservoirs, this lake is not used as a source of drinking water.

4.3 Meteorological Conditions

Amelia County has a moderate climate and is susceptible to varying weather events such as winter storms, including snow and ice, severe storms, including lightning, hail, tornadoes and hurricanes, and drought conditions [3].

For the years 1971-2000, Amelia County averaged 44 inches of precipitation per year with July and August being the wettest months, averaging 4.26 inches and 4.27 inches of precipitation respectively. The County averaged 12.4 inches of snowfall for these years. The temperatures in the County have been typically hottest during the month of July with an average minimum temperature of 18.1°C (64.6°F) and an average maximum temperature of 33.3°C (88.4°F). Temperatures in the County have been coldest during January with an average minimum temperature of -4.1°C (24.7°F) and an average maximum temperature of 8.3°C (46.9°F). The County averaged 70% humidity with the most humid months being August and September (both 77%) and the least humid month being April (61%) [25].

4.4 Land Use

Amelia County is predominately rural with most of its acreage in forest and agricultural districts. In 2000 there were approximately 4,850 residential units in the County, according to building permit data. Most of these units are generally dispersed indicating that only ~10% land use is for non-agricultural uses [2]. Section 4.1.4 and Table 10 detail estimated present and projected pervious and impervious surface areas in the County.

Recently, the draw of low cost rural residential lots combined with the close proximity to the business hubs of Richmond and Petersburg have increased the demand for rural residential lots in the County. Table 13 shows the current land use percentages in Amelia County.

Table 13
Land Use in Amelia County (2)

Land Use Category	% Land Area of County
Agriculture (20 to 99 acres)	30+%
Agriculture (over 99 acres)	60+%
Single Family Residential (Urban)	<1%
Single Family Residential (Suburban)	6%
Multi-Family Residential	<1%
Commercial/Industrial	<1%
Exempt (government, religious, etc.)	1%
Total	100%

Land uses can have a direct effect on surface and groundwater supplies and the effects can be positive or negative depending on the land use management. While forests, vegetation, and soils act as natural filters for water, human activities can alter these processes and introduce contaminants into the surface and groundwater systems. Of major concern in Amelia County are agricultural and forestry practices.

Agriculture represents a significant potential impact to water quality and quantity. Physical and hydrologic changes result from agricultural related activities and include increased run-off, increased erosion and sedimentation, altered soil characteristics, pesticide and herbicide contamination, and increased nutrient loading which contributes to algal growth in water bodies.

Nearly three-quarters of the County's land is forest, with approximately 74% of the forested land classified as timberland. Approximately two-thirds of the timberland is owned by farmers while about 30% of the forested land is owned by timber corporations [2]. While forestry and timbering is not as damaging as other forms of land use, it does have the potential to have a negative effect of water supplies. Removal of forest and forestry practices can result in increased sedimentation, increased run off, increased nutrient loading, decreased infiltration, reduced evapotranspiration, and herbicide contamination.

In addition to forests and agricultural uses, the other major land use in Amelia County is Urban/Suburban use. The Urban/Suburban land use category is a broad category that

encompasses commercial, industrial, as well as residential development. Though this category currently represents a small percentage of land use in the county, it is one of the fastest growing types of development and will continue to increase as the population of the county grows. This type of development also can have significant impacts on water quality. Increased non-point source pollution sources, decreased infiltration, and increased run-off are just a few of the impacts resulting from the presence of impervious surface areas, channelization of streams, and the simplification of drainage networks that accompanies urban and suburban development. These types of changes alter the natural flow of water and can result in reduced groundwater levels, increased flood peaks and increased stream erosion.

Currently, the greatest potential for resource depletion appears to be the large influx of residential water users that commute to nearby cities for jobs. The most recent data indicates that <1% of the land area within the County is used for commercial or industrial purposes. The County's economy has been largely based on agriculture, lumber, and timber. The County has made efforts to encourage local economic development through the establishment of an Industrial Development Authority and being an active member of the Piedmont Planning District Commission through which, Amelia County was designated a Re-development Area [2].

Within the County, commercial and industrial areas have concentrated along the Route 360 corridor, north of Route 360, and along Route 153. There have been decreases in the commercial retail and wholesale markets in the County and an increase in residential construction in part because over fifty percent (50%) of the residents commute to jobs outside of the County [2].

4.5 Other Environmental Conditions

As indicated previously, Amelia Courthouse Sanitary District currently uses groundwater exclusively to provide water for public consumption. In addition, groundwater serves as the drinking water source for the remainder of the county's residential and commercial/industrial water use. There are only limited agricultural surface water withdrawals and these are not expected to increase in numbers or volume in the future. In addition, there no plans for surface water withdrawals for use in drinking water applications now and into the future. As such, the current and future groundwater withdrawals in the County are not expected to directly impact:

- Anadromous, trout, and other types of fisheries;
- River segments that have recreational significance including state scenic river status;
- Riparian buffers and
- The presence of impaired streams of impaired streams and the type of impairment.

The location of wells and the siting of new wells may be affected by other environmental conditions as described below.

4.5.1 State or Federally Listed Threatened or Endangered Species or Habitats of Concern

Using information from the Virginia Department of Conservation and Recreation [26] and the Virginia Department of Game and Inland Fisheries [27], the following species found in Amelia County and identified in Table 14 are considered threatened or endangered:

Table 14
Threatened and Endangered Species in Amelia County, VA

Species Name	Common Name	Status*
Alasmidonta varicosa	Brook Floater (mussel)	SE
Bartramia longicauda	Upland Sandpiper (bird)	ST
Lanius ludovicianus	Loggerhead Shrike (bird)	ST
Ammodramus henslowii	Henslow's Sparrow (bird)	ST
Haliaeetus leucocephalus	Bald Eagle (bird)	FSST
Lanius ludovicianus migrans	Migrant Loggerhead Shrike (bird)	ST

* FE = Federal Endangered; FT = Federal Threatened; SE = State Endangered; ST = State Threatened

None of the species listed is expected to be directly affected by any future development of the County's water supply. There are no current plans for the development of surface waters which could affect the endangered mussel species, and any disturbance to the bird species habitat during well installation would likely be temporary.

4.5.2 Sites of Historic or Archaeological Significance

A search of the Virginia Department of Historic Resources (VDHR) websites was completed to identify any historic or archeological sites of significance in the County. Nine sites in the County are listed on the National Register of Historic Places [28, 29]:

- Dykeland
- Egglestetton
- Farmer House
- Haw Branch
- Ingleside
- Sayler's Creek Battlefield
- St. John's Church
- Wigwam
- Winterham

All but one of the sites is listed as privately owned. The ownership classification of Sayler's Creek Battlefield is listed as both private and public. There is not expected to be any effect by future water supply development as future wells siting is unlikely to occur at any of these significant sites.

A search of VDHR's Archaeology Network [29] website did not result in any identified archeological sites within the County. Future well siting would comply with all state and

federal requirements concerning the preservation of identified archaeological sites. Identified archaeological sites will be included in revisions to the water supply plan.

4.5.3 Unusual Geologic Formations and Special Soil Types

Section 4.1 identifies the characteristics of the geology of Amelia County and there affect on the quality and quantity of groundwater.

The County's Comprehensive plan [2] identified seven (7) major soil associations within the County as shown in Table 15.

Table 15
General Soil Associations in Amelia County, VA.*

Soil Unit	Approximate % of County
1. Cecil-Appling-Wedowee	60%
2. Georgeville-Cid-Herndon	5%
3. Wedowee-Appling-Chewacla	10%
4. Mayodan-Creedmoor	<3%
5. Appling-Wedowee-Winnsboro	15%
6. Winnsboro-Helena-Wedowee	<5%
7. Chewacla-Dogue-Chastain	<3%

*From Amelia County Comprehensive Plan 2000-2025 (2001) [2]

Selected Properties of the most abundant soil types are shown in Table 16. Generally, most of the soils within the County have a depth to bedrock of four to five feet although in some areas it is as little as two feet. Restrictions in the County due to soil factors such as low permeability, steep slopes and shallow depth to bedrock exist but are not considered severe and usually affect the development of on-site septic systems and building construction [2].

