CULPEPER COUNTY, VIRGINIA

Water and Sewer Master Plan

June 5, 2007

Wiley & Wilson
Employee-Owned

2310 Langhorne Road
Lynchburg, Virginia 24501
434.947.1901
434.947.1659 Fax
www.wileywilson.com

Contact:
Maynard K. Jones, Jr., P.E.
Project Manager
434.947.1657
mjones@wileywilson.com

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1.0 EXECUTIVE SUMMARY

Culpeper County, with a land area of 389 square miles, lies in the upper Piedmont Plateau where the land is rolling and hilly. Elevations vary from an average low of about 250 feet above sea level to about 600-650 feet, although there are specific points that are lower and higher. The entire County lies within the Rappahannock River Basin and is bordered on the northeast by this river for approximately 38 miles. A primary tributary of the Rappahannock River, the Rapidan River also borders the southern part of the County for approximately 38 miles. Other primary tributaries of the Rappahannock River, within Culpeper County, are Mountain Run and Hazel River.

Culpeper County is currently experiencing a significant amount of growth. However, the County is still mainly rural in nature. Much of the growth pressure is due to the proximity of the County to the Washington, D.C. and the Northern Virginia area. In April 2004, the County of Culpeper was identified by the U.S. Census Bureau as the 87th fastest growing county in the United States and in March 2006 it was identified as the 18th fastest growing county with an estimated population of 42,530 residents and a 5.9 percent annual growth rate. With this rate of growth it is important to recognize potential growth areas and provide public facilities as needed to support growth in those areas. Construction of water and sewer facilities in coordination with zoning amendments and comprehensive planning is a means of promoting and centralizing development to certain areas of the County while retaining the rural character of the remainder.

The purpose of this Water and Sewer Master Plan was to identify water and sewer service areas and their necessary facilities to support the Village Center and Convenience Center plans identified in the 2005 County Comprehensive Plan. The Town Environs, Clevengers Corner, Stevensburg, and Brandy Station/Elkwood are listed as Village Centers, whereas, Boston and Mitchells are designated Convenience Centers.

Population projections for a 20-year time period have been developed and are consistent with the demographics presented in the 2005 Culpeper County Comprehensive Plan. Although the current annual growth rate is higher than previous years, the data presented in the 2005 County Comprehensive Plan was used as a basis for projecting the future growth. In accordance with the Plan, a 3.85 percent annual population increase has been carried through the entire 20-year period to year 2025.

Each rural service area is intended to support growth and provide the necessary services for its specific service area. Water and sewer facilities have been identified to serve the needs of each service area through the 20-year growth period. Additional system capacity was incorporated for the primary sewerage facilities to serve the ultimate land area that would be served by the new County regional wastewater treatment facility. These primary sewerage facilities were sized based on 50-year growth projections. This capacity increase was also included to accommodate a potential increase in development density and/or future expansion of the service area. This area, that would ultimately be tributary to the new regional wastewater treatment facility, is referred to as the Mountain Run Planning Area in this Master Plan.

The Culpeper County Board of Supervisors on March 07, 2006, adopted the water and sewer plan for the Clevengers Corner Village Center, which had been presented earlier as a separate study. The plan has been incorporated into this document, as adopted, with numbered headings added for consistency and clarity. The adopted plan is Chapter 7 of this report. Listed in Table 1-1 are the Service Areas' current (2005) and future (2025) populations used in this Master Plan to ascertain the size of future systems. An overview of the existing water and sewer facilities in the service areas is also provided.

Table 1-1 Village Center Population and Existing Facilities

Service Area	Population		Permitted WW Treatment (gpd)	Water Source (gpm)
	2005	2025		
Village Centers				
Clevengers Corner	932	4,020	75,000/900,000[1]	Wells – 600
Town Environs				
Southwest	1,712	3,644	Town	Town
Lovers Lane	155	329	Town	Town
McDevit Drive	52	111	Town	Town
Inlet	313	667	County/Town	County/Town
Culpeper North	858	1,826	Town	Town
Brandy Station/Elkwood	390	831	25,000/900,000[1]	Wells – 100
Stevensburg	252	537	None	None
Convenience Centers				
Boston	37	3,000	450,000[2]	Wells – 190[2]
Mitchells	80	170	20,000[3]	None

[1] Existing capacity/Permitted capacity
[2] Private system
[3] Private system with allowance for public use
gpd – gallons per day
gpm – gallons per minute

While these population estimates are useful when an area is entirely residential, it can be misleading for mixed use developments. Most service areas have mixed land uses within their boundary. For this reason, equivalent residential connections (ERCs) were assigned to differing land uses within a service area to develop a more accurate overall flow demand. A comparison of the projected population to the equivalent population derived from the projected equivalent residential connections is included in Table 1-2 below.

Table 1-2 Comparison - Population Estimate vs. Equivalent Population

Service Area	Projected Pop. 2025	Projected ERCs 2025	Equiv. Pop. 2025
Village Centers			
Clevengers Corner	4,020	1,628	4,884
Town Environs			
Southwest	3,644	2,404	7,212
Lovers Lane	329	595	1,785
McDevit Drive	111	408	1,224
Inlet	667	1,626	4,878
Culpeper North	1,826	1,510	4,530
Brandy Station/Elkwood	831	1,538	4,614
Stevensburg	537	250	750
Convenience Centers			
Boston	3,000	1,000	3,000
Mitchells	170	67	201

The proposed water and sewer facilities were sized to accommodate the projected demands for build-out of the future land use plan included in the 2005 County Comprehensive Plan. Additional system capacity was incorporated for the primary sewerage improvements that would be very costly to upgrade in the future, including primary pump stations, force mains, and interceptors. This capacity increase was included to accommodate a potential increase in development density and/or future expansion of the service areas. It was also intended to provide additional capacity beyond the 20 year planning period in accordance with the Virginia Sewerage Collection and Treatment Regulations which states, *"In general, sewer systems should be designed for the estimated ultimate tributary population with an upper limit consisting of the 50-year population growth projection, except when considering parts of the systems that can be readily increased in capacity"*. A summary of the 20-year and 50-year flow demands is included below in Tables 1-3 and 1-4 respectively. The projected demand calculations can be found in Appendix A.

Table 1-3 Summary – 20 Year Projected Flows

Service Area	Projected ERCs 2025	Projected Flow (gpd)
Village Centers		
Clevengers Corner	1,628	488,400
Town Environs		
Southwest	2,404	721,200
Lovers Lane	595	178,500
McDevit Drive	408	122,400
Inlet	1,626	487,800
Culpeper North	1,510	453,000
Brandy Station/Elkwood	1,538	461,400
Stevensburg	250	75,000
Convenience Centers		
Boston	1,000	300,000
Mitchells	67	20,100

Table 1-4 Summary – 50 Year Projected flows

Service Area	Projected ERCs 2055	Projected Flow (gpd)
Village Centers		
Clevengers Corner	1,628	488,400
Town Environs		
Southwest	5,813	1,743,900
Lovers Lane	698	209,400
McDevit Drive	544	163,200
Inlet	6,513	1,953,900
Culpeper North	1,510	453,000
Brandy Station/Elkwood	10,591	3,177,300
Stevensburg	250	75,000
Convenience Centers		
Boston	1,000	300,000
Mitchells	67	20,100

A study by Wiley & Wilson completed in 2001, entitled *Culpeper County Reservoir Study*, identified 13 potential sites for surface water impoundment as a source of water for the County. However, the capital and operating costs associated with this type of water supply may be prohibitive for the anticipated water demand for the 20 year planning period. Therefore, groundwater will be considered the source water supply for this Master Plan.

A groundwater availability assessment was performed by Emory and Garrett

Groundwater, Inc. and is summarized in a report dated August 1998, entitled *Groundwater Exploration and Development Results of Phase I Investigation*. This assessment identified favorable groundwater zones and estimated the quantity of groundwater resources that can be developed practically from each groundwater zone. An update to that report is currently being conducted by Emory and Garrett Groundwater, Inc. Information on water quality of the groundwater is not part of the Emory and Garret report. For purposes of this Master Plan, only basic treatment costs have been included in the cost of providing groundwater as a source of water.

A summary of the recommended water and sewer facilities, based on this master plan, are shown in Table 1-5 below.

Table 1-5 Estimated Costs of Proposed Water and Sewer Facilities

Service Area	Sewer	Cost (millions)	Water	Cost (millions)
Village Centers				
Clevengers Corner	Linework & treatment	onsite	Treatment, linework, tank	onsite
Town Environs				
Southwest	Line work/PS	$3.90	Linework & 0.75MG tank	$5.30
Lovers Lane	Line work	$3.30	Linework & 1.0MG tank	$4.00
McDevit Drive	Line work	$1.75	Linework	$1.15
Inlet	Line work	$6.80	Linework	$4.30
Culpeper North	Line work	$2.35	Linework & .075MG tank	$2.75
Brandy Station/Elkwood	Line work	$11.60	Linework, 0.75 & 1.0MG tank	$6.40
Stevensburg	Line work	$2.15	Linework & 0.50MG tank	$1.95
Convenience Centers				
Boston	Linework	$0.28	Linework	Onsite
Mitchells	None	None	Linework	$3.20
Wastewater Treatment	High Sch. Interim	$2.10		
	Mt. Dumpl. Interim	$2.10		
	MdBrk. Run Interim	$2.10		
	Mt. Run Regional	$25.00		

PS – pumping station
MG – million gallon
Linework – includes gravity sewers, force mains, and/or water mains
Onsite – refers to developer funded improvements on or between developed parcels

Cost data is based on October 2006 opinion of cost and includes a 25 percent markup for project related cost (survey, design, easements, construction administration, shop drawing review, County inspection, and Record Drawings) and a 15 percent project contingency cost.

The next recommended step after adoption of this Water and Sewer Master Plan by the County would be the development of a Capital Improvement Plan (CIP) in order to define the costs of individual projects and their implementation schedule. A crucial extension of the CIP process is the development of a “financing plan” to

evaluate the County's financial needs and evaluate potential sources of revenue. A rate study should be performed as part of this effort to determine the monthly fee and annual escalation of costs and fees.

2.0 INTRODUCTION

Culpeper County, with a land area of 389 square miles, lies in the upper Piedmont Plateau where the land is rolling and hilly. The Blue Ridge Mountains, to the west, are visible in the distance from much of the County. Elevations vary from an average low of about 250 feet above sea level to about 600-650 feet, although there are specific points that are lower and higher. The entire County lies within the Rappahannock River Basin and is bordered on the northeast by this river for approximately 38 miles. A primary tributary of the Rappahannock River, the Rapidan River also borders the southern part of the County for approximately 38 miles. Other primary tributaries of the Rappahannock River, within Culpeper County, are Mountain Run and Hazel River. Mountain Run, with a drainage area of 124.65 square miles lies exclusively within Culpeper County, while the Hazel River, with a drainage area of 351.43 square miles, drains the northern third of the County.

Temperatures vary from an average monthly of approximately 34 degrees F in January to 76 degrees F in July. Average annual rainfall is approximately 41 inches per year. Precipitation is well distributed throughout the year with the maximum in July and August and the minimum in February. Stream flow gages on the Hazel River at Rixeyville and Mountain Run near Culpeper indicate an average annual runoff of 14-15 inches per year from these drainage areas.

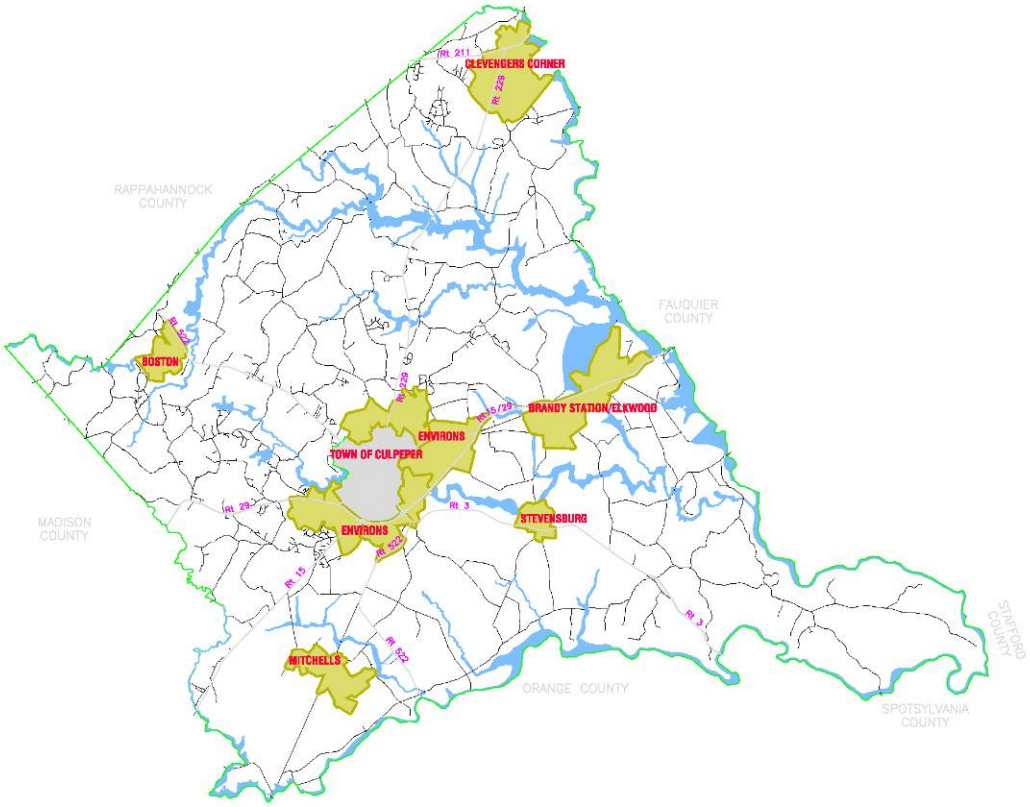
Two reservoirs, located within the upper reaches of the Mountain Run drainage area, are used by the Town of Culpeper for their water supply. They are called Mountain Run Lake and Lake Pelham. The entire land area that feeds these two reservoirs is referred to as the Lake Pelham Watershed. The combined storage available for water supply from these two reservoirs is approximately 499,000,000 gallons. Currently, the Town of Culpeper has a 4,000,000-gpd water treatment plant capability.