Table 16
Selected Properties of Soils in Amelia County

Soil Series	Slope Range	Depth to Bedrock	Shrink / Swell Potential	Permeability	Suitability for General Agriculture	Suitability for Timber-Pulpwood	Suitability for Septic Drainfields
1. Appling	0-15 %	60"	Moderate	Moderate	Good	Fair	Moderate
2. Cecil	0-15 %	60"	Moderate	Moderate	Good	Fair	Moderate
3. Georgeville	0-15 %	60"	Low	Moderate	Good	Good	Moderate
4. Helena	0-15 %	48-60"	Moderate	Slow	Fair	Fair	Severe
5. Herndon	0-15 %	84"	Low/Mod.	Moderate	Good/Fair /Poor	Fair	Mod./Severe

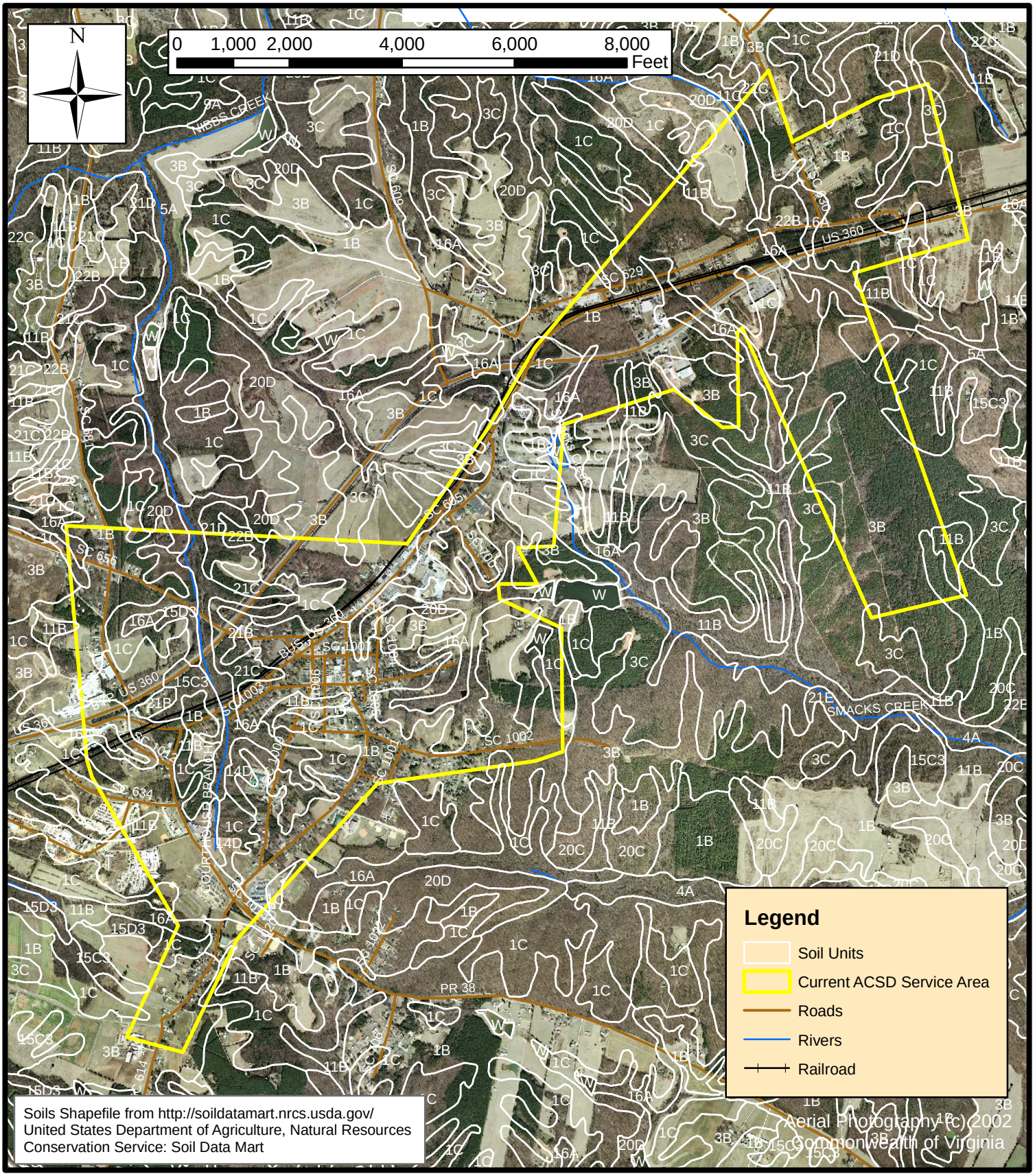
*From Amelia County Comprehensive Plan 2000-2025 (2001)

A more detailed Web Soil Survey [30] was conducted on the area in the County where the Amelia Courthouse Sanitary District (ACSD) is located and where the development of additional wells for the community water supply is likely to occur. This survey identified one additional dominant soil type in the ACSD. Partlow Fine Sandy Loam has 0-2% slopes, depths greater than 80 inches to bedrock, moderately high to high permeability, suitable for agriculture and forest, and is poorly suited for septic drainfields. No special soil types were identified within the ACSD. Figure 5 is a map of the soil types in the ACSD area.

4.5.4 Wetlands

The Virginia Department of Conservation and Recreation has identified approximately 2.7% of the County's total land area as non-tidal wetlands. Most of these wetlands are located along rivers and within valleys. Although wetlands occupy only a small percentage of the County's land base, they are a valuable resource responsible for the reduction of floodwater peaks by storing the floodwater and reducing velocity, by serving as groundwater discharge and recharge areas, and by improving water quality and provide food and habitat for fish and wildlife [2].

Although development in these areas due to water supply planning is unlikely since the County has no plans to utilize surface water for a community water source, and that well siting is unlikely to occur in these areas, all applicable permitting and regulations would be adhered to in the event of development. Figure 6 shows wetlands identified near the Amelia



NRCS Soil Survey Map
Amelia Courthouse Sanitary District Service Area
Figure 5

Major Soil Types	Symbol
Appling Fine Sandy Loam	1
Cecil Fine Sandy Loam	3
Partlow Fine Sandy Loam	16
Wedowee Sandy Loam	20

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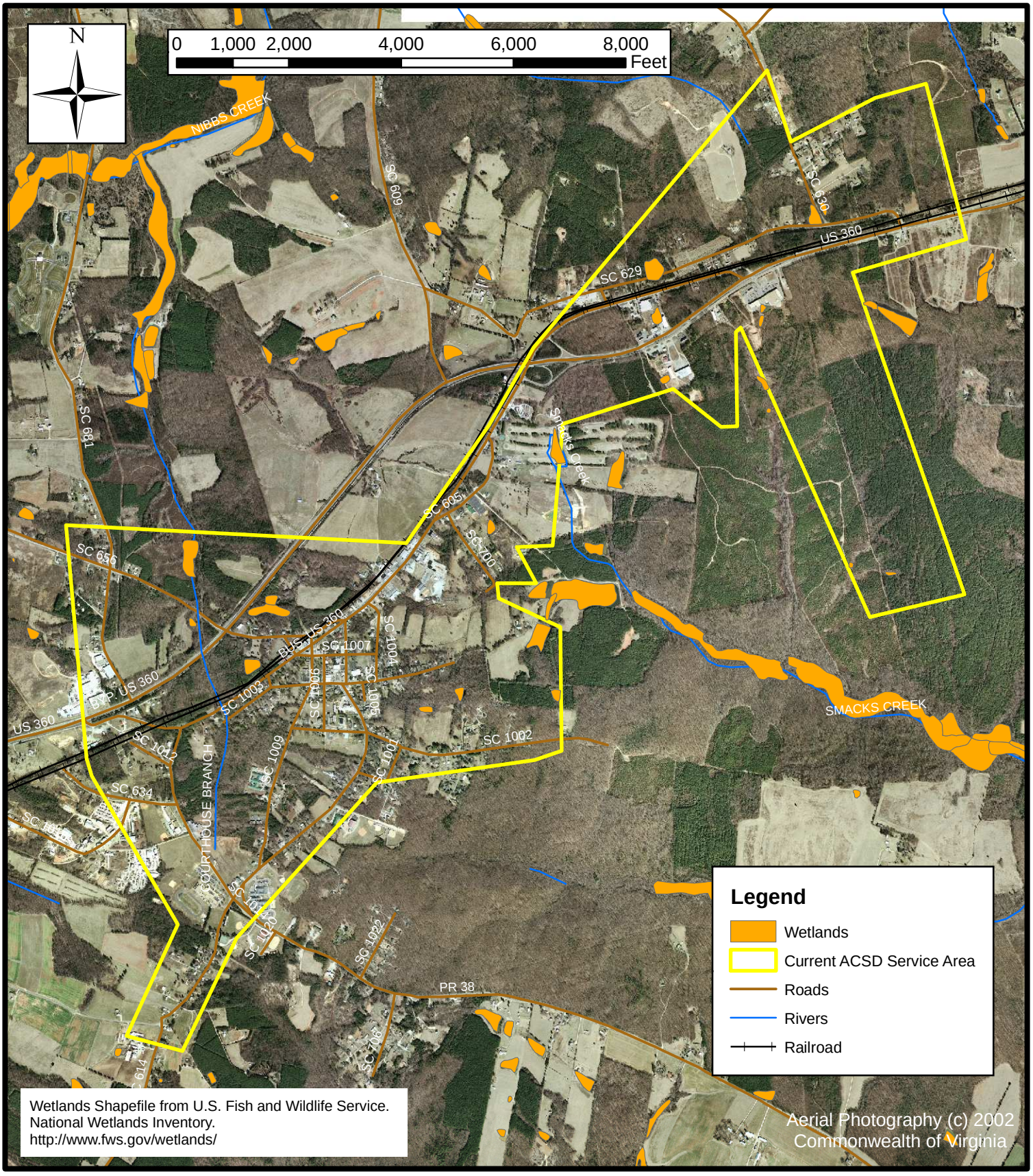