Culpeper County is currently experiencing a significant amount of growth. However, the County is still mainly rural in nature. Much of the growth pressure is due to the proximity of the County to the Washington, D.C. and the Northern Virginia area, which is approximately 75 miles to the northeast. In April 2004, the County of Culpeper was identified by the U.S. Census Bureau as the 87th fastest growing county in the United States and in March 2006 it was identified as the 18th fastest growing county with an estimated population of 42,530 residents and a 5.9 percent annual growth rate. With this rate of growth it is important to recognize potential growth areas and provide public facilities as needed to support growth in those areas. Construction of water and sewer facilities in coordination with zoning amendments and comprehensive planning is a means of promoting and centralizing development to certain areas of the County while retaining the rural character of the remainder. Several water and sewer service areas have been identified in preparation of this water and sewer master plan to support the Village Center and Convenience Center plans identified in the 2005 County Comprehensive Plan. The water and sewer service areas that were identified and included in this master plan are:

Brandy Station/Elkwood
Clevengers Corner
Town of Culpeper Environs
Stevensburg
Boston
Mitchells

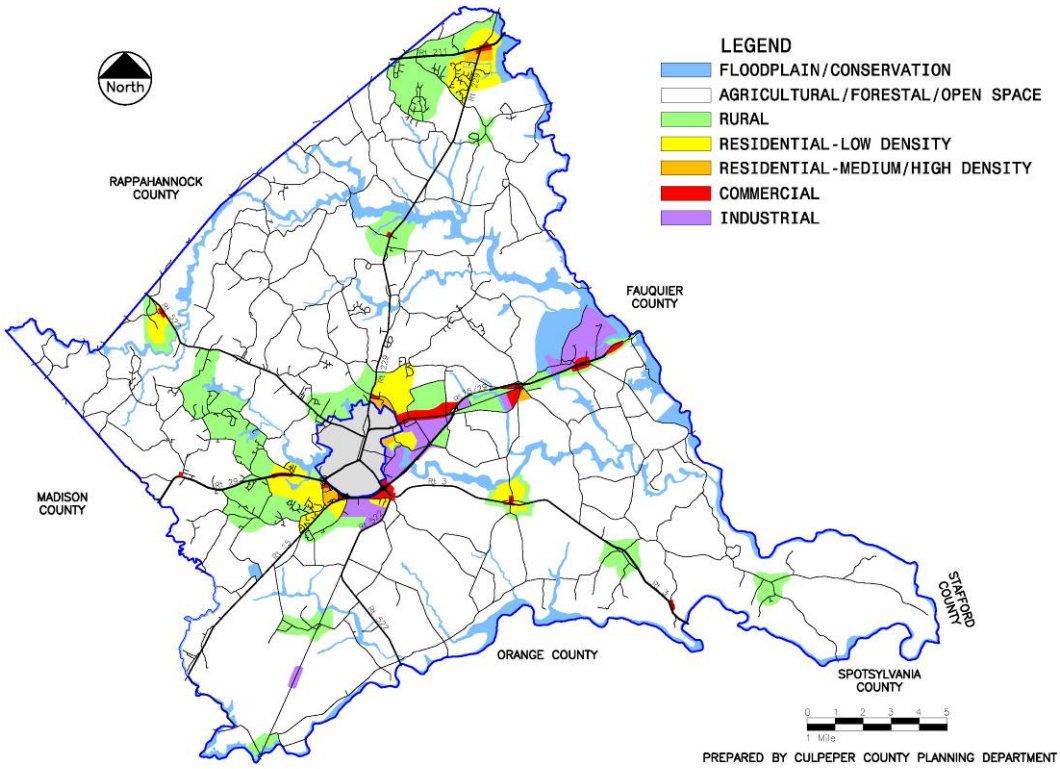
Additional information regarding each of these service areas will be given in the subsequent chapters. This study develops a conceptual master plan for the provision of water and sewer facilities within these service areas. The report's objective is to identify these facilities and the resources required to meet the population demands through the year 2025 and beyond. The Village Centers and Convenience Centers listed above are shown in Figure 2-1 below.

Figure 2-1 Village Center and Convenience Center service areas



In accordance with the 2005 County Comprehensive Plan, a village center is intended to serve the needs of the population residing within a 5-mile radius of it. It is also intended to be the primary focus for rural commercial services including neighborhood retail, general business, and offices conducive to rural community development. A convenience center is intended to concentrate services at the crossroads rather than spread out along highways or isolated as home occupations. It is also intended for these areas to provide opportunities for limited local convenience services to serve rural residents and supplement neighborhood and community areas. The future land use plan as presented in the 2005 County Comprehensive Plan is shown in Figure 2-2 below.

Figure 2-2 Culpeper County Future Land Use Plan



Population projections for a 20-year time period have been developed and are consistent with the demographics presented in the 2005 Culpeper County Comprehensive Plan. Although the current annual growth rate is quite a bit higher than previous years, the data presented in the 2005 County Comprehensive Plan was used as a basis for projecting the future growth. In accordance with the Plan, a 3.85 percent annual population increase has been carried through the entire 20-year period to year 2025. The base population data was obtained from the Year 2000 Census Block Data and is included for reference. Where service area boundaries crossed the middle of Census Blocks, an estimate was made to divide the population block data. The population projections represent an estimate of population increases; however, some service areas may grow at a rate much faster than the current. The projected population for each service area has been summarized in Table 2-1.

Table 2-1 Village Center and Convenience Center Population Estimates

Service Area	2005	2015	2025
Village Centers			
Clevengers Corner[1]	932	3,765	4,020
Town Environs			
Southwest	1,712	2,497	3,644
Lovers Lane[3]	155	226	329
McDevit Drive	52	76	111
Inlet	313	457	667
Culpeper North	858	1,251	1,826
Brandy Station/Elkwood	390	589	831
Stevensburg	252	368	537
Convenience Centers			
Boston[2]	37	55	3,000
Mitchells	80	117	170

[1] Calculated by multiplying res. connection projections by 2.68 persons/connection
[2] Includes the Longlea planned community.
[3] Primarily industrial. (Residential pop. only)

The populations shown here reflect the residential portion of sewerage flow only. While some areas will be entirely residential and no additional flows will be contributed by other sources; some areas, such as Lovers Lane, are primarily industrial or commercial and will have a significant wastewater contribution and water demand beyond the residential aspect. Wastewater flows and water demand calculations have been produced taking these factors into account. Each village center area has been divided into sections that group land uses together. An estimated flow was then generated for each sub-section based on equivalent residential connections.

The 2000 Census data indicates an occupancy rate of approximately 2.68 persons per household. It is assumed that the occupancy rate will not increase significantly over time. The Virginia Department of Environmental Quality and Department of Drinking Water recommend an allowance of 100 gpd/individual for use in sizing water and wastewater facilities. Rounding up to an average

occupancy of 3 persons per household and an average water consumption rate of 100 gpd/individual, the equivalent residential connection (ERC) used will be 300 gpd/connection. The equivalent residential population would be calculated by dividing the total average daily wastewater flow by 100 gpd, or by multiplying the equivalent residential connections by three. Water use rates for commercial and industrial areas were obtained using Forecasting Urban Water Demand, published by the American Water Works Association. Percent coverage is defined as the fraction of land area occupied with buildings used for a given activity. Percent utilization is defined as the fraction of building space used for a given activity. Facilities have been sized using the connections per land use presented in Table 2-2.

Table 2-2 Connections per acre for sizing of facilities

Zoning Classification	% Coverage	% Utilization	Conn./acre	Zoning-density
Agricultural	N/A	N/A	1 per 5 acres	1 per 5 acres
Rural (RA)	N/A	N/A	1 per 3 acres	1 per 3 acres
Residential (R1/R2)	N/A	N/A	1 per acre	1-1.75 per acre
Residential (R3)	N/A	N/A	2.5 per acre	3-8 per acre
Industrial	10%	80%	0.7 per acre	
Commercial	10%	70%	1.0 per acre	

The connections per acre do not correspond exactly with density in the Culpeper County zoning regulation. The development densities in the zoning regulation give the allowable dwelling units per lot. However, this number does not take into effect open spaces, roadway corridors, or non-developable land typically associated with residential, commercial, and industrial developments. The Conn./acre column in the table above is the methodology used to take these items into account. The land areas were divided by drainage basin, land use, and parcel boundaries to calculate the projected flows. The drainage basins and sub-areas are shown for each service area in the corresponding service area chapter. A summary of the projected flows from all service areas is shown in Chapter 1.

The proposed facilities were sized to accommodate the projected demands for buildout of the future land use plan included in the 2005 County Comprehensive Plan and shown in Figure 2-2. Additional system capacity was incorporated for the primary sewerage improvements that would be very costly to upgrade including primary pump stations, force mains, and interceptors. This capacity increase was included to accommodate a potential increase in development density and/or future expansion of the service areas. It was also intended to provide additional capacity beyond the 20 year planning period in accordance with the Virginia Sewerage Collection and Treatment Regulations which states *"In general, sewer systems should be designed for the estimated ultimate tributary population with an upper limit consisting of the 50-year population growth projection, except when considering parts of the systems that can be readily increased in capacity"*. A summary of the 20-year and 50-year flow demands is included below in Tables 2-3 and 2-4 respectively. The projected demand calculations can be found in Appendix A.

Table 2-3 Summary – 20 Year Projected flows

Service Area	Projected ERCs 2025	Projected Flow (gpd)
Village Centers		
Clevengers Corner	1,628	488,400
Town Environs		
Southwest	2,404	721,200
Lovers Lane	595	178,500
McDevit Drive	408	122,400
Inlet	1,626	487,800
Culpeper North	1,510	453,000
Brandy Station/Elkwood	1,538	461,400
Stevensburg	250	75,000
Convenience Centers		
Boston	1,000	300,000
Mitchells	67	20,100

Table 2-4 Summary – 50 Year Projected flows

Service Area	Projected ERCs 2055	Projected Flow (gpd)
Village Centers		
Clevengers Corner	1,628	488,400
Town Environs		
Southwest	5,813	1,743,900
Lovers Lane	698	209,400
McDevit Drive	544	163,200
Inlet	6,513	1,953,900
Culpeper North	1,510	453,000
Brandy Station/Elkwood	10,591	3,177,300
Stevensburg	250	75,000
Convenience Centers		
Boston	1,000	300,000
Mitchells	67	20,100

3.0 COUNTY WATERSHED DESCRIPTIONS

Culpeper County lies completely within the Rappahannock River Basin. It is bordered on the northeast by the Rappahannock River, on the south by the Rapidan River, and the northwest area contains the Hazel River. The Rapidan River and the Hazel River are primary tributaries to the Rappahannock River.

Listed below are the primary tributaries to the Rappahannock River, along with their total drainage areas, that are located completely or partially within Culpeper County:

Table 3-1 Rappahannock River Tributaries and Drainage Areas

Name	Area (sq miles)
Rapidan River	693.26
Hazel River	351.43
Mountain Run	124.65
Ruffans Run	9.75
Hubbard Run	4.88

The Rapidan River, a major tributary to the Rappahannock River, has the following minor tributaries located completely within Culpeper County:

Table 3-2 Rapidan River Tributaries and Drainage Areas

Name	Area (sq miles)
Cedar Run	22.98
Sumerduck Run	13.07
Potato Run	12.40
Brook Run	11.93

The Hazel River, another major tributary to the Rappahannock River, has the following tributaries located completely or partially within Culpeper County:

Table 3-3 Hazel River Tributaries and Drainage Areas

Name	Area (sq miles)
Thornton River	88.29
Muddy Run	29.47
Indian Run	16.94
Devils Run	9.53

See Figure 3-1 for the location of the Rappahannock River, Rapidan River, Hazel River, and their tributaries and drainage sheds located within Culpeper County.

As shown on Figure 3-1, approximately the northern third of the County drains to the Hazel River. The major tributaries to the Hazel River, which are completely located or primarily located in Culpeper County, are the Thornton River, Muddy Run, Indian Run, and Devils Run. The Thornton River begins outside of Culpeper County, although most of its drainage area is located within the County. It is located in the northwestern portion of the County near Homeland and Monumental Mills and converges with the Hazel River just northeast of Rixeyville. The drainage area encompasses 88.29 square miles. Muddy Run is located in the central portion of the County between Rixeyville and Catalpa and has a drainage area of 29.47 square miles. The mouth of Muddy Run is located on the County line midway between Routes 29 and 621. Indian Run is located in the northern portion of the County between Routes 611 and 621 with its mouth east of Rixeyville. This drainage area encompasses 16.94 square miles. The last primary drainage area is Devils Run. It is located in the western portion of the county near Reva and Griffinsburg, and has a drainage area of 9.35 square miles. The mouth of this drainage area is located just north of Griffinsburg.

Mountain Run, a large tributary to the Rappahannock River, covers the central portion of the County, including the Town of Culpeper. Mountain Run lies exclusively in Culpeper County and has a drainage area of 124.65 square miles. It is fed by Jonas Run, Lake Pelham, Caynor Lake, Merrimac Lake, Mountain Run Lake, Hungry Run, and Flat Run. It reaches from Reva in the west to its confluence with the Rappahannock River in the east near Edwards Shop.

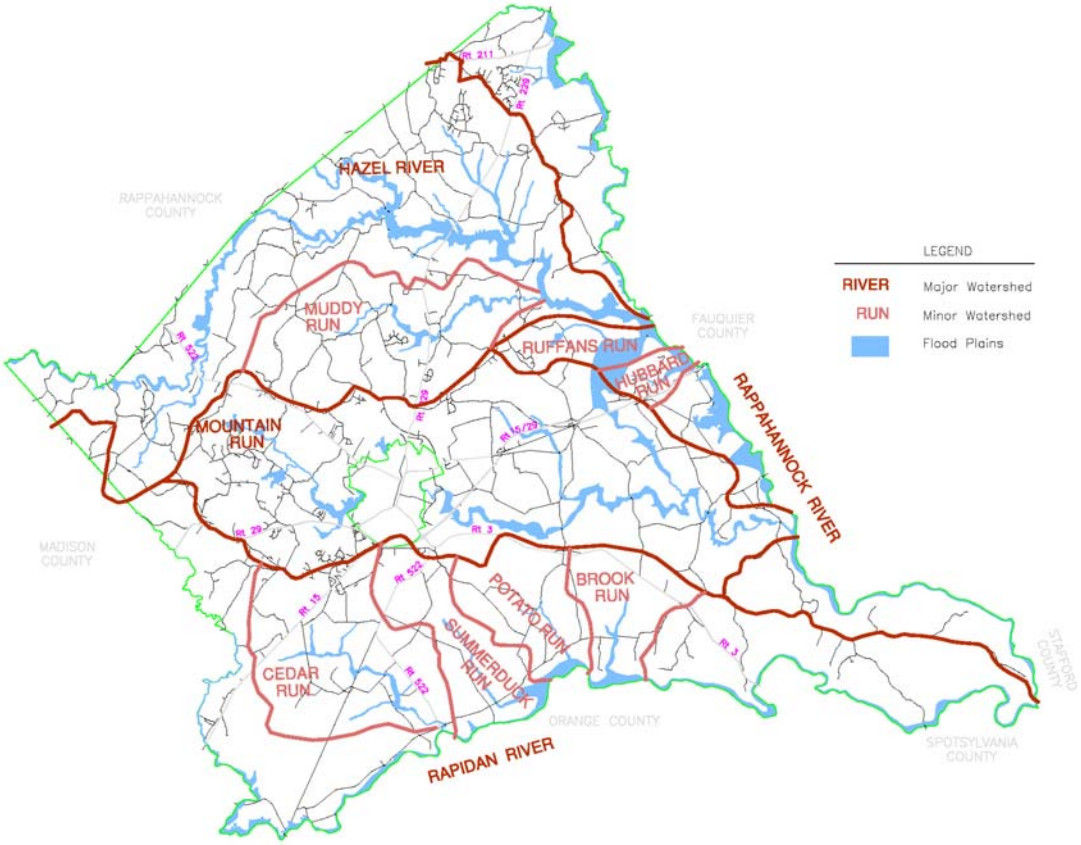
The southern portion of Culpeper County is comprised of Cedar Run, Sumerduck Run, Potato Run, and Brook Run. These drainage areas are tributaries to the Rapidan River, which in turn is a tributary to the Rappahannock River. Cedar Run is located near Winston and Mitchells with its confluence with the Rapidan River near the intersection of Routes 522 and 647. Sumerduck Run and Potato Run are located between Routes 522 and 663 and south of Route 3. Their confluences with the Rapidan River are located near Racoon Ford and Batna, respectively. Brook Run is located between Routes 663 and 3 with its mouth southeast of Batna. These four drainage areas comprise approximately 60 square miles of the 693.26 total square miles of drainage area in the Rapidan River drainage shed.

Hubbard Run, which is located in the eastern portion of the County north of Route 29 and east of Route 663, is a direct tributary to the Rappahannock River. This is a small drainage shed and has just under 5 square miles of drainage area with its mouth located where Route 29 crosses the Rappahannock River. The existing county wastewater plant at the Airpark is located on this stream.

Ruffans Run is a small drainage area comprised of approximately 10 square miles and is located just north of the Hubbard Run drainage area and east of Route 663. Ruffans Run is also a direct tributary to the Rappahannock River with its mouth just upstream of Hubbard Run.

Culpeper County encompasses 389 square miles of the Rappahannock River watershed and plays a significant role in the 2,715 square miles of total watershed that form the Rappahannock River Basin.

Figure 3-1 Culpeper County Watersheds



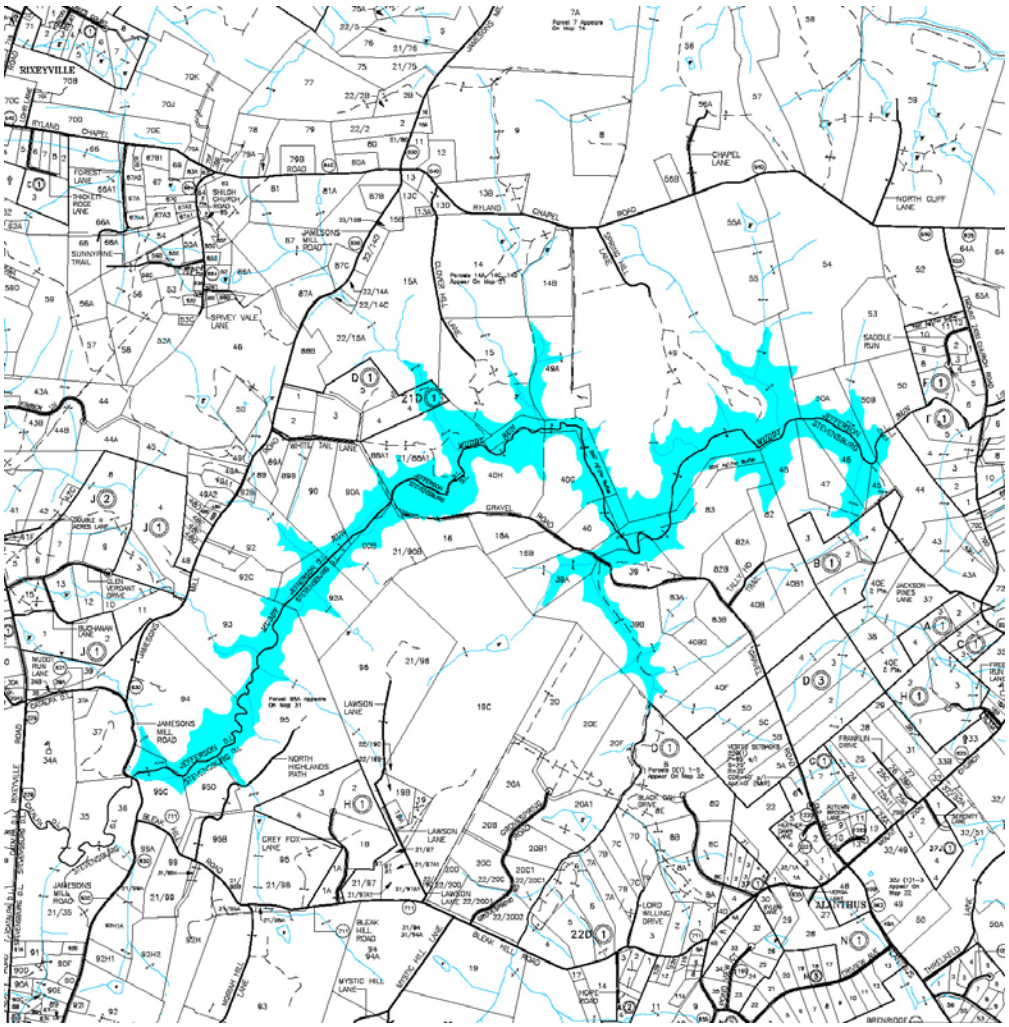
4.0 SOURCE WATER ALTERNATIVES

Several watersheds in Culpeper County were considered as potential sites for surface water reservoirs. A study by Wiley & Wilson completed in 2001, entitled *Culpeper County Reservoir Study*, identified 13 potential sites for surface water impoundment. Site No. 10 was identified by the Public Works Committee of the Board of Supervisors as the site of choice. Located on Muddy Run, the report estimated a cost of $810,000 per million gallons per day capacity with a maximum safe yield of 3.5 mgd. The raw water reservoir would require construction of an impoundment dam and a water treatment plant. The reservoir study includes the following summary as outlined in the 2005 County Comprehensive Plan, Chapter 6:

"Site No. 10 & 10 A: Reservoir No. 10 and 10A would entail the construction of a dam on Muddy Run, to the west of Route 625.

- The water to fill this reservoir would be pumped from the Hazel River, directly to its east and flow directly from the watershed of Muddy Run.
- The dam at this site would have a maximum height of 33.0 feet and crest length of 408 feet. The normal pool elevation would be 313 feet, with 7 feet of free board, a normal pool surface area of 243 acres, and a normal pool volume of 763 million gallons.
- The earthwork volume required for the dam embankment would be 33,900 cubic yards.
- The maximum yield of this reservoir would be 3.5 MGD with or without diversion pumping. This indicates that Muddy Run Watershed is adequate to fill the reservoir and that pumping is unnecessary.
- The maximum yield of the reservoir is dictated by the drought years of 1965 to 1966, where the mean daily flow in the Hazel River was below the mean annual flow for 311 consecutive days.
- It is located in an area that is dominated by metabasalt geology with deep soil containing mica schist silts.
- The reservoir would impact 27 parcels.

Figure 4-1 Reservoir Site #10



The entire reservoir study is included in Appendix C. The capital and operating costs associated with this type of water supply may be prohibitive for the anticipated initial water demand. Conversely, the development of groundwater sources can be staged incrementally with the phasing of land development projects, thereby reducing initial capital costs. However, the use of groundwater is only economically feasible if high yielding wells are available.

A groundwater availability assessment was performed by Emory and Garrett Groundwater, Inc. and is summarized in a report dated August 1998, entitled *Groundwater Exploration and Development Results of Phase I Investigation*.

This assessment identified favorable groundwater zones and estimated the quantity of groundwater resources that can be developed practically from each groundwater zone. An update to that report is currently being conducted by Emory and Garrett Groundwater, Inc. Results of their investigation are expected soon. The preliminary results of favorable groundwater zones are shown on Figure 4-2 at the end of this Chapter. Groundwater will be considered the source water supply through the remainder of this report.

Although groundwater wells will be beneficial in deterring debt service during the initial infrastructure installations, future growth may make well sources impractical. At that time a detailed study of the selected surface water impoundment site will be necessary.

FIGURE 1

Topographic Setting of the Groundwater Development Zones,
Culpeper County Groundwater Investigation

STUDY AREA B

STUDY AREA A

CCO-15
CCO-18
CCO-17
CCO-13
CCO-14
CCO-5
CCO-7
CCO-8
CCO-2
CCO-4
CCO-3
CWW-3
CCO-6
CCO-1
CWW-1
CWW-5
CCO-10
CCO-16
CCO-9

D
G
I
J
K
L

Legend

- Service Authority
- Service Authority Boundary
- EGGI Study Areas

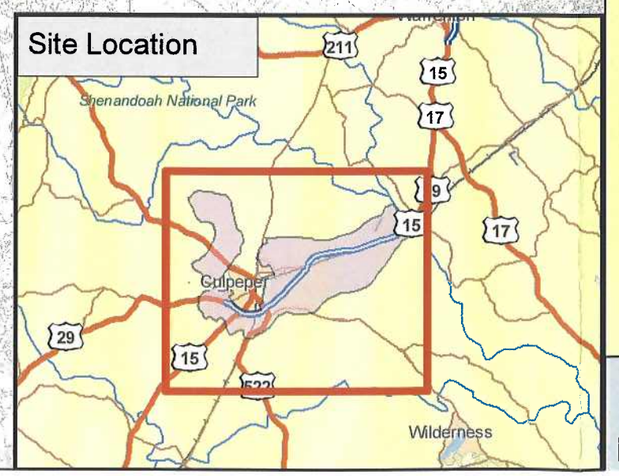
Groundwater Development Zone

Rank

- Primary
- Secondary
- Tertiary

Map ID	Community Water System	Lots Served
D	Norman Acres	19
G	Brenridge	38
I	Lakeside Mobile Home Park	22
J	Pelham Manor	32
K	Gibson Mills	11
L	Overlook Heights I & II	51

Site Location



N

Scale is 1:80,000

1 inch equals 6,667 feet

0 0.5 1 2 3 4 Kilometers

0 0.125 0.25 0.5 0.75 1 Miles

Water and Sewer Master Plan (Figure 4-2)

FIGURE 1

Emery & Garrett Groundwater, Inc.

5.0 BOSTON SERVICE AREA

5.1 Introduction

The Boston service area includes the Boston post office area and Longlea planned unit development to the south. It encompasses approximately 900 acres and drains entirely to the Hazel River, a tributary of the Rappahannock River. The current population within the service area limits has been estimated at 37 based on 2000 census block data. The area is only slightly developed and a large portion remains wooded and undisturbed. Steep slopes are prevalent in portions of the Service Area and will severely limit development. The service area is shown in Figure 5-1 at the end of the Chapter.

The Boston area is located approximately 7.0 miles northwest of the Town of Culpeper along State Route 522 (Sperryville Pike). It is the location of a general store and post office. A conference center known as Longlea and a commercial mailing facility known as Communication Corporation of America (CCA) are located just south of Boston and are included in the service area. The Boston area has been classified as a convenience center in the 2005 County Comprehensive Plan. The Longlea property is currently zoned as a planned unit development which could include commercial facilities, an 18-hole golf course, and up to 1,000 residential units. The area is listed in the future land use plan as an area of potential residential development. If the planned unit development proceeds, the population could grow to nearly 3,000 within the utility service area.

5.2 Existing Water Facilities

The Boston service area is not supplied by a public water system. The residents and commercial establishments have individual wells to supply their daily water usage. The planned unit development will require additional groundwater supplies and a water distribution system. The installation of a publicly-owned system is discussed in Section 5.4.

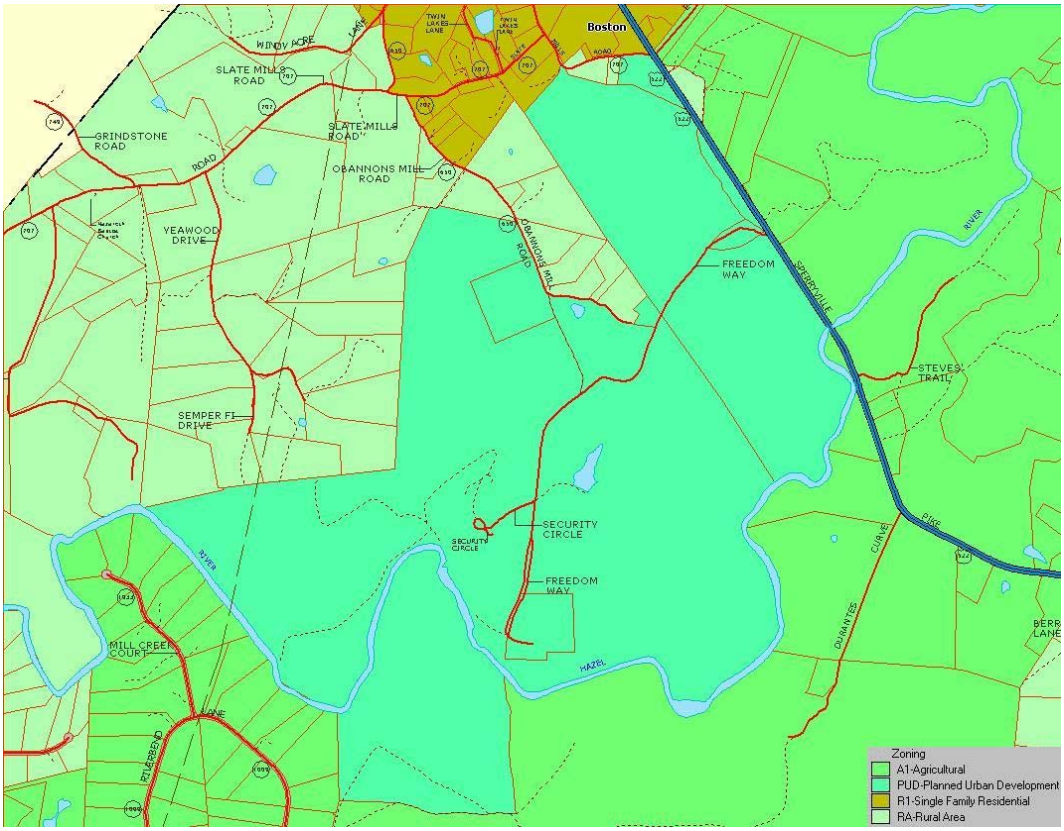
5.3 Existing Wastewater Facilities

The Boston service area does not have a public sewer system. However, Communication Corporation of America and the American Security Council has a wastewater treatment facility near their operations that treats their wastewater effluent. The plant is regulated under the discharge permit VA0065358 held by the Boston Water and Sewer Company. It is permitted for a discharge of approximately 15,000 gallons per day. All existing residential development is served by onsite drainfields. The development density expected with Longlea would not permit septic tank/drainfield systems. The soil conditions in most of the area are not considered adequate for the proper operation of septic tank/drainfield systems. This is due to expansive clay soils 3 to 4 feet deep overlaying bedrock. A public sewer facility will be required and is discussed in Section 5.5.

5.4 Future Water Facilities

Water facilities for the Boston Service area will include supply, treatment, storage, and distribution improvements. The following includes a discussion of each system component and the recommended facilities. The proposed development plan for Longlea will comprise the bulk of Boston's growth and is shown by the area zoned "Planned Urban Development" included in Figure 5-2 below. Figure 5-3 presents a conceptual layout of the future water supply system. This concept was derived from the latest Longlea development plan. It is unknown what the constructed development plan will be.

Figure 5-2 Boston Zoning



5.4.1 Supply

Water for the Boston service area will be supplied by groundwater wells. A groundwater availability assessment has been performed by Emery & Garrett Groundwater, Inc. to determine the safe yield of groundwater in the service area. The result of that assessment is the location of 3 groundwater wells capable of yielding a total of 365 gallons per minute (gpm) or 525,600 gallons per day (gpd). The Virginia Health Department regulations state that a waterworks using well water must calculate the system supply capacity with the largest well out of service. Additionally, the source supply must be able to provide 0.5 gpm per equivalent residential connection. The largest well of the three has a yield of 175 gpm. Removing this well from service leaves a total supply of 190 gpm or

273,600 gpd. In compliance with Virginia Waterworks Regulations, the existing three wells would be capable of supplying (190 gpm/0.5 gpm/connection) or 380 connections. The Culpeper County standards state that a source water supply utilizing only groundwater must have a safe yield of 1.0 gpm per connection. Using this standard, the existing wells could serve (365 gpm/1.0 gpm/connection) or 365 connections. The most stringent standard would apply. Therefore, to reach the buildout provided in the latest development plan, an additional well supply of 635 gpm must be developed. However, since the extent of development is not actually known at this time, additional wells may or may not be needed to meet future demand. If additional wells are needed, they could be phased to meet demand. However, prior to acceptance of any development plan, the ability to provide an adequate water supply should be demonstrated.