National Wetlands Index Map
Amelia Courthouse Sanitary District Service Area
Figure 6

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This map is general refernce only and does not constitute all the wetlands in this area.

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Courthouse Sanitary District (ACSD). This map is general reference only and does not constitute all of the wetlands in the area [31].

4.5.5 Conservation Easements

As one of the County's general policies for natural resource protection outlined in the comprehensive plan, the County encourages the donation of land as conservation easements for open space, scenic, agricultural and environmental preservation [2]. Fifteen conservation easements are identified in the Department of Conservation and Recreation's Land Conservation Data Explorer. Fourteen of these easements are managed by the Virginia Outdoors Foundation (VOF) and one is managed by the Natural Resources Conservation Service (NRCS) as part of the Farm and Ranch Land Protection Program (FRPP) [32].

According to the VOF's website, their goal is to "to promote the preservation of open-space lands and to encourage private gifts of money, securities, land or other property to preserve the natural, scenic, historic, scientific, open-space and recreational areas of the Commonwealth." The site indicates that 13,265.95 acres are under open-space easements through the VOF [32].

The NRCS's FRPP was developed to provide matching funds to purchase development rights to keep productive farm and ranchland in agricultural uses [33]. According to the Land Conservation Data Explorer, 174 acres of land within Amelia County are under conservation easement through the NRCS's FRPP. It should be noted that this value may be inflated as acreage values listed in the DCR Land Conservation Data Explorer are not split by county or watershed boundaries so that any county-based query reflects the total acreage values for all intersecting lands. Acreage does not include water bodies [33].

4.5.6 Point Source Dischargers

Five facilities were identified in Amelia County as having Virginia Pollutant Discharge Elimination System (VPDES) permits to discharge wastewater into streams as summarized in Table 17 [34].

Table 17
VPDES Permit Holders in Amelia County, VA

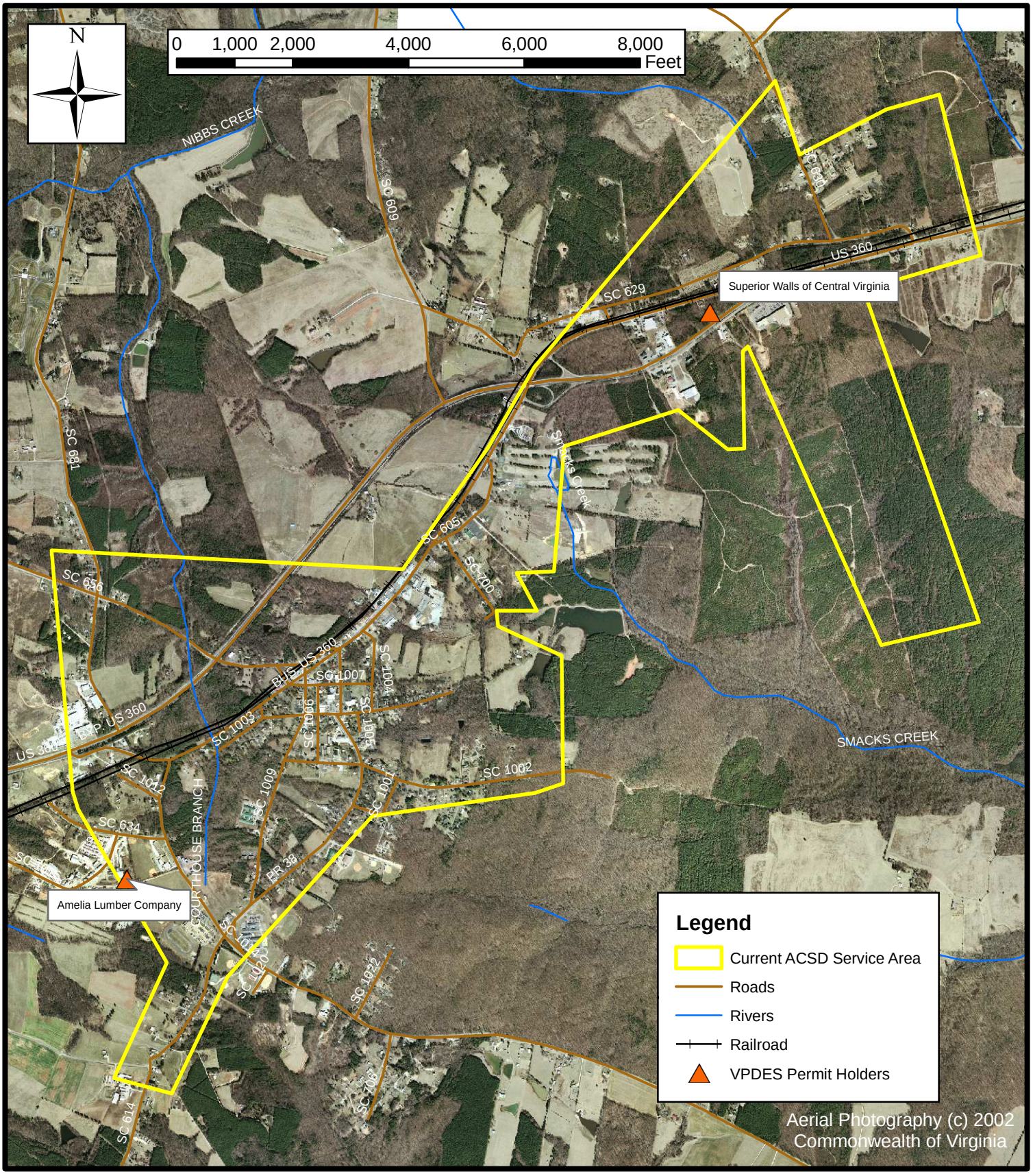
VPDES ID	Name	SIC Description	Violations
VA0086681	Amelia Courthouse Sanitary District	Sewerage System	None Found
VA0091707	Amelia Courthouse Sanitary District	Sewerage System	None Found
VA0091979	Amelia Lumber Company	Wood Preserving	None Found
VAU001725	Superior Walls of Central Virginia	Ready-mixed Concrete	None Found
VA0090131	Tyson Foods Inc.	Prepared Feeds and feed ingredients for animals and fowls, except dogs and cats	None Found

* From EPA Envirofacts http://www.epa.gov/enviro/facts/topicsearch.html#water[34].

Two of these permitted facilities are located within the Amelia Courthouse Sanitary District (ACSD): Amelia Lumber Company and Superior Walls of Central Virginia. None of the facilities were found to have violations or compliance issues and therefore should not be considered high risks to the wells located within the ACSD. The locations of the two facilities located within the ACSD are shown in Figure 7.