5.4.2 Treatment

The treatment system for this area will be based on results of sampling performed for each well. Samples for the three wells discussed above were analyzed and found to meet all EPA Primary Drinking Water Standards. However, treatment will be required for exceeding recommended secondary drinking water parameters. The wells will need to undergo additional water chemistry testing prior to final acceptance by the Virginia Department of Health. Design of water treatment processes will be based on specific concentrations of contaminants. The current Longlea plan indicates using small package facilities at each well head. However, a single treatment facility may be more beneficial if the additional wells yield contaminants requiring a higher level of treatment.

5.4.3 Storage

The Virginia Water Works Regulations specify that a water system must have enough storage for a minimum of 200 gallons per equivalent residential connection plus fire flow. Fire flow requirements are dependant on zoning and land use. For this type of development a fire flow of 2000 gpm for 2 hours will be used. County standards specify a storage capacity of 400 gallons per equivalent residential connection or a storage capacity equal to the Waterworks

Regulations, whichever is higher. Assuming a buildout of 1000 connections, the waterworks regulation would require 0.44 million gallons. The County standards would require 0.40 million gallons. Using the most stringent regulation, a 0.45 million gallon tank should be sited at the location shown on Figure 5-3 at the end of this chapter. If you assume a buildout of 500 connections, the waterworks regulation would require 0.34 million gallons of storage. The County standards would require 0.20 million gallons. Using the most stringent regulation, a 0.35 million gallon tank would be used. The elevation at the proposed tank location is approximately 680. In order to provide the minimum pressure requirement of 30 psi, the tank would need to be approximately 70 feet in height. The storage capacity is based on an assumed development plan of 1,000 units and should be adjusted once the plan is finalized. The final planned storage must meet the Virginia Waterworks Regulations and Culpeper County Water and Sewer Authority minimum requirements.

5.4.4 Distribution

The distribution system for this area will be primarily confined to the Longlea development. A series of 8-inch and 12-inch distribution lines will be installed to serve the residential development and provide fire flow.

5.5 Future Wastewater Facilities

Wastewater generation in the Boston Service Area will occur primarily in the Longlea planned development. With an estimated population of 3,000 people and an average of 3 persons per connection, approximately 1,000 connections are expected. Each connection will generate an average 300 gallons per day of sewerage. Commercial establishments will likely generate an average flow of 10,000 gallons per day for a total of 310,000 gallons per day of wastewater flow. The service area will utilize gravity sewers, pump stations, and force mains to convey the wastewater flow to a new wastewater treatment facility within Longlea. The pump stations, force mains, collector sewers, and treatment facility location are shown on Figure 5-4. The following is a description of the necessary collection and conveyance lines and the required treatment facilities.

5.5.1 Collection and Conveyance

As previously discussed, the final development plans have not been established for the Longlea property. A conceptual layout of sewerage facilities is shown on Figure 5-4 and is based on the latest development submittal. Upon approval of the final development plan, facilities shall be sized for each area in accordance with the Culpeper County Water and Sewer Authority Design and Construction Standards. Although not shown, additional gravity sewers from the Boston post office area could be installed to provide sanitary sewer service to the properties directly adjacent to State Route 522 (Sperryville Pike). An 8-inch gravity line would be capable of conveying this flow. All onsite facilities would be financed by the land developer.

5.5.2 Treatment

The Longlea wastewater treatment plant will discharge directly to Hazel River, a tributary of the Rappahannock River. Therefore, it will be subject to the requirements of the Chesapeake Bay Tributary Strategy. The VDEQ enacted regulations that placed a cap on waste load allocations and concentration limits for nutrients that are discharged from wastewater treatment plants within the Chesapeake Bay Watershed, classified as significant dischargers. This WWTP will be classified as a significant discharger. Currently, there is no waste load allocation associated with the Longlea development or Boston area. Of additional importance is the designation of the Hazel River as a Tier III natural resource. In the summer of 2006 the river was recommended by the VDEQ for designation. If approved, no new VDPES point source discharges to this river would be allowed, thereby eliminating any significant development in the Boston area. Prior to adoption into the Exceptional Waters Program there are several public comment periods and Board approvals required. Therefore, it is possible that the stream may not be adopted.

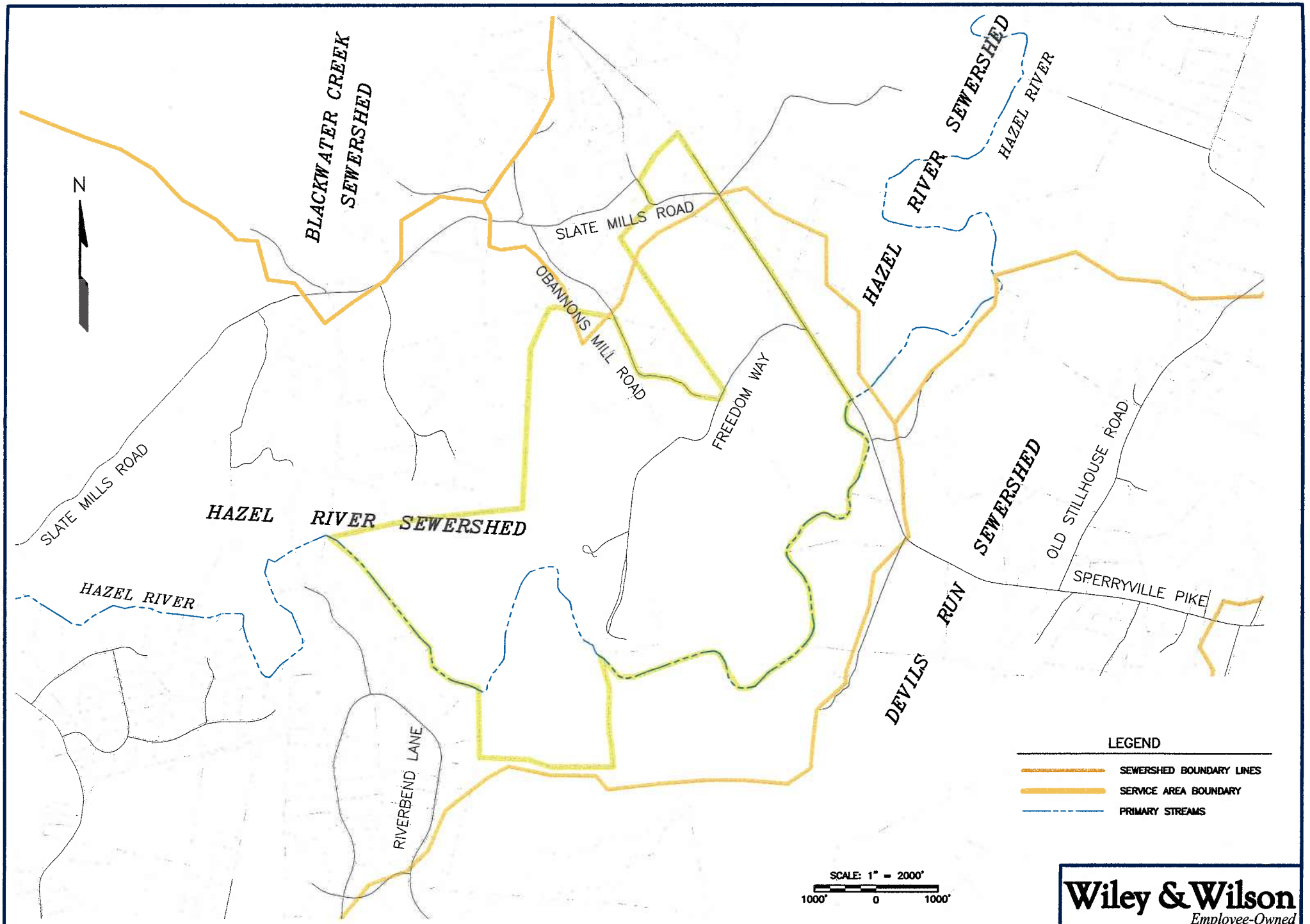


FIGURE 5-1 BOSTON SERVICE AREA

Wiley & Wilson
Employee-Owned
2310 Langhorne Road
Lynchburg, VA 24501-1547
www.wileywilson.com

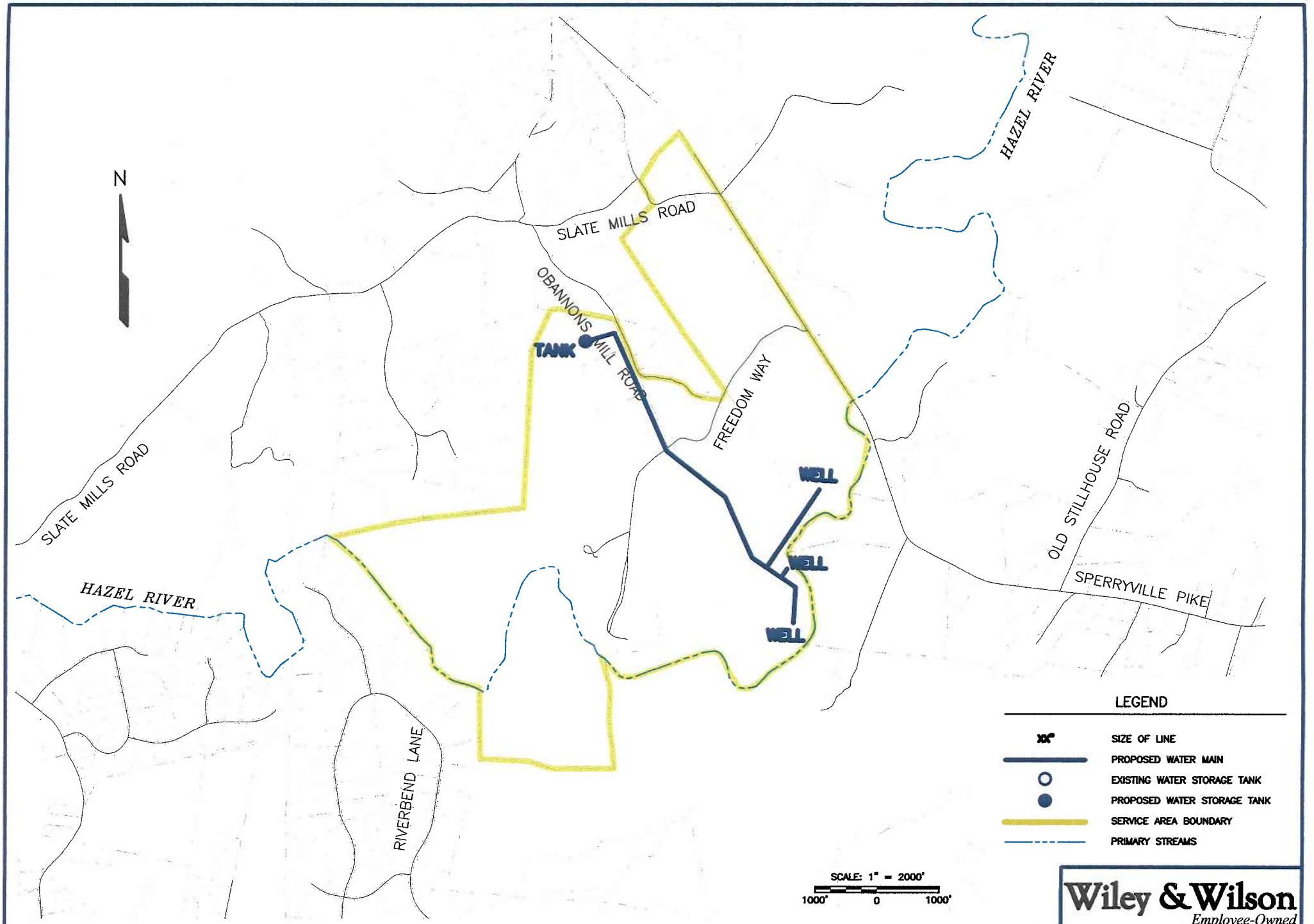


FIGURE 5-3 BOSTON FUTURE WATER IMPROVEMENTS

Wiley & Wilson
Employee-Owned
2310 Langhorne Road
Lynchburg, VA 24501-1547
www.wileywilson.com

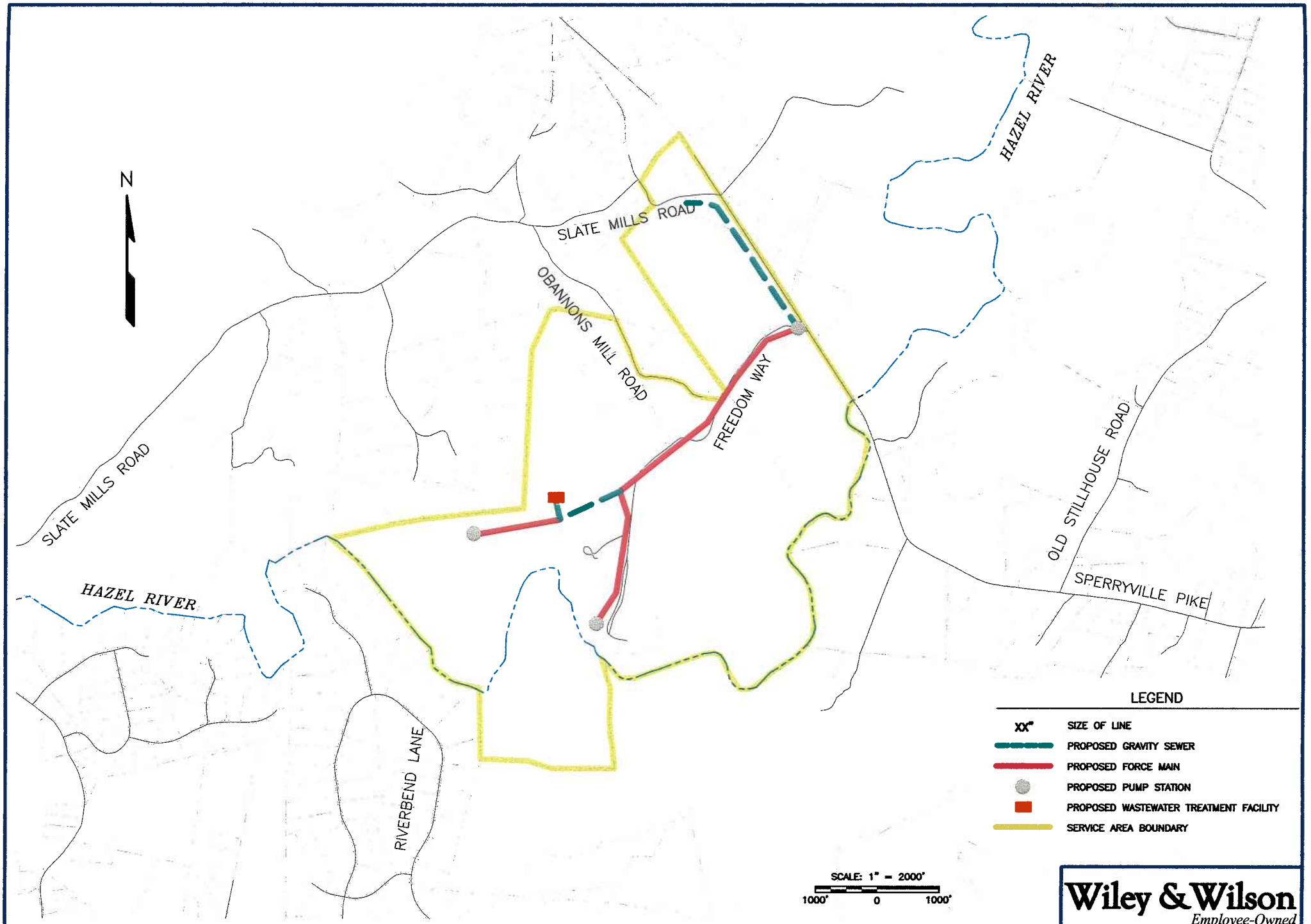


FIGURE 5-4 BOSTON FUTURE SEWERAGE IMPROVEMENTS

Wiley & Wilson
Employee-Owned
2310 Langhorne Road
Lynchburg, VA 24501-1547
www.wileywilson.com