4.5.7 Additional Environmental Factors

As part of the Source Water Assessment Program, as described in Section 2.2.4, the Virginia Department of Health had identified potential sources of contamination within Amelia County. Within the Wellhead Protection Plan for the Amelia Courthouse Sanitary District (ACSD), the identified potential sources of contamination included: on-site sewage systems, feed storage, underground storage tanks, industrial sites, a golf course, railroad and roadways, and gasoline stations. These are shown in Figure 8. The Wellhead Protection Plan



Locations of VPDES Permit Holders within Amelia Courthouse Sanitary District Service Area

Figure 7

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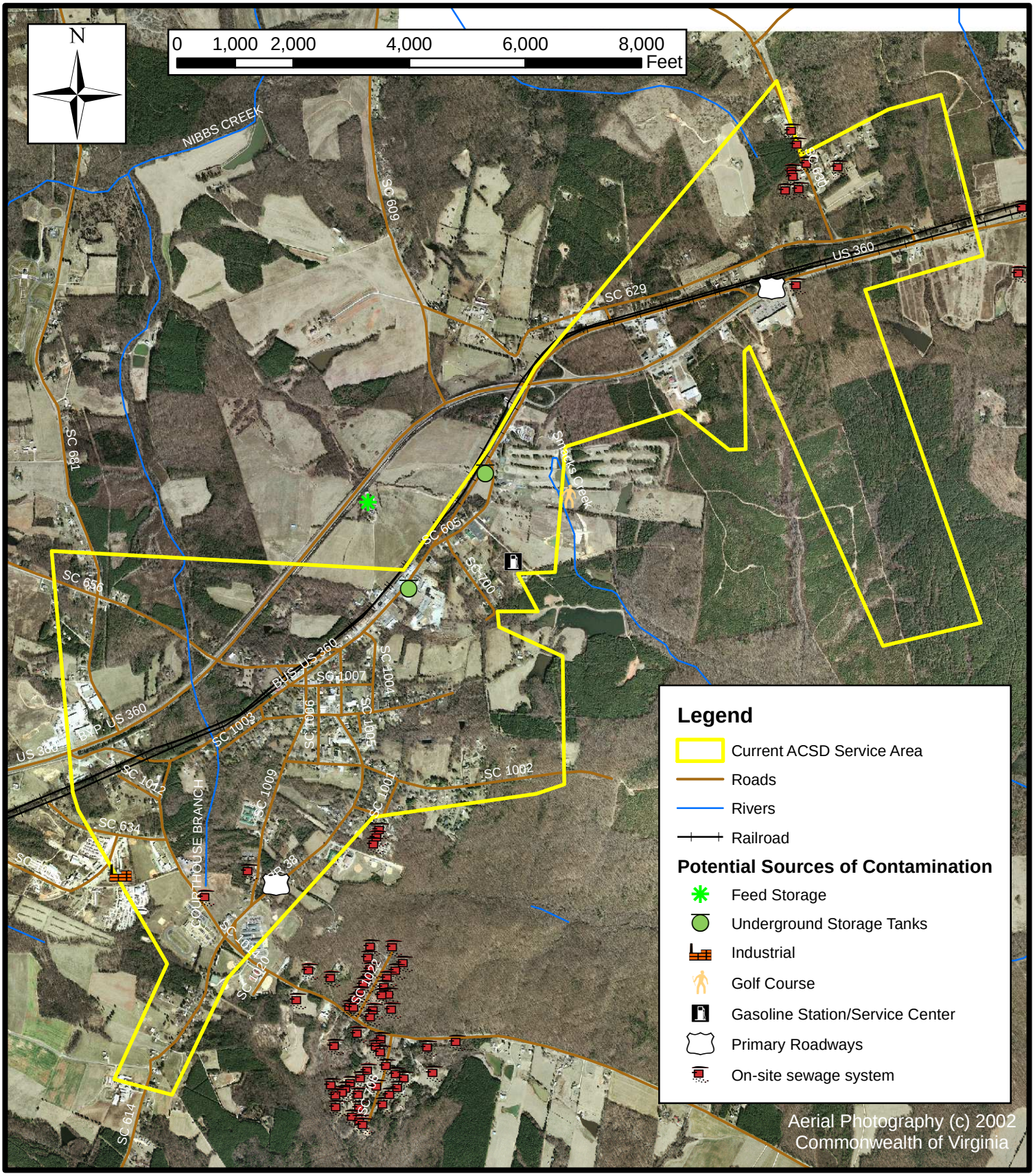

Potential Sources of Contamination Within the Wellhead Protection Areas

Figure 8

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has several implementation actions that deal with these potential sources of contamination to decrease risks of groundwater contamination.

SECTION 5.0

PROJECTED WATER DEMAND

(9 VAC 25-780-100)

5.1 Population Growth

Table 18 illustrates the current population and housing for Amelia County according to the 2000 Census [7].

Table 18
Amelia County Current Population

Locality	Population	Housing Units	Density (Population/HH)
Amelia County	11,400	4,609	2.47

Most of the recent population growth in the County is due to the movement of people into the County while a lesser portion can be attributed to the natural increase in population caused by a greater number of births than deaths. Table 19 shows the growth rate from 1980 through 2008 based on information from the U.S. Census Bureau [7]. Amelia County is located near the cities of Richmond and Petersburg and the Town of Farmville which has created demand for affordable land in the surrounding counties that are within a reasonable commuting distance to jobs in these areas [2].

Table 19
Amelia County Growth Rates: 1990-2008

Population				Percent Change 1980-1990	Percent Change 1990-2000	Percent Change 2000-2008
1980	1990	2000	2008 (Estimate)			
8,405	8,787	11,400	12,808	4.5%	29.7%	12.4%

5.2 Population Projection and Water Use

The basis for determining future water needs of the County is future population growth projections. Growth in the County is expected to continue to follow the same trends observed in the past few decades, and the County is expected to become less rural and more residential. The population projections in the Amelia County Comprehensive Plan 2000-2050

were based largely on the Virginia Employment Commission (VEC) population projections through 2025 [2]. As described in the comprehensive plan, the extrapolated VEC population forecast was considered to be the most accurate since it combined the official VEC information with trends most closely matching the growth rate seen in the County. For this Water Supply Plan, the corresponding growth rate projected for this period was used to further extrapolate population projections through 2060. Table 20 shows the resulting population projections for the 1995-2060 period.

Table 20
Population Forecast for Amelia County: 1995- 2060

	1995	2000	2005	2010	2015	2020	2025
Extrapolated VEC (2.16% avg. annual)[1]	9,700	11,303	12,581	14,003	15,588	17,351	19,313
	2030[2]	**2035(2)**	**2040[2]**	**2045[2]**	**2050[2]**	**2055[2]**	**2060[2]**
	21,495	23,925	26,629	29,638	32,987	36,715	40,864

1. Selected data from the ACCP, 2001 [1].
2. Extrapolated by Olver Incorporated.

5.2.1 Projected Total Water Use for the County by the Single Coefficient Method

The single coefficient method described by Dzurik was used to project total County water demand through 2060 to represent a 'worst-case scenario' approach to estimating projected water use through 2060 [35]. The per capita water use (calculated by dividing the total water usage estimated by USGS in 1995 by the census estimated population for 1995) was multiplied by the population forecasts to estimate the total water use in the future. As shown previously in Section 5.2 on Table 15, the population within the County is expected to more than quadruple between 1995 and 2060. As depicted in Table 16, the corresponding water use in the County is projected to more than quadruple during the same period. These projections assume both agricultural and industrial uses will increase at the same rate as residential uses. As shown in the sections below which divide the water consumption in the County by user type, and which make more realistic assumptions about individual user type growth in the future, the projected water use values indicated in Table 16 are expected to significantly overestimate actual use.

Table 21
Amelia County Projected Population and Total Water Use: 1995-2060

Year	Projected Population	Projected Water Use [(1)] (MGD)	Projected Water Use (MGY)
1995	9,700	2.31[(2)]	843
2000	11,303	2.69	982
2005	12,581	2.99	1,091
2010	14,003	3.33	1,215
2015	15,588	3.71	1.354
2020	17,351	4.13	1,507
2025	19,313	4.60	1,679
2030	21,495	5.12	1,869
2035	23,925	5.70	2,080
2040	26,629	6.34	2,314
2045	29,638	7.06	2,577
2050	32,927	7.86	2,869
2055	36,715	8.75	3,194
2060	40,864	9.74	3,555

1. Includes water used for domestic, agricultural, industrial, and commercial purposes from both groundwater and surface water.
2. USGS, 1998 (*Withdrawals of Water in Virginia – 1995*) [1].

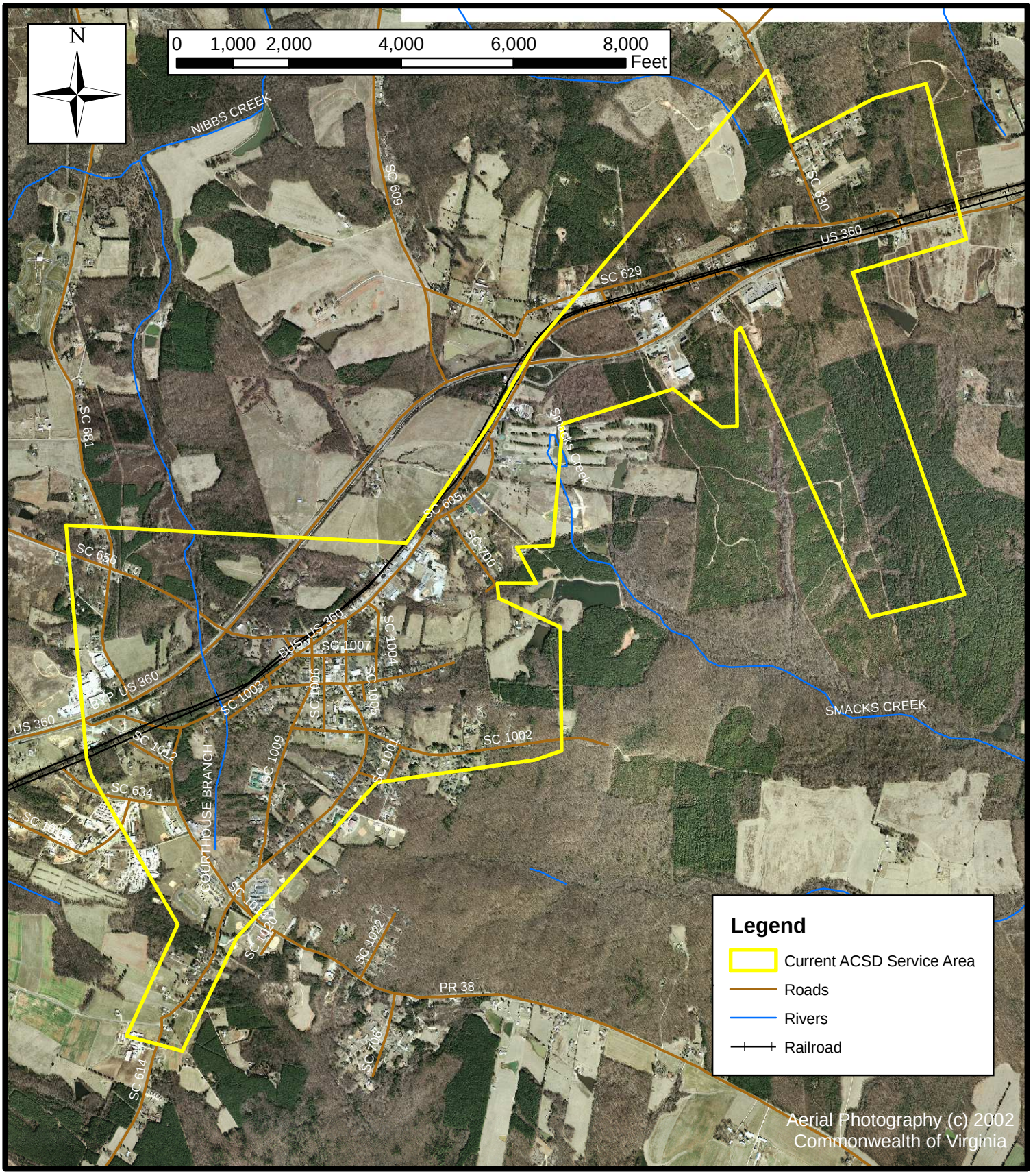
5.2.2 Projected Total Water Use for the County by Water User Type

The sections below describe each of the identified water users in the County and the current and projected water use based on conservative growth assumptions.

5.2.2.1 Community Water System

Most of the connections to the system occurred during 2001-2004 shortly after the community water system was completed (Buddy Webster, Chief Water Operator, ACSD, personal communication, October 8, 2009). In 2006, 75 new connections were made. Accordingly, a total of approximately 20 new connections were made for the last three year period of 2007 through 2009. A map of the current service area is provided in Figure 9.

There are currently no plans for significant expansions of the Amelia Courthouse Sanitary District community water system, although several additional residential connections are expected to occur annually for the foreseeable future (Buddy Webster, Chief Water Operator, Amelia Courthouse Sanitary District, personal communication, October 8, 2009). Recognizing the limited number of new



Amelia Courthouse Sanitary District Service Area
Figure 9

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connections, (assuming ten (10) new residential connections per year and two (2) new commercial/industrial connections per year) starting in 2010, the projected number of connections and total water demand for the ACSD system is summarized as depicted in Table 22. As described in Section 3.1.1, peak flow days for each month and the corresponding peak days in each week are not recorded although ASCD staff has observed trends as noted in the section. If peak flow data becomes available, the County will incorporate this information into this plan.

Table 22
Projected ACSD Community Water System Water Use Through 2060

Year	Projected Residential Service Connections in ACSD	Projected Residential Population within ACSD[1]	Projected Residential Water Use[2] (MGD)	Projected Commercial/ Industrial Service Connections in ACSD	Projected Commercial/ Industrial Water Use[3] (MGD)	Projected Water Losses (MGD)[4]	Projected Total Water Use (MGD)	Projected Total Water Use (MGY)
2010	290	809	0.039	150	0.055	0.010	0.10	36.5
2015	340	948	0.046	160	0.059	0.011	0.11	40.1
2020	390	1,087	0.052	170	0.062	0.012	0.12	43.8
2025	440	1,226	0.059	180	0.066	0.013	0.13	47.5
2030	490	1,365	0.066	190	0.070	0.014	0.14	51.1
2035	540	1,504	0.073	200	0.073	0.016	0.16	58.4
2040	590	1,643	0.079	210	0.077	0.017	0.17	62.0
2045	640	1,782	0.086	220	0.081	0.018	0.18	65.7
2050	690	1,921	0.093	230	0.084	0.019	0.19	69.4
2055	740	2,060	0.100	240	0.088	0.020	0.20	73.0
2060	790	2,199	0.106	250	0.092	0.021	0.21	76.7

1. Current residential population based on 2000 census data and includes residential connections and apartment users within the ACSD (Daryl Gough, Maintenance Supervisor, Amelia Courthouse Sanitary District, personal communication, September 28, 2010). Each user utilizes approximately 50 gallons of water each day.
2. Residential use based on 0.0001345 MGD/ connection derived from metered usage in September 2009.
3. Commercial/Industrial use based on 0.0003667MGD/ connection derived from metered usage in September 2009.
4. Water Loss based on assumption of 10% (Daryl Gough, Maintenance Supervisor, Amelia Courthouse Sanitary District, personal communication, May 26, 2010).
5. There is no military water use, agricultural water use, water used in water production processes, heavy industrial water use, or sale of water to other community systems.

5.2.2.2 Self-supplied Non-agricultural Users

To project the residential water use of self-supplied non-agricultural users through 2060, the population utilizing the community water system was subtracted from the projected total population of the County (as shown on Table 21 in Section 5.2.1). For the commercial/industrial users' projections, the baseline was established

in 2010 as four (4) users with an assumption of an increase of 0.5 commercial users per year. A summary of projected self-supplied non-agricultural users water use through 2060 is shown in Table 23.

Table 23
Projected Self-supplied Non-agricultural Users Water Use Through 2060

Year	Projected Residents Outside Community System	Projected Residential Water Use (MGD)[1]	Projected Commercial/ Industrial Users Outside Community System[2]	Projected Commercial/ Industrial Water Use (MGD)	Projected Total Water Use (MGD)	Projected Total Water Use (MGY)
2010	13,194	1.32	4.0	0.025	1.35	493
2015	14,640	1.46	6.5	0.038	1.50	548
2020	16,264	1.63	9.0	0.051	1.68	613
2025	18,087	1.81	11.5	0.064	1.87	683
2030	20,130	2.01	14.0	0.077	2.09	763
2035	22,421	2.24	16.5	0.090	2.33	850
2040	24,986	2.50	19.0	0.103	2.60	949
2045	27,856	2.79	21.5	0.116	2.91	1,062
2050	31,006	3.10	24.0	0.129	3.23	1,179
2055	34,655	3.47	26.5	0.142	3.61	1,318
2060	38,665	3.87	29.0	0.155	4.03	1,471

1. Each person is assumed to use 100 gallons/day. Information from the Virginia Green website, 2009 (http://www.deq.state.va.us/p2/virginiagreen/water) [15].
2. Currently three of the four commercial users are restaurant type businesses and one is a campground [11]. *To be conservative, all new businesses will be assumed to be 150 seat restaurants which generally use more water than other types of businesses.*

The projected water use by commercial/industrial users is likely greater than what will occur since it assumes a somewhat high commercial/industrial growth rate outside of the community water system area which historically is where most new businesses have been located. None of the projected new commercial/industrial users will likely use more than 300,000 gallons per month if they are limited to restaurants and retail stores, and other similar small businesses. However, it should be noted that the projected water use does not account for a large industry that will use process water. As such, these projections are believed to be reasonable.