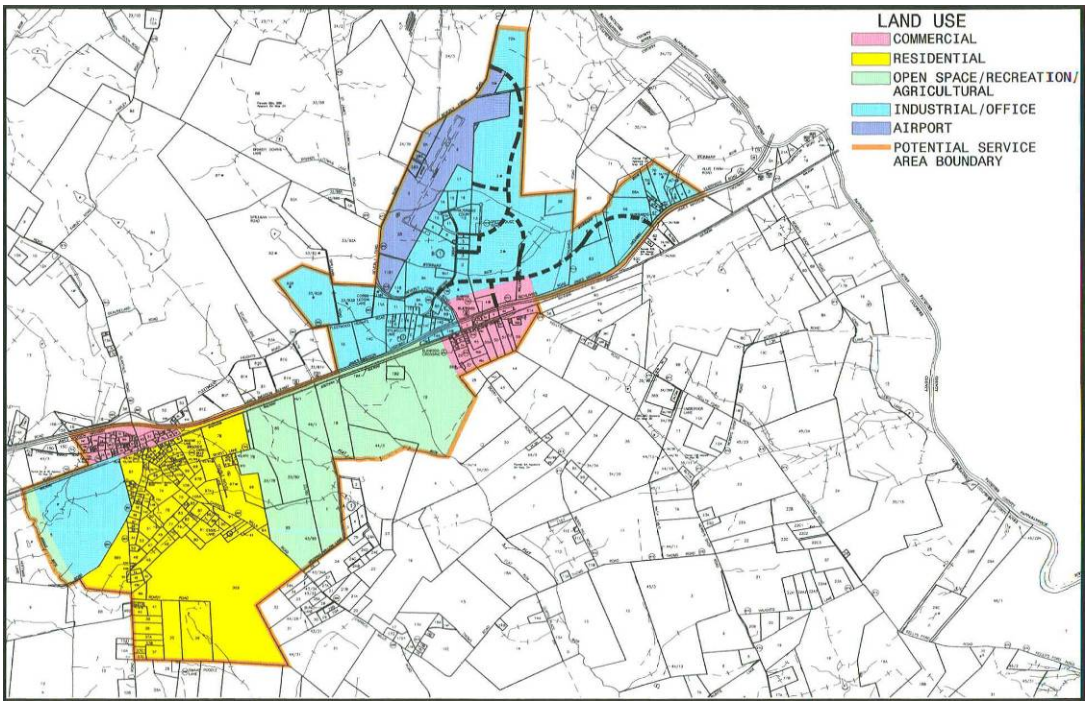
6.0 BRANDY STATION/ELKWOOD

6.1 Introduction

The Brandy Station/Elkwood Utility Service Area is generally located along the U.S. Route 15/29 corridor, approximately 4 miles east of the Town of Culpeper, and stretches nearly to the Rappahannock River, the eastern border of the County. The service area corresponds with the Village Center identified in the 2005 County Comprehensive Plan. It contains portions of the Jonas Run, Flat Run, and Hubbard Run drainage basins. It encompasses 3,200 acres and includes the two communities of Brandy Station and Elkwood, and the surrounding areas. Brandy Station is primarily a residential area with some minor commercial and industrial properties. Elkwood has a small residential area, but is primarily zoned for industry including the Culpeper Regional Airport and Culpeper County Industrial Airpark.

The 2005 Comprehensive Plan projects a village center population of 1,500 persons at build-out, with 218 acres of commercial property and 1,183 acres of industrial property. The development plans for the area include a mixed use that includes industrial areas to the eastern and western ends of the service area, a residential area adjacent to and south of Brandy Station, and commercial areas located at Elkwood and at the intersection of State Route 762 (Brandy Road) and U.S. Route 15/29. The Future Land Use Plan included in the Comprehensive Plan, is shown on Figure 6-1 below. With large developments anticipated, Elkwood will likely become an employment and commercial center in Culpeper County. Open space is also included in the future land use plan and should be incorporated into each individual development as indicated in the 2005 County Comprehensive Plan.

Figure 6-1 Future Land Use Plan



It should be noted throughout the planning and development process that the Brandy Station area holds significant historical value in relation to the Civil War era. The Comprehensive Plan states that the village center includes some significant historic resources that should be respected and preserved.

6.2 Existing Water Facilities

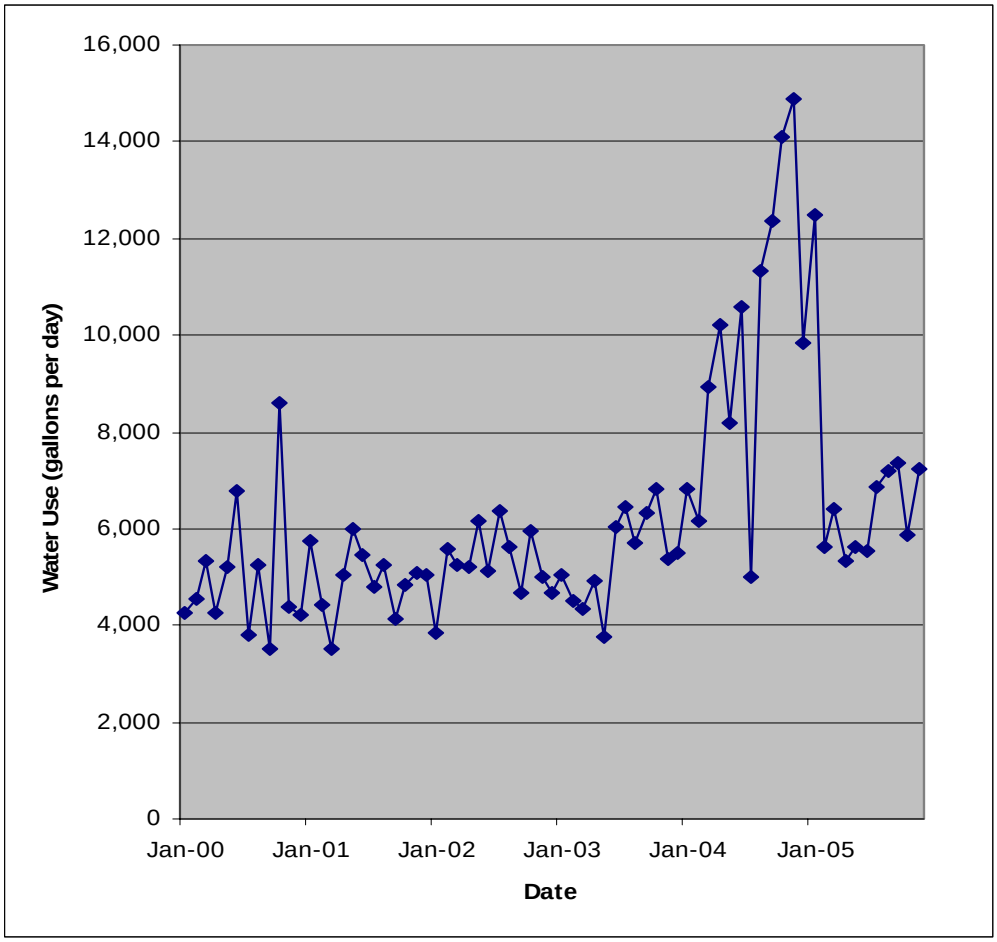
Culpeper County maintains a water system at the Industrial Airpark near Elkwood. The Airpark system provides water to the Culpeper Regional Airport and adjacent industrial parcels. The system, which is shown on Figure 3, consists of two groundwater wells, a water storage tank, hydropneumatic tank, fire pumps, and distribution lines.

The wells have safe yields of 100 gallons per minute and 120 gallons per minute. They are drilled to depths of 220 feet and 295 feet, respectively. The Virginia Department of Health (VDH) water description sheets for these wells indicate that

both wells exceed secondary contaminant levels for iron and manganese set forth by the Virginia Waterworks Regulation 2004. Since reduction of these contaminants is not mandated by the VDH, treatment is not included at the wells or point of collection. Additional information regarding treatment for secondary contaminant levels and future regulatory requirements is included in this Chapter under the Section labeled “Future Water Facilities”.

The Virginia Waterworks Regulation requires groundwater systems to supply daily water demands with the largest well out of service. Using this requirement, the rated capacity of the existing supply source is 144,000 gallons per day (gpd). The current water consumption rates, given in Chart 6-1, are much less. The average daily water consumption over the past 12 months is approximately 7,000 GPD.

Chart 6-1
Airpark Water Usage Rates



The system contains a 300,000-gallon ground storage tank to supply required fire flows and additional peak water demands. A fire pump with a rated flow rate of 2,250 gallons per minute is included in the system to meet the fire flow requirements. Normal daily water demand is supplied by a 5,000-gallon hydropneumatic tank. The water distribution system is a network of 8-inch, 10-inch, and 12-inch diameter mains. The system is shown on Figure 6-2 at the end of this section.

The Airpark water system is limited to the area directly adjacent to the Culpeper Regional Airport. There is no central network south of U.S. Route 29. Individual parcels in the Brandy Station area are served by on-site wells; however,

groundwater contamination is a concern. Failing drainfields have left the shallow ground water bacteriologically unsafe. The Culpeper County Department of Health requires any new wells to penetrate a deeper groundwater aquifer approximately 250-feet deep. In addition, new wells must be grouted to the ground surface to avoid contamination.

6.3 Existing Wastewater Facilities

The Brandy Station community, a low density residential area, is currently served by individual drainfields. The Elkwood community, likewise, is served by individual drainfields. However, the area adjacent to Elkwood, including the Culpeper County Industrial Airpark contains office space and light industrial development. This development is served by a County wastewater collection and treatment system.

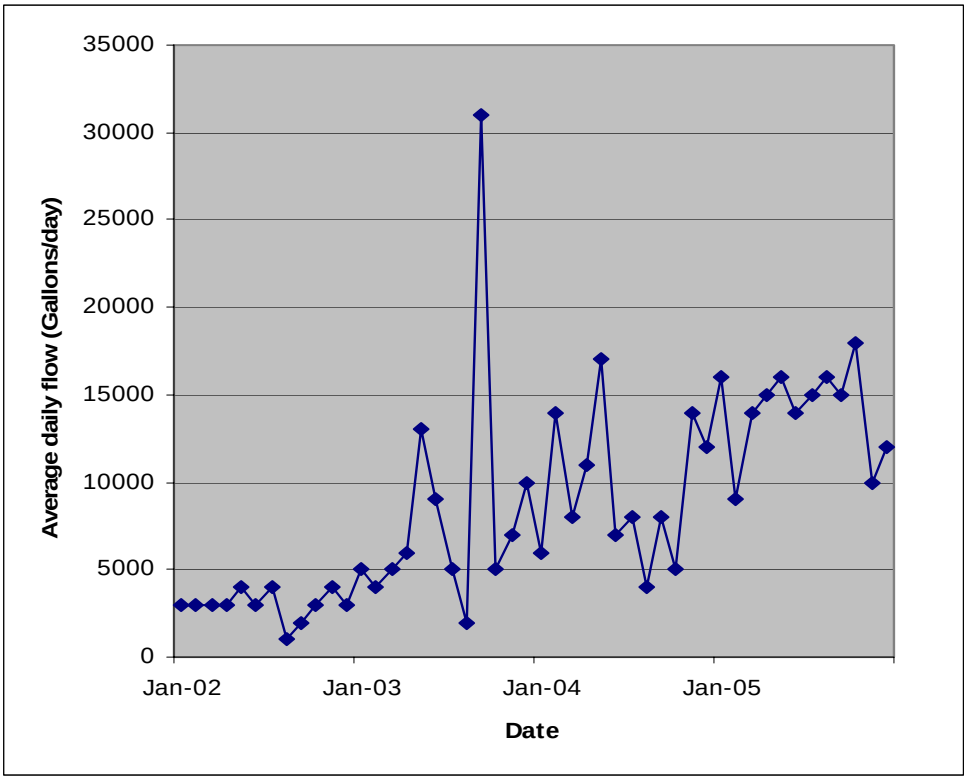
The County Airpark, which includes 106 acres, has been divided into 14 industrial sites with roads, potential runway access, and utility infrastructure. The collection and conveyance system consists of 8 and 12-inch diameter gravity sewer lines, two wastewater pump stations, and force mains. The existing system is shown on Figure 6-3. The wastewater is pumped to the treatment facility located on and discharging to Hubbard Run, a tributary of the Rappahannock River.

The plant discharge is authorized and regulated according to VPDES Permit No. VA0068586. The facility is owned by the Culpeper County Board of Supervisors. The discharge limits for the treatment plant are shown in Table 6-1. The current hydraulic design capacity of the plant is 25,000 gpd. The average daily plant effluent is currently 14,200 GPD. The VPDES permit is written to allow expansion of this facility up to 300,000 gpd without having to reissue the permit. The hydraulic upgrade request was based on previously projected growth. Recent wastewater flow data is presented in Chart 6-2.

Table 6-1
Discharge Limits for Airpark VDPES Permit
Design Flow = 0.075MGD

Effluent Characteristic	Discharge Limitations				Instantaneous Limitations	
	Monthly Avg.		Weekly Avg.		Min.	Max.
Flow	None		None		N/A	N/A
CBOD5	30mg/l	2.84kg/day	45mg/l	4.26kg/day	N/A	N/A
Suspended Solids	30mg/l	2.84kg/day	45mg/l	4.26kg/day	N/A	N/A
Ammonia (Nov1-Apr30)	3.1mg/l		mg/l		N/A	N/A
Ammonia (May1-Oct30)	2.1mg/l		mg/l		N/A	N/A
TRC (Final)	.008mg/l		.010mg/l		N/A	N/A
pH	N/A		N/A		6.0 S.U.	9.0 S.U.
Dissolved Oxygen	N/A		N/A		6.0 mg/l	N/A

Chart 6-2
Airpark Wastewater Treatment Plant
Average Daily Discharge



Because of the limitations for future expansion of the Airpark Wastewater Treatment Plant (WWTP) on the existing site, the County purchased property further downstream on Hubbard Run. The new site is capable of serving a much larger area. A VPDES permit obtained in May 2001 allows the construction and operation of a 900,000-gallon per day treatment plant at the new site. Effluent limits given in Permit No. VA0090603 are shown in Table 6-2. The permit was effective July 11, 2006 and expires date of July 10, 2011. A renewal request has been made. The Elkwood WWTP can accommodate the large commercial and industrial developments east of the Airpark and provide some capacity for pumped flow from Brandy Station. The plant has not been constructed.