5.2.2.3 Self-supplied Agricultural Users

To project the future water use by self-supplied agricultural users, an assumption of no increase in agricultural use was made due to the projected loss of agricultural lands to residential and commercial/industrial growth which may be offset by increased production on less land. Based on historic information the number of reporting self-supplied agricultural users of more than 10,000 gallons per day on average for at least one month per year has remained fairly consistent for the past eight (8) years [12]; as such, it is believed that there will not be any additional reportable users in the foreseeable future. Table 24 summarizes the projected self-supplied agricultural water use from 1995-2060. The values provided by the USGS account for all self-supplied water users including those not required to report withdrawals. For this reason, in addition to the reasons described in Section 3.1.3, more conservative data from 1995 was used to project self-supplied agricultural water use through 2060.

Table 24
Projected Self-supplied Agricultural Users Water Use 1995-2060

Source	Current Use (MGD)*	Projected Total Water Use (MGD)	Projected Total Water Use (MGY)
Surface Water	1.22	1.22	445
Groundwater	0.18	0.18	66
Total	**1.40**	**1.40**	**511**

*USGS, 1998 (*Withdrawals of Water in Virginia – 1995*) [19].

5.2.2.4 Total Projected Water Use in County

The projected needs of all users including domestic consumption, economic development, and limited in-stream use (by agricultural users only) in the County have been accounted for in the Sections in 5.2.2. This included making conservative assumptions about residential, agricultural, and commercial growth based on available information and current trends in the County. The total projected water use shown in Table 25 is considered more reasonable than the method used in Section 5.2.1 and

summarized in Table 21 which assumed that total water use would increase at the same rate as population growth regardless of the use of the water.

Table 25
Total Projected Water Use by User Type in Amelia County 2010 -2060.

Year	Projected Water Use by Community Water System (MGD)	Projected Water Use by Self-supplied Non-agricultural Users (MGD)	Projected Water Use by Self-supplied Agricultural Water Users (MGD)*	Total Projected Water Use by County Users (MGD)	Total Projected Water Use by County Users (MGY)
2010	0.10	1.35	1.40	2.85	1,040
2015	0.11	1.50	1.40	3.01	1,099
2020	0.12	1.68	1.40	3.20	1,168
2025	0.13	1.87	1.40	3.40	1,241
2030	0.14	2.09	1.40	3.63	1,325
2035	0.16	2.33	1.40	3.89	1,420
2040	0.17	2.60	1.40	4.17	1,522
2045	0.18	2.91	1.40	4.49	1,639
2050	0.19	3.23	1.40	4.82	1,759
2055	0.20	3.61	1.40	5.21	1,902
2060	0.21	4.03	1.40	5.64	2,059

*This includes groundwater and surface water projections.

5.2.2.5 Cumulative Demand, Use Conflict, and In-stream Flow

At this time, the State Water Resources Plan is not complete and therefore such information cannot be incorporated into this water supply plan. The County will update its plan to include this information when it becomes available.

SECTION 6.0

WATER DEMAND MANAGEMENT INFORMATION

(9 VAC 780-110)

6.1 Water Efficiency and Conservation

In 1988, the County adopted the Virginia Uniform Statewide Building Codes (USBC) that limits the maximum flow of water closets, urinals, and appliances. The USBC was promulgated by the Virginia Department of Housing and Community Development for the purpose of establishing minimum regulations for the construction and maintenance of buildings and structures [36].

The USBC has incorporated by reference the International Plumbing Code (IPC) which limits the flow rate of showers and kitchen sinks to three (3) gpm based on a water pressure of 80psi. In public facilities, lavatories must have faucets producing no more than 0.5 gpm. Toilets can use no more than 4 gallons per flush and urinals no more than one (1) gallon per flush [37].

The County also initiated the Indoor Plumbing Rehabilitation Program in 2000 to assist County residents who did not have adequate indoor plumbing. The Virginia Department of Housing and Community Development funds the program. Eligible homes have bathrooms added and the structure brought up to Virginia's Section 8 Housing Standard. If rehab is not cost-effective, a comparable house is constructed and the existing structure removed [14]. Although this program may not directly impact water efficiency and conservation, it does positively impact water quality and accountability in the County.

The County does not currently have policies or practices in place regarding low-water use landscaping, increased irrigation efficiency, public education regarding water conservation, or incentive programs to customers to encourage reduced water use.

6.2 Water Loss Reduction

6.2.1 Preventative Maintenance

The Amelia Courthouse Sanitary District (ACSD) follows the Operations and Maintenance (O&M) manual developed for the water system to handle maintenance, inspections, and parts replacement. The O&M manual has been designed to adhere to manufacturer's maintenance recommendations. Along with a copy of the O&M manual, records of maintenance activities are kept on file in the office of the Utilities Department. Drawings and maps of the entire water system are kept current and allow staff to track potential issues in the system. Preventative maintenance per the manufacturer's recommendations is performed once per year on hydrants and valves. Additional maintenance is completed on an as-needed basis using mostly in-house staff to complete repairs or contractors when necessary (Daryl Gough, Maintenance Supervisor, Amelia Courthouse Sanitary District, personal communication, May 26, 2010).

6.2.2 Water System Inspections

Inspections of the water system's valves and hydrants and other visible areas of the system are conducted twice a year. As part of these inspections, Amelia Courthouse Sanitary District (ACSD) staff maintain notes on potential issues and needed repairs found during this process. Once a year, a joint inspection with ACSD staff and Virginia Department of Health staff is performed on the well houses (Daryl Gough, Maintenance Supervisor, Amelia Courthouse Sanitary District, personal communication, May 26, 2010). The ACSD currently flushes the water lines twice a year. Unauthorized connections are determined through unannounced/unscheduled inspections of the water distribution area (Buddy Webster, Chief Water Operator, Amelia Courthouse Sanitary District, personal communication, October 8, 2009).

6.2.3 Water Audits and Meter Monitoring

The Amelia Courthouse Sanitary District (ACSD) is unaware of any significant water loss in the system, and it should be noted that the water system is relatively new (since 2001). The ACSD has implemented a program whereby monthly water audits are conducted. These audits allow the ACSD to measure water accountability on a system-wide basis. The ACSD's water audits compare the amount of water produced by the water system with the amount sold as measured by the connection meters. Since the implementation of the audits, 90-92% of the water produced by the system has been accounted for on a monthly basis while only 8-10% is considered loss. Due to the newness of the system, most of this 'loss' is believed to occur from fire hydrant testing and evaporation from water storage tanks (Daryl Gough, Maintenance Supervisor, Amelia Courthouse Sanitary District, personal communication, May 26, 2010).

In addition to water audits, the ACSD is able to determine more specifically the locations and the amount of water used and lost in its system through the use and review of service connection meter readings. An electronic meter reading program tracks unusually high or unusually low individual customer readings from one month to the next and flags these customers for review by the ACSD. The ACSD also responds to customer complaints when water use has drastically increased for a customer. When these calls are received by the ACSD, a work order is completed and when needed, repairs are made to restore efficient service to the customer (Daryl Gough, Maintenance Supervisor, Amelia Courthouse Sanitary District, personal communication, May 26, 2010).

SECTION 7.0

DROUGHT RESPONSE AND CONTINGENCY

(9 VAC 25-780-120)

7.1 Hazards Analysis and Emergency Operations

In 2005, Amelia County prepared, with the assistance of Howlett & Associates, a Hazards Mitigation Plan to act as a tool for the County and emergency personnel to identify hazards to citizens, public and private property; assess the frequency, intensity, and potential damage of hazards; and identify actions or strategies to protect citizens and decrease or prevent damage. Drought was one of the hazards identified and analyzed as part of this plan. According to information from the plan, the County has been included in three (3) multijurisdictional drought events (1997-1998) that have caused over 100 million dollars worth of crop damage across the region. In Amelia County, agricultural losses are usually covered by private insurance and as such, the extent of financial damage to the County is not known. Prolonged droughts can also impact forest land and increase the chances of forest fires [4].

Within this plan, the County has deemed the threat of droughts to be low. The threats to the County include limited water for crops and the primary water supply. Since the primary water supply is wells, an extreme and prolonged drought would have to occur to affect the water table and ultimately affect the water supply [4].

In June of 2007, the Amelia County Emergency Operations Plan was adopted to define the measures that will be taken by Amelia County in the event of disasters and other emergencies. As part of this plan, there were a series of annexes and appendices adopted to determine the response to specific hazards. Although drought response is not addressed directly, several of the appendices reference procedures for dealing with shortage and distribution of potable water to citizens during natural and man-made disasters [3]. Within

the next several years, the County has plans to update this plan and change the format to the Emergency Support Function (ESF) structure used by state and federal agencies (Kent Emerson, Director of Emergency Management, Amelia County, personal communication, August 19, 2009).

7.2 Drought Response and Contingency

7.2.1 Statewide Drought Monitoring Network

Although drought has been determined to be a low threat in the County, the County will monitor drought conditions based on groundwater levels and precipitation monitored by the Virginia Drought Monitoring Task Force (VDMTF) per the Virginia Drought Assessment and Response Plan (VDARP) dated March 28, 2003. The VDARP divides the Commonwealth into 13 drought evaluation regions. These regions were established based on a consideration of river basins, climatic divisions, physiographic provinces, major geomorphologic features, and service areas of major water supplies. Amelia County is part of the Middle James Drought Evaluation Region. The following sections summarize the County's response as described in the VDARP [38].

7.2.1.1 Groundwater Levels

Water table groundwater monitoring wells representing drought evaluation regions will be used to monitor shallow groundwater responses to drought conditions. Measured groundwater levels will be compared with historic level statistics for the period of record. Table 26 indicates the drought stages based on measured groundwater levels.

Table 26
Drought Stages Based on Groundwater Levels [38]

Drought Stage	Criteria
Normal	Measured groundwater levels above the 25th percentile for all historic levels
Watch	Measured groundwater levels between the 10th and 25th percentile for all historic levels
Warning	Measured groundwater levels between the 5th and 10th percentile for all historic levels
Emergency	Measured groundwater levels below the 5th percentile for all historic levels.

For Amelia County, there are two observation wells that will be monitored by the VDMTF for groundwater levels: Buckingham Observation Well (USGS Local Number 41H 3) and Virginia Maples Observation Well (USGS Local Number 53K 19 SOW 080). These wells represent the Middle James River Drought Evaluation Region, which includes Amelia County. Measured groundwater levels will be compared to historic level statistics for the period of record.

7.2.1.2 Precipitation Deficits

Precipitation deficits will be monitored by the VDMTF by comparing current precipitation amounts with historical precipitation values as a percent of normal long-term average values. Comparisons will be made for each drought evaluation region using data compiled by the Office of the State Climatologist.

Normal long-term average precipitation is defined as the mean precipitation for a thirty-year period of record for the area and time period being evaluated. Precipitation amounts will be evaluated based on the water year (beginning October 1). Water years are a natural dividing point for water supply drought, as precipitation that occurs during this six-month period has the potential to recharge groundwater, which will sustain stream flows and support withdrawals from wells during the following six-month period when moisture deficits naturally develop as evaporation and plant transpiration generally exceed precipitation. If a precipitation deficit

outside of the normal range exists at the end of a water year, the precipitation records will carry forward until a normal condition is reached (i.e. if a precipitation deficit exists on October 1, precipitation records for the previous twelve months will be evaluated until the twelve month deficit is eliminated).

Because the significance of a precipitation deficit changes as the water year progresses, drought response stages will trigger at different percentages of normal depending upon the date of evaluation. Table 27 indicates the triggers for the three drought response stages regarding precipitation.

Table 27
Precipitation Deficit as a Trigger for Drought Response Stages [38]

Months Analyzed	Normal (% of Normal Precipitation)	Watch (% of Normal Precipitation)	Warning (% of Normal Precipitation)	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 Declaration of Drought Stages

The County will respond to drought stages as they are declared by the VDMTF for the region that includes Amelia County or on a statewide basis. There are three stages of response: drought watch, drought warning, and drought emergency. The VDMTF uses specific criteria and the data from the indicators (such as precipitation and groundwater levels) for the area of concern to determine the appropriate drought response stage. The public will be notified of the current drought stage through publication of a message via the Town's website

and the local newspaper, the Amelia Bulletin Monitor. The notice will also provide to the public information regarding appropriate water conservation measures.

7.2.2.1 Drought Watch

This stage is generally intended to increase awareness, in the public and private sector, to climatic conditions that are likely to precede the occurrence of a significant drought event. During this drought stage, the primary activities that are suggested are to prepare for the onset of a drought event. It is unlikely that significant water use reductions will occur at this stage although it is possible that the increased public awareness of water conservation activities may reduce water use up to 5%.

7.2.2.2 Drought Warning

This response is generally required when the onset of a significant drought event is imminent. Water conservation plans that have been prepared during a drought watch stage would begin to be implemented. The water conservation activities at this stage would be voluntary. Voluntary water conservation activities generally result in reductions in water use of 5-10%.

7.2.2.3 Drought Emergency

This response is generally required during the height of a significant drought event. During these times, it is likely that some water supplies will not provide the quantity of water needed by all users. Non-essential uses of water should be eliminated. Mandatory water conservation requirements should be initiated at this stage. Mandatory water conservation activities usually result in water use reductions of 10-15%.

7.2.3 Conservation Measures for Drought Response Stages

7.2.3.1 Drought Watch

During the drought watch, the public will be notified of the potential for drought conditions to intensify. Information regarding potential water conservation activities that may be utilized will be available on the County's website.

7.2.3.2 Drought Warning

Voluntary restrictions are implemented during a drought warning. All County water users are requested to voluntarily reduce normal consumption of water by 5-10%.

Suggestions for voluntary water conservation efforts include:

Outdoors

- Decrease the frequency of watering lawns, flower and vegetable gardens, and ball/athletic fields;
- Do not wash sidewalks, driveways, parking areas, or other hard areas except for sanitary or safety purposes;
- Do not fill or refill swimming pools;
- Non-commercial washing of vehicles, trailers, or boats show be minimized ; and
- Do not use water for dust control.

Indoors

- Fix leaks in faucets and water using appliances;
- Wash only full loads of laundry and only run the dishwasher when it is full;
- Take shorter showers and turn off water while brushing teeth or shaving, etc.; and
- Where possible, adapt plumbing with flow-restricting or other water-saving devices.

7.2.3.3 Drought Emergency

During the drought emergency stage, the County will issue mandatory water restrictions and prohibitions to reduce water use by 10-15%.

The following is a list of prohibited non-essential water uses during a drought emergency:

Outdoors

- Do not water lawns, inedible plants, or ball/athletic fields;
- Only water vegetable gardens and food trees as needed;
- Non-commercial washing of vehicles, trailers, or boats is prohibited;
- Do not use sprinklers or allow children to play with hoses or sprinklers;
- Do not wash sidewalks, driveways, parking areas, or other hard areas;
- Topping off or refilling swimming pools is prohibited; and
- Do not operate ornamental fountains, artificial waterfalls, misting machines, etc. unless using recycled water.

Indoors

- Restaurants shall serve water to customers only as requested by the customer.

The County will also encourage residents to practice in home conservation activities as well in order to reduce water consumption. These include turning off the shower while soaping up and using disposable eating utensils.

7.2.4 Enforcement

The County retains the right to adopt a local ordinance to enforce the mandatory water restrictions during times of drought emergency in order to protect public health and safety. This ordinance may establish, collect, and retain fines for violations of these mandatory water restrictions. If adopted, these ordinances will be incorporated by reference into the water supply plan.

SECTION 8.0

STATEMENT OF NEED AND ALTERNATIVES

(9 VAC 25-780-130)

8.1 Statement of need

8.1.1 Current Demands

Current Amelia County water demand is ~1,041 MGY which accounts for all water use by residents and businesses within the ACSD (36.5 MGY), all residents and businesses utilizing private wells (493 MGY), and all agricultural users of both groundwater and surface water (511 MGY). Existing water supplies appear to be adequate for current demands.