Table 6-2
Discharge Limits for Elkwood VDPES Permit
Design Flow = 0.90 MGD

Effluent Characteristic	Discharge Limitations				Instantaneous Limitations	
	Monthly Avg.		Weekly Avg.		Min.	Max.
Flow	None		N/A		N/A	None
CBOD5	10mg/l	34.1kg/day	15mg/l	51.2kg/day	N/A	N/A
Suspended Solids	10mg/l	34.1kg/day	15mg/l	51.2kg/day	N/A	N/A
TKN	3.0mg/l	10.2kg/day	4.5mg/l	15.3kg/day	N/A	N/A
TRC (Final)	.008mg/l		.010mg/l		N/A	N/A
pH	N/A		N/A		6.0 S.U.	9.0 S.U.
Dissolved Oxygen	N/A		N/A		6.0 mg/l	N/A

The Brandy Station community, which is primarily residential, is currently served by individual drainfields on each parcel. The surface geology consists of 3 to 4 feet of expansive clays overlaying bedrock. This geologic condition has lead to many failing drainfields. The drainfield failures along with a shallow groundwater table have caused bacteriological groundwater contamination. Alternative on-site or regional wastewater treatment must be pursued.

A developer, Mount Dumplin, LLC has proposed a residential development in the southern Brandy Station area. The development includes 350 single family

dwellings. Mount Dumplin, LLC has a VPDES permit to build and operate a 300,000-gallon per day treatment facility to serve the development and provide excess capacity. The effluent requirements for Permit No. VA0087149 are listed in Table 6-3. It was effective August 24, 2003, and expires date of August 23, 2008. The plant has not been constructed.

Table 6-3
Discharge Limits for Mt. Dumplin VDPES Permit
Design Flow = 0.3MGD

Effluent Characteristic	Discharge Limitations				Instantaneous Limitations	
	Monthly Avg.		Weekly Avg.		Min.	Max.
Flow	None		N/A		N/A	None
CBOD5	7mg/l	7.9kg/day	10mg/l	11kg/day	N/A	N/A
Suspended Solids	7.0mg/l	7.9kg/day	10.0mg/l	11kg/day	N/A	N/A
TKN	3.0mg/l	3.4kg/day	4.5mg/l	5.1kg/day	N/A	N/A
TRC (Final)	.008mg/l		.010mg/l		N/A	N/A
pH	N/A		N/A		6.0 S.U.	9.0 S.U.
Dissolved Oxygen	N/A		N/A		5.8 mg/l	N/A

6.4 Future Water Facilities

Water facilities for the Brandy Station/Elkwood utility service area will include supply, treatment, distribution, and storage. The following includes a discussion of each system component and the recommended facilities. Figure 6-5 presents a conceptual layout of the future water supply system.

6.4.1 Supply

A groundwater well system in lieu of developing a surface water supply system is recommended to provide water for the Brandy Station/Elkwood Service Area. This recommendation is based on the following considerations:

- A surface water supply would consist of a water reservoir and water treatment plant. The associated capital and operating cost for this type of water supply is much higher than groundwater systems.

- Groundwater with adequate water quality and quantity is available for this area.
- The development of groundwater sources can be staged incrementally with the phasing of land development projects. This reduces the initial capital required to develop the water supply system.
- The Brandy Station/Elkwood Village Center is in an environmentally-sensitive area. The development of a surface water reservoir would require a great deal of regulatory review such as Section 401 and 404 reviews. It is also likely that the reservoir would impact wetlands and, therefore, require mitigation.

A groundwater availability assessment is being performed by Emery & Garrett Groundwater, Inc. to determine the quantity and availability of water in the service area. The final report has not been compiled. However preliminary results of the investigation show 6 primary groundwater development zones in or within close proximity to the utility service area. The safe yield of each zone has not been defined.

A previous groundwater availability assessment was performed for the County and is summarized in a report dated August 1998, entitled *Groundwater Exploration and Development Results of Phase I Investigation.* The previous groundwater resources investigation for the Brandy Station/Elkwood sub-area, performed by Emery & Garrett Groundwater, Inc., suggests that expected well yields could vary between 100 and 300 gpm and 1.4 and 2.2 mgd of potable groundwater could be developed within this area on a sustainable basis.

The Virginia Department of Health regulations state that a waterworks using well water must calculate the system supply capacity with the largest well out of service. Additionally, the source supply must be able to provide 0.5 gpm per equivalent residential connection. As discussed previously, the largest well has a yield of 120 gpm. Removing this well from service leaves a total supply of 100 gpm or 144,000 gpd. In compliance with Virginia Waterworks Regulations, the

existing wells would be capable of supplying (100 gpm / 0.5 gpm/connection) or 200 connections. The Culpeper County standards state that a source water supply utilizing only groundwater must have a safe yield of 1.0 gpm per connection. Using this standard, the existing wells could serve (220 gpm/1.0 gpm/connection) or 220 connections. The most stringent standard would apply.

A summary of water demands within the utility service area is included in Table 6-4 below. A detailed list of flows can be found in Appendix A and on Figure 6-4 at the end of this Chapter.

Table 6-4 Projected Average Daily Flow Rate

Drainage Basin	Connections	Flow rate (gpd)
Hubbard Run	4,154	1,246,200
Flat Run	860	258,000
Jonas Run	336	100,800
Mountain Run	87	26,100

The connections and flow rates include residential, commercial, and industrial uses. Connections will increase incrementally over a number of years. An estimate of the cumulative connection phasing has been provided in Table 6-5 below.

Table 6-5 Projected Connection Phasing

Year	Cumulative connections
FY 2006	47
FY 2007	47
FY 2008	47
FY 2009	50
FY 2010	150
FY 2011	300
FY 2012	475
FY 2013	612
FY 2014	687
FY 2015	917
FY 2020	1277
FY 2025	1538
Later	5437

Based on this phasing projection, additional well sources will be required in 2010. However, if development occurs at a reduced rate, the new well supply could be delayed. Further monitoring of development trends should be performed to more accurately determine the phasing of new groundwater sources. A total of 5,237 gpm additional yield will be required if the predicted growth occurs. At an average yield of 200 gpm per well, 27 additional wells will be required to meet this need.

6.4.2 Treatment

The required treatment system will be based on results of sampling performed as new groundwater wells are developed. Design of water treatment processes will be based on concentrations of contaminants including, but not limited to, radon, arsenic, iron, manganese, and radium. The pH of the treated water may also require adjustment to prevent corrosion of the distribution system piping and to avoid violations of the Lead and Copper Rule. In addition, it is recommended that all new groundwater supplies be provided with a disinfection system.

The groundwater contaminants most often observed in the Culpeper County region are iron, manganese, and total dissolved solids. These contaminants are considered secondary contaminants by the Virginia Waterworks Regulations. By definition, secondary contaminants are substances involving aesthetics, such as color, staining, taste, and odor. Treatment for removal of excess secondary contaminant concentrations is recommended to insure that aesthetic considerations are satisfied, thereby minimizing customer complaints. Secondary maximum contaminant levels for iron, manganese, and total dissolved solids are presented in Table 6-6.

Table 6-6

Secondary Drinking Water Contaminant Standards

Contaminant	MCL	Units
Iron	0.3	mg/L
Manganese	0.05	mg/L
Total Dissolved Solids	500	mg/L

The 1996 Safe Drinking Water Act (SDWA) amendments direct the Environmental Protection Agency to issue regulations requiring disinfection as necessary for groundwater systems. The Groundwater Rule (GWR) has been developed in response to this regulatory requirement. The regulatory goal of the GWR will be to prevent infective fecal contamination from reaching the consumer. EPA published the Ground Water Rule in the Federal Register on November 08, 2006 with a correction to the table on Analytical Methods for Source Water Monitoring published November 21, 2006. The published regulation promotes a risk-based strategy including periodic evaluation to determine risks, monitoring if risks are found, corrective action if deficiencies are found, and compliance monitoring to ensure viral removal. Disinfection of the groundwater sources may be required to satisfy this regulation and prevent re-growth within the distribution network. Treatment systems would be installed at each groundwater well location to effectively treat the contaminants present at each well. Alternatively, if several wells are within close proximity to each other, they could be piped to a central treatment location. Once well locations, yields, and water quality are determined a more detailed plan of treatment can be established.

6.4.3 Distribution

Figure 6-5 shows the primary water system improvements required to provide the projected water system demands within the Brandy Station /Elkwood service area. The improvements include a 12-inch water line extending west along US Route 15/29 (James Madison Highway) from the Airpark/Elkwood area to the Brandy Station area. A 16-inch/12-inch water line loop will also be extended south along Stevensburg Road, east through Mt. Dumplin, and then north along Carrico Mill Road back to US Route 15/29.

6.4.4 Storage

The Virginia Water Works Regulations specify that a water system must have enough storage for a minimum of 200 gallons per equivalent residential connection plus fire flow. Fire flow requirements are dependant on zoning, land

use, and building construction. The Culpeper County Water and Sewer Authority Design Standards specify the storage requirement for domestic and fire flow usage as 400 gallons per equivalent residential connection. These two standards produce different volume requirements; therefore the larger volume was specified when selecting the tank size. Calculations have been included in Appendix A.

To satisfy the requirements, two elevated water storage tanks are required. The conceptual locations of these tanks are shown on Figure 6-5 and include a 1,000,000 gallon tank at the Airpark (ground elevation 290) and a 750,000 gallon tank at the Mt. Dumplin development (ground elevation 370). With an overflow at elevation 420, the entire service area will be provided the minimum 30 psi pressure requirement. Using this overflow elevation the Airpark tank would have a height of 130 feet and the Mt. Dumplin tank would have a height of 50 feet. Initially, only the Mt. Dumplin tank would be constructed with the Airpark tank being installed when demand dictates.

6.5 Future Wastewater Facilities

The Brandy Station/Elkwood utility service area will utilize gravity sewers, pump stations, and force mains to convey wastewater flow to the new Mountain Run Regional Wastewater Treatment Plant (WWTP). The collector sewer and treatment facility locations are shown on Figure 6-6. The wastewater flow projections correspond with the projections given in the previous section on Future Water Facilities and are also shown on Figure 6-4 at the end of this Chapter with a detailed list in Appendix A. The following is a description of the necessary collection and conveyance lines and the required treatment facilities.

6.5.1 Collection and Conveyance

The Brandy Station/Elkwood area is situated in three drainage basins; Hubbard Run, Flat Run, and Jonas Run. Additionally, a small amount of land drains directly to Mountain Run. The Hubbard Run drainage basin includes the lands of Culpeper Regional Airport, Culpeper Industrial Airpark, and additional lands north

and east of the Airpark. It drains directly into the Rappahannock River just north of U.S. Route 15/29. The future land use plan calls for industrial/commercial zoning in the entire Hubbard Run drainage basin within the defined service area. The Flat Run basin drains to Mountain Run, a tributary of the Rappahannock River. This basin includes much of the Brandy Station community, as well as large undeveloped tracts along Flat Run. The Mount Dumplin development, located due south of Brandy Station, is included in this basin. The development company has a VPDES permit for discharging into a tributary of Flat Run. However, this will discharge into the Mountain Run Regional WWTP once constructed. The future land use plan maintains much of the current land use pattern. Brandy Station will remain a residential center with light industrial and commercial support services located along U.S. Route 15/29. The Elkwood area north of Route 15/29 will be incorporated into the Airpark industrial center with commercial services south of Route 15/29.

The wastewater generated within the Hubbard Run drainage basin would be collected in a network of 8-inch to 24-inch diameter gravity sewers flowing towards the Rappahannock River. Plans for a major Airpark plant upgrade were abandoned with issuance of a VPDES permit for the Elkwood WWTP site. The Airpark site was upstream of much of the future service area. This would require pumping the wastewater back to the treatment plant which would be cost prohibitive. In addition, major plant upgrades would be required to meet more stringent discharge limits being imposed by the Virginia Department of Environmental Quality (VDEQ). The Elkwood plant site had limitations as well. When looking to provide a regional WWTP facility, the Hubbard Run basin was not a suitable location. If constructed at the permitted site, wastewater from two of the three basins within the utility service area (Flat Run and Jonas Run) would have to be pumped. Because of conveyance cost, the Elkwood WWTP is not the most economical solution to regional wastewater treatment and, therefore, may not be constructed at its permitted site. Instead, a pump station will be installed on the property obtained for the Elkwood plant. This pump station would serve

the entire Hubbard Run basin. Wastewater will be pumped via a 16-inch force main over the drainage divide to the Flat Run basin.

The force main would terminate just inside the Flat Run drainage basin, combining with additional gravity flows from the industrially zoned areas north of U.S. Route 15/29. A 24-inch gravity sewer would carry the effluent down Flat Run collecting additional flows along the route. If developed, the large parcels along the stream would be served by 8-inch gravity sewers connected to the interceptor. The wastewater from Brandy Station would be collected by this 24-inch interceptor as well. An 8-inch collector sewer along Carrico Mills Road would convey the wastewater to a 12-inch gravity sewer flowing to the 24-inch Flat Run interceptor. A pump station will be installed at the convergence of Flat Run and its tributary flowing from Brandy Station. The pump station will convey the flow through a 20-inch force main to a 24-inch gravity sewer feeding the new regional WWTP. Wastewater flows from the Mount Dumplin development will also enter the 24-inch interceptor at this location.

The Jonas Run sewershed is located on the western edge of Brandy Station. Commercial and industrial properties in the northern portion of the service area would be served by 8-inch diameter gravity sewers and a 12-inch collector sewer along Jonas Run. A pump station at the intersection of State Route 684 (Bel Pre Road) and Jonas Run will carry the sewerage to a gravity sewer in Brandy Station flowing to the Flat Run pump station.

As previously mentioned, the Mount Dumplin development located south of Brandy Station has obtained a VPDES permit for discharging to a tributary of Flat Run. Currently, a waste load allocation has not been assigned to this permit and the owner is contemplating turning the permit over to the County. In lieu of building a permanent wastewater treatment plant on-site, an interim plant may be constructed on the property with an outfall conveying the plant effluent to a tributary of Mountain Run. Once the Mountain Run Regional WWTP is

constructed the interim plant will be removed from operation. Untreated wastewater will flow directly to the regional facility.

6.5.2 Treatment

The new regional WWTP will discharge directly to Mountain Run, a tributary of the Rappahannock River. Therefore, it will be subject to the requirements of the Chesapeake Bay Tributary Strategy. The VDEQ enacted regulations that placed a cap on waste load allocations and concentration limits for nutrients that are discharged from wastewater treatment plants within the Chesapeake Bay Watershed, classified as significant dischargers. The Mountain Run Regional WWTP is classified as a significant discharger. It has been assigned a Total Nitrogen (TN) allocation of 30,456 pounds per year (4.0 mg/l of TN at 2.5 mgd) and Total Phosphorus (TP) allocation of 2,284 pounds per year (0.30 mg/l TP at 2.5 mgd). However, the allocation is based on the County having a certificate to operate no later than December 31, 2010. The plant will have to meet, as a minimum, a TN limit of 4.0 mg/l and a TP limit of 0.30 mg/l. These limits will require state-of-the-art enhanced biological nutrient removal. To address these requirements, a set of preliminary screening alternatives were developed. These alternatives were compared in terms of cost, reliability, and ease of operation.