8.1.2 Projected Demands

As described in Section 5.2.1, conservative estimates show the projected total water demand in the County through 2060 could increase to approximately 3,555 MGY. These projections were made using a single coefficient method based on projected service area population and current per capita water use and also assume the agricultural users and industrial users will increase at the same rate as residential users. This has not been a recent trend in the County. Agricultural users in the County currently account for ~56% of total water use in the County; this percentage is expected to decrease in the future especially if agricultural water demands remain stagnant and residential growth and water demand continue to increase. Similarly, industrial growth in the County is not expected to increase as rapidly as residential growth. As such, actual total water demand water in 2060 could be significantly less than 3,555 MGY.

A more realistic projection of future water demand may be obtained using growth assumptions specific to each of the main types of users in the County. For this estimation approach, residential growth was assumed to remain high, commercial growth was assumed to be less than residential growth, and agricultural uses were assumed to remain similar to

current levels. These assumptions were based on growth projections and other information from the County's Comprehensive Plan as well as data from state and federal agencies. Using this approach, the corresponding water use projections indicate potential water demands to double from the current demand of 1,041 MGY to 2,059MGY by 2060. The projected water use by user type is summarized in Table 28.

Table 28
Projected Water Demand in Amelia County in 2060 by Category

Projected Water Use by Category	Type	Total Water Use
Amelia Courthouse Sanitary District	Groundwater	77 MGY
Self-supplied Non-agricultural Users	Groundwater	1,471 MGY
Self-supplied Agricultural Users	Groundwater	66MGY
	Surface Water	445 MGY
Total Groundwater Use		1,614 MGY
Total Combined Use		2,059MGY

8.1.2.1 Surface Water

The amount of water used by self-supplied agricultural users includes surface water and groundwater. As discussed in Section 5.2.4, the amount of agricultural water use will likely remain consistent in the future. As such, future surface water use is expected to remain the same as it is only used within the County for agricultural purposes. Unless there are significant changes in the volume of surface water available in the County as a result of drought or diversion of water for other uses, there should be more than enough surface water for the limited number of agricultural users.

8.1.2.1 Groundwater

As depicted in Table 22, total groundwater use by self-supplied agricultural users in Year 2060 is projected to equal 445 MGY, and total County-wide groundwater use will be 1,614 MGY. The projected groundwater demand in 2060 is less than the expected 2,560 MGY of available groundwater based on the conservative aquifer

recharge and recovery assumptions described in Section 4.1.4. Therefore the existing source is adequate to meet current and projected groundwater demands.

8.2 Demand Management

Although the current and projected demands are adequately met by the available surface and groundwater sources in Amelia County through 2060, it is important to effectively manage the demand through programs that focus on water use reduction in the County. These demand management strategies could also support voluntary and mandatory conservation efforts in the event of a catastrophic drought or contamination event. As such, the following management options can be used to increase water efficiency and conservation in the County and reduce water loss.

8.2.1 Water Efficiency and Conservation

Although the County has initiated several policies and programs that positively impact water conservation, efficiency, quality, and accountability, as described in Section 6.1, there are some areas of improvements that can be made. These include, but are not limited to adopting policies or practices regarding low-water use landscaping, increased irrigation efficiency, public education regarding water conservation, and incentive programs to customers to encourage reduced water use. If the County adopts such practices in the future, these will be incorporated into this water supply plan.

8.2.2 Water Loss

Currently there are no areas within the system that are known to be sources of water loss. As described in Section 6.2, the Amelia Courthouse Sanitary District performs maintenance, inspections, and repairs on the system in accordance with its Operations and Maintenance manual. These measures include routine preventative maintenance, as-needed water system repairs, routine inspections, meter monitoring and response to customer complaints.

8.2.3 Other Sources

In the event of a future water shortage, the County should investigate additional means of increasing water supplies and reducing water demand. These could include, but not be limited to, bulk water purchases from nearby localities and recycling and reuse of water.

8.3 Alternative Sources

8.3.1 Development of Additional Groundwater Sources

As described in Section 4.1, the County has been working in conjunction with consultants to explore the development of additional groundwater sources in the area surrounding Amelia Courthouse. At this stage, several promising locations have been identified through geophysical surveys. The County may need to continue this work in the future to determine the overall yield potential for these sites. Should these sites provide insufficient volumes of water, additional locations should be investigated to provide the volume of water needed to support continued residential and commercial growth in the County.

8.3.2 Use of Surface Waters

As discussed in Section 4.2.1, the Appomattox River has been recognized as having the potential for the development of a large regional water supply and some studies have been conducted to evaluate that potential. Currently, the County has decided to not participate in further evaluation of, and participation in, a regional water authority. The option of an independent surface water withdrawal for the County has not been investigated in years, but could be an option in the event that water demand exceeds the availability of the groundwater sources. Alternatively, renewed participation in any future regional water system could be another option. The local reservoirs could be other potential surface water sources, but the relatively small size of these reservoirs may limit the volume of water that can be provided.

SECTION 9.0

CONCLUSIONS

This water supply plan was prepared to evaluate the adequacy of the existing water supply sources to meet the current and projected future water needs of Amelia County. This evaluation utilized information from the Amelia Courthouse Sanitary District along with data obtained from the Amelia County Comprehensive Plan and other resources to project population growth, commercial development and agricultural activities for the 50-year planning period through 2060. As a result of this evaluation, the following conclusions are provided:

- The County currently has only one community system (ACSD) which serves approximately 3,000 people and commercial users; the rest of the County's population obtains their drinking water from private wells.

- Records indicate that the total annual water use from January to December 2008 for the ACSD water system was 37.8 MG. This averages to approximately 3.2 MG per month and 0.10 MGD.

- The County does not currently and is not planning on purchasing water from other localities.

- No residents or commercial/industrial users in the County are believed to withdraw more than 300,000 gallons of groundwater each per month. In 2008, there were three agricultural users who withdrew more than 10,000 gallons on average a day for at least one month during the year.

- Currently, self-supplied non-agricultural users are estimated to use1.35 MGD (493 MGY). Self-supplied agricultural users are estimated to use 1.22 MGD surface water (445 MGY) and 0.18 MGD (66 MGY) groundwater for a total of 1.40 MGD (511 MDY).

- Amelia County encompasses four geologic terranes: Goochland, Richmond Mesozoic Basin, Raleigh, and Eastern Slate Belt and two aquifers: Early Mesozoic Basin Aquifer and the Crystalline Rock Aquifer. Information from DEQ indicates that the Goochland and Raleigh terranes that comprise most of the County have the greatest sustained yield.

- Comparisons of wells indicate that there is significant variation of the production rates of groundwater wells within Amelia County. In some locations, production is limited while in other areas, good production has been achieved. If placed in productive locations, additional wells within these aquifer(s) can provide significant water volume to support future water needs.

- The population within the County is expected to more than quadruple between 1995 and 2060 as a result of a large influx of residents that commute to nearby cities for jobs.

- Based on projected population growth and similar rates of commercial/industrial growth and agricultural growth within Amelia County, water use in the County could reach 3,555 MGY by 2060. Recent trends indicate these two groups of users (commercial/industrial and agricultural) will not increase as quickly as residential growth and this projection may overestimate actual use. A more accurate projection may be obtained by assuming growth and use based on the main user types in the County. This projection indicates a water use of 2,059 MGY by 2060.

- The projected groundwater demand for 2060 is less than the expected 2,560 MGY of available groundwater based on the conservative aquifer recharge and recovery assumptions. Recovery of this volume of water will require the location and installation of a suitable number of wells in areas with good groundwater production.

- Unless there are significant changes in the volume of surface water available in the County as a result of drought or diversion of water for other uses, there should be more than enough surface water for the limited number of agricultural users.

- The County will monitor drought conditions based on groundwater levels and precipitation monitored by the Virginia Drought Monitoring Task Force per the Virginia Drought Assessment and Response Plan.

- The County has several plans and policies in place to increase water conservation and efficiency and reduce water loss in the ACSD system.

- The County has several options to increase water conservation and efficiency and decrease water loss in the ACSD system further. In addition, the County could investigate the development of alternative sources including additional groundwater sources and potential surface water sources.

- The Appomattox River has been recognized as having the potential for the development of a large regional water supply and some studies were carried out to evaluate that potential. Over the past several years, a group of counties agreed to move forward with the permitting phase of developing the Lake Genito reservoir although Amelia County decided not to participate in this effort. To date, the formation of a regional water supply and the creation of the Lake Genito impoundment have not been completed.

SECTION 10.0

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