Based on review of existing permit conditions, along with nutrient limits defined in recent legislation, the following effluent limits are anticipated for the design of this facility.

BOD	3 mg/l
TSS	3 mg/l
Total Nitrogen	4 mg/l
Total Phosphorus	0.3 mg/l

A site has been identified for the new Mountain Run Regional WWTP. The site is located due south of Brandy Station approximately 2,500 feet downstream of the confluence of Jonas Run and Mountain Run. It is located in a bend of the

stream, on a primarily wooded parcel. The wooded parcel will provide screening and buffering for the surrounding area. The site location is shown on Figure 6-6 at the end of this chapter. The County purchased approximately 78 acres for the facility and buffer requirements.

N

WELL 1 - 100 gpm safe yield
WELL 2 - 120 gpm safe yield
TANK - 300,000 gallon storage capacity
FIRE PUMP - 2,000 gpm capacity
HYDROPNEUMATIC TANK - 5,000 gallon storage capacity

WELL 1
PUMP
WELL 2
TANK

12"
8"
10"

BEVERLY FORD ROAD
RICHLANDS ROAD
KELLYS FORD ROAD
ROAD
HUBBARD RUN
RAILROAD
SOUTHERN
U.S. 15/29
ELKWOOD

LEGEND

- EXISTING WATER LINE
- EXISTING WELL
- PARCEL BOUNDARY
- MAJOR STREAMS
- SERVICE AREA BOUNDARY

SCALE: 1" = 1000'
0 1000'

FIGURE 6-2 BRANDY STATION/ELKWOOD - EXISTING WATER SYSTEM

Wiley & Wilson
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Lynchburg, VA 24501-1547
www.wileywilson.com

N

PUMP STATION

PUMP STATION

PUMP STATION

PUMP STATION

WASTEWATER TREATMENT PLANT

8"
2"
2"
8"
8"
8"
8"
4"
4"
4"
3"
12"
12"
12"
6"
12"

ROAD

BEVERLY FORD ROAD

RICHLANDS ROAD

HUBBARD RUN

SOUTHERN RAILROAD

U.S. 15/29

ELKWOOD

KELLYS FORD ROAD

ROAD

RAILROAD

LEGEND

XX"	SIZE OF LINE
	EXISTING GRAVITY SEWER
	EXISTING FORCE MAIN
	EXISTING PUMP STATION
	PARCEL BOUNDARY
	MAJOR STREAMS
	SERVICE AREA BOUNDARY

SCALE: 1" = 1000'

0 1000'

FIGURE 6-3 BRANDY STATION/ELKWOOD - EXISTING SEWERAGE SYSTEM

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Lynchburg, VA 24501-1547
www.wileywilson.com

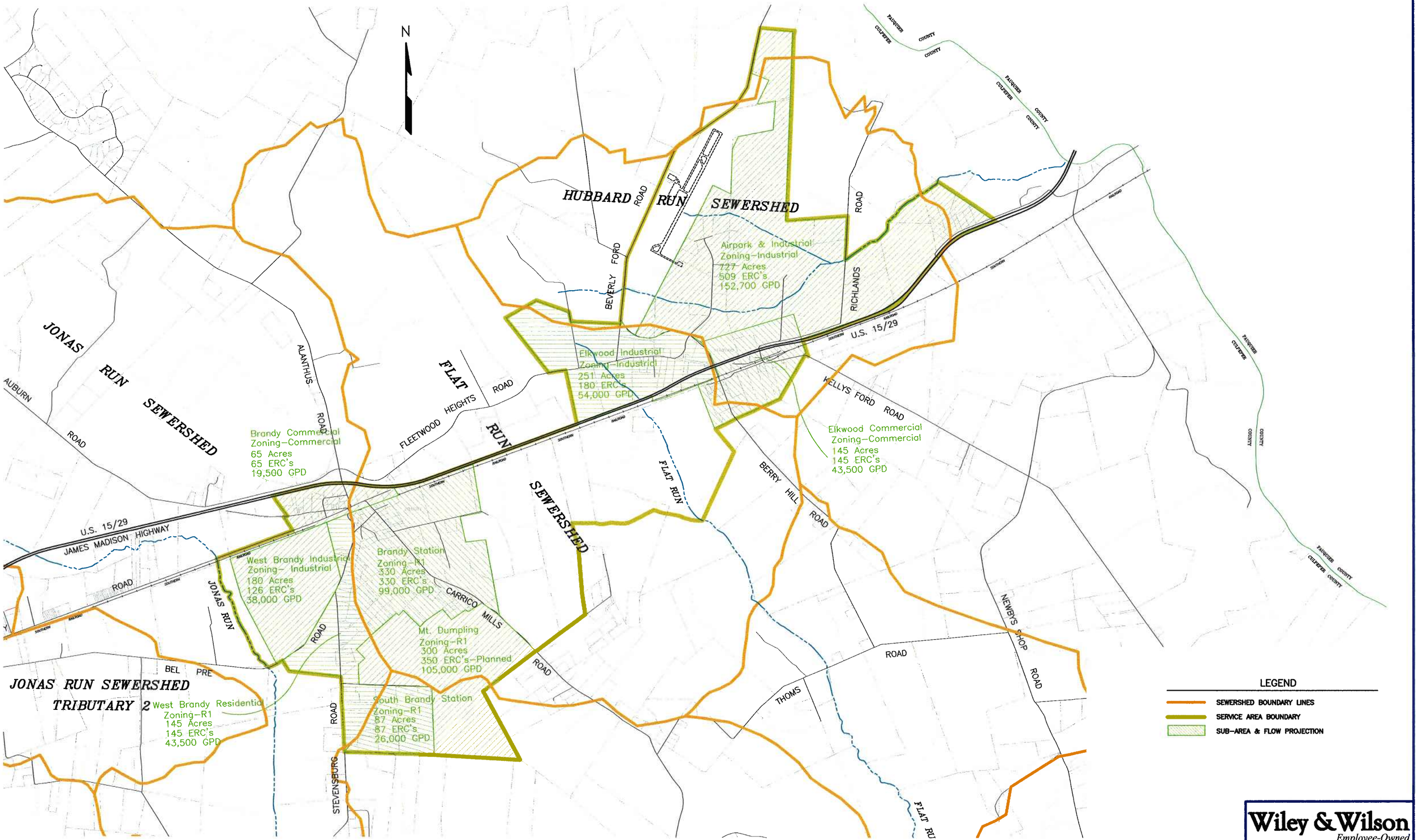

FIGURE 6-4 BRANDY STATION/ELKWOOD - PROJECTED FLOWS

Wiley & Wilson
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AIRPARK/ELKWOOD AREA

TANK
1.0 MG

0.3 MG

12"

16"

BRANDY STATION

TANK
0.75 MG

FAUQUIER COUNTY
CULPEPER COUNTY

N

BEVERLY FORD ROAD

RICHLANDS ROAD

U.S. 15/29

JAMES MADISON HIGHWAY

AUBURN ROAD

ALANTHUS ROAD

FLEETWOOD HEIGHTS ROAD

KELLYS FORD ROAD

FLAT RUN

BERRY HILL ROAD

NEWBYS SHOP ROAD

THOMS ROAD

JONAS RUN

CARRICO MILLS ROAD

BEL PRE ROAD

STEVENSBURG ROAD

SOUTHERN RAILROAD

LEGEND

XX"	SIZE OF LINE
	PROPOSED WATER MAIN
	EXISTING WATER STORAGE TANK
	PROPOSED WATER STORAGE TANK
	SERVICE AREA BOUNDARY
	PRIMARY STREAMS

FIGURE 6-5 BRANDY STATION/ELKWOOD - FUTURE WATER IMPROVEMENTS

SCALE: 1" = 5000'
2500' 0 2500'

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www.wileywilson.com

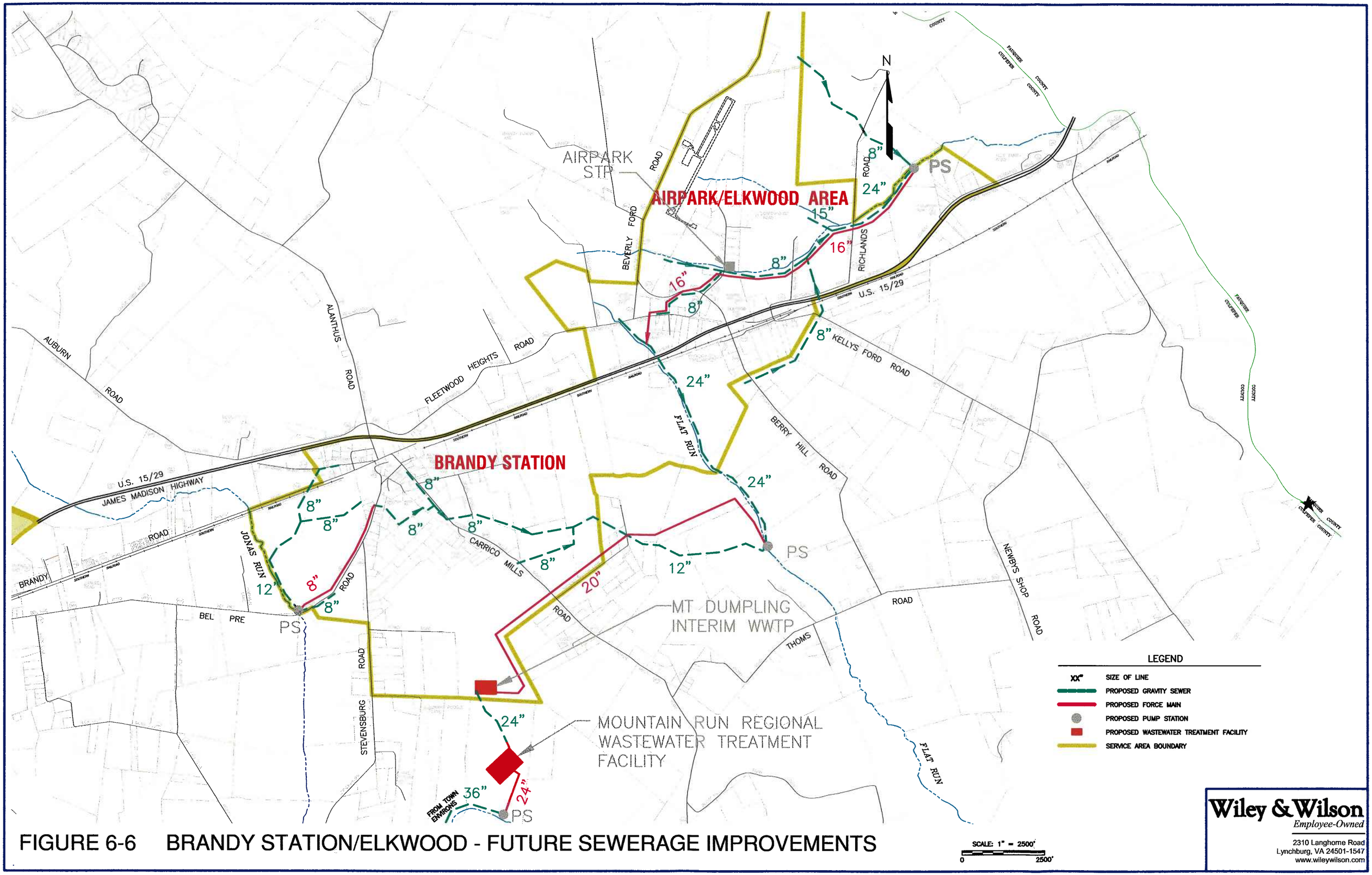

FIGURE 6-6 BRANDY STATION/ELKWOOD - FUTURE SEWERAGE IMPROVEMENTS

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7.0 CLEVENGERS CORNER

7.1 Introduction

Clevengers Corner Village Center is one of the three Village Centers identified in the Culpeper County Comprehensive Plan. The Village Center is located south of the intersection of Route 211 and Route 229 in the northern portion of the County, approximately 13 miles north of the Town of Culpeper. The Clevengers Corner Village Center includes the existing South Wales subdivision, the proposed Centex Homes residential and commercial development which is known as Clevengers Village, parcels known as the Epstein Property and River Ridge subdivision, and two other adjacent parcels. The purpose of this Master Plan is to identify the water and sewer facilities required to serve the Clevengers Corner Village Center through buildout and does not anticipate or require any additional development or expansion of the service area to support the water and sewer infrastructure. The Clevengers Corner Village Center Service Area is shown on Figure 1 and is consistent with the 2005 Comprehensive Plan.

7.2 Existing Waterworks System Description

The existing waterworks in the Clevengers Corner Village Center is owned and operated by Clevengers Village Utility, Inc. and currently serves the South Wales development. The Virginia Department of Health (VDH) permit number is 6047480 and was last amended February 3, 2003. The system consists of the following:

- Three well heads with a combined yield of 385 gallons per minute
- Four 20,000-gallon finished water atmospheric storage tanks
- Six manganese greensand filters
- Chemical feed pumps and solution tanks for feeding sodium hypochlorite, potassium permanganate, and blended polyphosphate
- Four booster pumps
- Two hydropneumatic tanks
- Approximately 33,500 feet of water main piping

The wells are drilled to various depths within the groundwater aquifer. Well No. 1 is 305 feet deep and has a safe yield of approximately 70 gpm. It will serve as a backup well in the expanded Clevengers Village waterworks system. Well No. 10A is 390 feet deep and has a safe yield of approximately 40.7 gpm. Well No. 6 is 268 feet deep and has a yield of approximately 275 gpm. It will serve as a primary supply source within the new waterworks system. The existing distribution system consists of approximately 2,000 ft. of 10-inch, 14,000 ft. of 8-inch, 14,500 ft. of 6-inch, and 3,000 ft. of 4-inch and smaller water mains. The mains are a combination of C900 PVC and ductile iron.

The oldest water mains in the system are approximately 15 years old and are in good working order. The storage and treatment facilities serving the existing system are located adjacent to the existing wells, and they will be removed after the new water treatment facility is complete and in operation. The existing system does not provide any fire protection to the South Wales Subdivision. The existing South Wales water system is shown on Figure 2.

7.3 Existing Wastewater System Description

The existing wastewater system in the Clevengers Village area is owned and operated by Clevengers Village Utility, Inc. and serves the South Wales development. The sewer system is composed of a gravity collection system, two pump stations, and a 70,000 gallon per day (gpd) package type wastewater treatment plant that discharges into a tributary of the Rappahannock River.

The gravity collection system has been inspected and the manholes have been tested to the extent possible. The system, especially some manholes, requires some repair and rehabilitation before the County assumes ownership. This repair and rehabilitation is in progress at this time. The existing South Wales wastewater system is shown on Figure 3.

7.4 Projected Service Connections and Flows

Present and future water consumption and wastewater flows are based on Equivalent Residential Connections (ERC). The projected service area buildout for Clevengers Corner Village Center, including the existing South Wales subdivision, the Epstein property and River Ridge subdivision totals approximately 1,595 equivalent residential connections. The 2000 Census data for Culpeper County indicates that the average household size for Culpeper County is 2.68 persons. Using an average of 3 persons per dwelling and 100 gallons per person, per day, yields 300 gallons per residential connection. The Projected Equivalent Residential Connections and Flows are shown on Table 1. The service area, proposed land use, and projected flows are shown in Figure 4.

DRAFT

TABLE 7-1
Clevenger's Corner Service Area
Wastewater Treatment Plant
Projected Equivalent Residential Connections and Flows

New Connections	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	Later
South Wales - Existing											0
Clevenger's Village (Res.)	125	150	150	150	150	49					0
Clevenger's Village (Comm.)		20	20	20	20	20	20	13			0
Area 1								20	20	20	20
River Ridge			20	20	20	20	20	10			0
Epstein Property			30	30	30	30	30				0
New Wales								33			0
	125	170	220	220	220	119	70	76	20	20	20
Cumulative Connections											
South Wales - Existing	348	348	348	348	348	348	348	348	348	348	348
Clevenger's Village (Res.)	125	275	425	575	725	774	774	774	774	774	774
Clevenger's Village (Comm.)		20	40	60	80	100	120	133	133	133	133
Area 1								20	40	60	80
River Ridge			20	40	60	80	100	110	110	110	110
Epstein Property			30	60	90	120	150	150	150	150	150
New Wales								33	33	33	33
	473	**643**	**863**	**1083**	**1303**	**1422**	**1492**	**1568**	**1588**	**1608**	**1628**
Projected Flows:	**141,900**	**192,900**	**258,900**	**324,900**	**390,900**	**426,600**	**447,600**	**470,400**	**476,400**	**482,400**	**488,400**

7.5 Future Water Facilities

The water facilities for the Clevengers Corner Village Center service area will include supply, treatment, distribution, and storage. The following is a discussion of each and the recommended facilities:

7.5.1 Supply

Groundwater will be the water supply source for the Village Center. The existing wells on the Clevengers Village property, NWL-11, NWL-12, NWL-16, and NWL-18 provide a total flow of 600 gpm to the Clevengers Village service area. South Wales Well No. 6 (capacity 275 gpm), and Well No. 1, will be connected to the raw water system on the Clevengers Village property. Due to its remote location, relatively low yield, and relatively poor water quality, Well No. 10A will be abandoned. Emery and Garrett Groundwater, Inc. designated Well Nos. 10 and 17 on the Clevengers Village property as reserve wells due to their influence on the other wells and they will be maintained as such. In the future, when additional properties develop within the Service Area, the developers will be required to provide a water supply that meets the Counties then current Design Standards requirement, currently 1.0 gpm per connection.

7.5.2 Treatment

A new treatment plant will be required to treat the groundwater to meet all Virginia Department of Health Office of Water Program and United States Environmental Protection Agency Safe Drinking Water Act requirements. The capacity of the plant will be 600 gallons per minute (gpm). Existing Clevengers Village Wells NWL-11, 12, 16, and 18, along with existing South Wales Well No. 6, will supply average daily flow to the water treatment plant. The existing South Wales water system supply (Well No. 1) will also be connected to the raw water supply piping. This well is capable of providing approximately 70 gpm of additional supply to the proposed treatment facility.

The water treatment facility design will be based on concentrations of radon, arsenic, iron, manganese, and radium in water from the four Clevengers Village water supply wells and two existing South Wales' wells. The plant will be

designed to treat the "worst case" combination of flows and pollutant concentrations from the six wells. The pH of the treated water will also be controlled to prevent corrosion of the distribution system piping and avoid violations of the Lead and Copper Rule.

Water will normally be supplied to the WTP from five wells (NWL-11, 12, 16, 18, and well No. 6. The water will be treated to meet the Maximum Contaminant Level (MCL) and Secondary Maximum Contaminant Level (SMCL) requirements set forth by the Virginia Department of Health. These wells are not under the influence of surface water.

WATER TREATMENT PLANT		
Unit Process	**Number or Size**	**Function**
Aerator	1 each	Remove radon by air stripping
Sodium hypochlorite feed	N/A	Preliminary disinfection and oxidize iron and manganese
Raw water storage tank	100,000 gallons	Provide raw water storage to allow constant flow through the plant and provide contact time for the preliminary disinfection
Raw water pumps	2 each @ 600 gpm	Feed treatment process
Hydrous manganese oxide (HMO) feed	N/A	Facilitate removal of radium 226 and 228 by sequestering
Vertical pressure filters	2 each @ 300 gpm	Remove the sequestered radium 226 and 228 and the oxidized iron, manganese and other particulate matter.
Vertical pressure adsorption vessel with granular ferric hydroxide (GFH) media	3 each @ 200 gpm	Absorb arsenic
Sodium hypochlorite feed	N/A	Final disinfection

WATER TREATMENT PLANT		
Unit Process	**Number or Size**	**Function**
Zinc orthoposphate feed	N/A	Corrosion inhibitor for distribution system
Sodium fluoride feed	N/A	Source of fluoride
Finished water storage (Clearwell)	250,000 gallons (350,000 gallons if a single elevated tank is provided)	Provide contact time for final disinfection, storage for finished water pumping and fire flow
Finished water pumps	2 each @ 900 gpm	Pump finished water to the distribution system

7.5.3 Distribution

The Clevengers Village distribution and storage system will be designed to provide sufficient water throughout the Service Area and to meet the Culpeper County Water and Sewer Authority Design Standards for domestic flows, fire flows, and system pressure. The first phase of the system design will serve the new Clevengers Village development and the existing South Wales subdivision. The design will include provisions for extending the system into the remaining portions of the Service Area. Due to inadequate storage, the existing South Wales water system supplies only domestic demands and does not provide fire protection. Connecting the existing water system to the proposed Clevengers Village water system will provide the existing South Wales subdivision with adequate supply and storage for both domestic and fire flow demands. The existing South Wales water system is shown on Figure 2.

A WaterCAD model of the existing South Wales system and the proposed Clevengers Village water system was created to verify distribution line sizes and to determine if improvements to the existing South Wales water system are required. The pipe lengths and diameters of the existing system were obtained from record drawings provided by Culpeper County. The location and lengths of the water lines in the proposed Clevengers Village subdivision were obtained from a conceptual layout of the utilities provided by Rickmond Engineering, Inc.

For the initial modeling, it was assumed that all water lines in the proposed Clevengers Village distribution system would be 8-inch diameter pipes, with the exception of the main transmission line through the center of Clevengers Village, which links the water storage facilities, the proposed water treatment plant, the proposed school site to the south, and the proposed commercial area to the north, which is assumed to be a 12-inch diameter pipe. Demands were allocated based on the proposed commercial development concentrated at the northern end of Clevengers Village, around the intersection of Route 229 and Route 211, residential areas located north and south of Route 211 and the two proposed school site at the southern end.

Once the model was developed, available fire flows in the existing and proposed residential, commercial and school areas were evaluated under a variety of scenarios. A primary goal of the modeling effort was to evaluate system pressure during residential and commercial fire flow events. A minimum fire flow of 1,000 gpm for 2 hours was evaluated for the residential areas while maintaining system pressure of at least 20 psi (pounds per square inch) throughout the combined water system and a minimum fire flow of 2,000 gpm for 2 hours was evaluated for the commercial and school areas while maintaining a system pressure of at least 20 psi through the combined water system. These fire flow requirements were derived from the Authority Standards.

A number of model runs were made that evaluated various tank locations and their effect on available fire flows and system pressure, as well as interconnections between the existing South Wales system and the proposed Clevengers Village system. The model results showed that, if 8-inch distribution lines are used throughout the developed area in Clevengers Village, a 12-inch transmission main is used through the center of the area, and 12-inch lines are extended to the commercial area and the school complex area, the flow and pressure requirements can be met in all areas.

Interconnections between the Clevengers Village water system and the existing South Wales water system were also evaluated. These evaluations included single-pipe connections and multiple-pipe connections. A single 12-inch pipe connection at Berkshire Drive or two 12-inch connections, one at Chatham Lane and one at Somerset Lane, were adequate for domestic demands, but inadequate for fire flow demands within the South Wales subdivision. Three 8-inch connections to the existing South Wales system, one at Chatham Lane, one at Somerset Lane, and one at Berkshire Drive are required to provide the 1,000-gpm fire flow and maintain a system pressure of 20 psi. We recommend that the waterline at Chatham Lane be constructed as a 12-inch line to meet the west side of Route 229 and the line at Somerset Lane be constructed as a 12-inch line to the connection point at Somerset Lane to provide optimal fire flow protection.

The proposed water facilities for the Service Area are shown on Figure 5.

7.5.4 Storage

Based on Virginia Department of Health Waterworks Regulations, the minimum acceptable effective finished water storage for domestic purposes shall not be less than 200 gallons per equivalent residential connection (ERC) at minimum pressure. Therefore, 200 gallons per ERC for the total projected 1,595 ERCs requires 319,000 gallons of storage for domestic purposes. Fire flow storage is based on the most severe fire flow requirement within the service area. For the Clevengers Village development, that fire flow is 2,000 gpm. Fire flow storage of 2,000 gpm for a 2-hour period requires an additional 240,000 gallons of storage. Therefore, the total storage required, including domestic and fire flow storage, is 559,000 gallons. The Culpeper Design Standards require a minimum of 400 gallons per ERC, which is 638,000 gallons. Therefore, the minimum storage requirement is 638,000 gallons. The tank overflow elevation would be set at 600 feet to satisfy Culpeper County Design Standards and Virginia Department of Health (VDH) requirements for water service pressure. The preferred tank site is located in the vicinity of the water treatment plant and the ground elevation of this

site is approximately 453 feet, which would require a tank height of 147 feet to the overflow.

- Cost: The estimated cost of the 750,000-gallon tank is $1,925,000.
- Visibility: The tank site is located within Clevengers Village away from the Route 229 and Route 211 corridors. This site has a high ground surface elevation, resulting in a shorter tank height.
- Maintenance: With one tank, the systems cannot provide fire flow when the tank is off-line for maintenance. Provisions would have to be made to pump water continuously to meet the domestic demands. In addition, provisions would have to be made to meet the fire flow requirements. Both of these scenarios are best addressed by providing additional pumps and enlarging the clearwell to 350,000 gallons. A minimum of two (one as backup) small domestic service pumps that would run continuously while the elevated tank is off line would be permanently located at the treatment facility and connected to the distribution system. These domestic pumps would be sized to meet normal domestic demands and maintain adequate system pressure. The Water Treatment Plant finished water pumps would continue to operate based on system pressure. When the small domestic service pumps cannot keep up with peak demands, the WTP finished water pumps would be turned on automatically by the falling system pressure. They could then operate for a set period of time or be turned off at a set high system pressure.

  Portable pumps are necessary to provide fire flows. These pumps would be connected to the distribution system and would be operated automatically based on system pressure. If the WTP finished water pumps were operating and system pressure continued to fall, these pumps would activate automatically at a set system pressure and provide additional water to the system. These pumps would be sized to provide the required fire flow to the system.

Another issue with meeting the fire flow demands with one elevated storage tank is the quantity of storage available. The clearwell at the water treatment plant will have a capacity of 350,000 gallons, which will provide the 2 hours of fire flow at 2,000 gpm, including the 600 gpm domestic demand provided by the WTP.

- Redundancy: To minimize the risks associated with a single elevated storage tank, installation of a larger clearwell, small domestic service pumps, and a portable fire pump are required.
- Water Quality: To insure adequate water quality, it is essential to turn the water over in the single elevated storage tank. This will be accomplished in two ways. One is having a dedicated line feeding into the top of the elevated storage tank and a separate line removing water from the bottom of the tank and sending it into the distribution system. This will ensure the "first water in is the first water out" and prevent short-circuiting of the flow of water through the tank. Also, by setting the control points for the WTP finished water pumps so that the tank level is allowed to fluctuate, fresh water is periodically added to the elevated tank. The head range of the tank will likely be set to vary over a larger range in the beginning when the demands are lower. The tank level fluctuations will be reduced as the average system demands increase to keep the tank level higher so that more water is kept in storage to meet the higher peak system demands as the system is built out.
- Storage Distribution: One 750,000 gallon elevated storage tank located at the southern tank site will provide adequate domestic and fire flows to Clevengers Corner Village Center and the entire service area.

The single tank should be located at the south tank site to take advantage of the higher ground surface elevation which reduces the height of the tank. This results in reduced visibility, since the site is located away from major highway corridors. The south site is also located relatively close to

the other utility infrastructure improvements being constructed in Clevengers Village, which will allow for a dual piping arrangement to facilitate water turnover. The tank can also provide service to an expanded service area in the future if it is required, including the areas to the south of Clevengers Corner along Route 211. If service is required north of Route 211, an additional tank will be required, since this area is higher in elevation and the Clevengers Village tank cannot provide the required pressure.

7.6 Future Wastewater Facilities

The wastewater facilities for the Clevengers Village Service Area will include collection and treatment. Following is a discussion of each and the recommended facilities.

7.6.1 Collection

The Clevengers Village wastewater collection system will be designed to collect all of the wastewater throughout the Service Area, convey the wastewater to the wastewater treatment plant, and meet the requirements of the Culpeper County Water and Sewer Authority Design Standards. The first phase of the design will serve the new Clevengers Village development and the existing South Wales subdivision. The design will include provisions for extending the system in the future. The existing South Wales wastewater facilities are shown on Figure 3.

The collection system will be a series of gravity sewer lines that convey the wastewater to a regional wastewater pump station that will then pump the wastewater to the treatment plant. The collector lines serving the Clevengers Village development will be extended to and across Route 229, and the existing South Wales subdivision system will be connected to the new lines. This allows the two existing South Wales pump stations to be taken off line and the wastewater will flow to the regional pump station by gravity. The existing 10-inch gravity sewer from South Wales will remain in place to continue to serve that area and to serve a portion of the new Clevengers Village development. The

collection for the Clevengers Village system will require one additional small pump station to serve the northeast portion of the Clevengers Village commercial area. The New Wales property will also be served by this pump station in the future. The only other pump station that will be required is one to serve the northern portion of River Ridge Subdivision.

The proposed collector sewer layout for the Service Area is shown on Figure 6.

7.6.2 Treatment

A new wastewater treatment plant will be constructed to serve the Clevengers Village Center area. The plant was originally planned to serve the new Centex Homes development at Clevengers Village, the existing South Wales subdivision, the Epstein Subdivision, River Ridge Subdivision, and some small surrounding areas for a total of 1,595 ERCs. Centex Homes agreed to pay for the construction of a 600,000 gpd treatment facility. Subsequent to this agreement, the County decided to increase the capacity of the plant to 900,000 gpd to provide additional treatment capacity to preserve the County's waste load allocation.

Since the proposed plant will discharge to the Rappahannock River, it will be subject to the requirements of the Chesapeake Bay Tributary Strategy. The Virginia Department of Environmental Quality (VDEQ) enacted regulations that establish a cap on waste load allocations and concentration limits on the nutrients that are discharged from wastewater treatment plants that are classified as "significant dischargers" to waters that are in the Chesapeake Bay Watershed. The proposed plant is classified as a significant discharger and has been assigned a Total Nitrogen (TN) allocation of 10,964 pounds per year (4.0 mg/l of TN at 0.9 mgd) and total phosphorus (TP) allocation of 822 pounds per year (0.30 mg/l TP at 0.9 mgd). Therefore, the proposed wastewater treatment plant will have to meet, as a minimum, a TN limit of 4.0 mg/l and a TP limit of 0.30 mg/l, which will require "state-of-the-art" enhanced nutrient removal. To address these requirements, a set of preliminary screening alternatives was developed.

These alternatives were compared in terms of cost, reliability, and ease of operation.

Several treatment processes were evaluated for the wastewater treatment plant. It was concluded that a suspended growth, single-sludge system, known as a five-stage Bardenpho process, would best meet the needs of the County.

Based on review of existing permit conditions, along with nutrient limits as a result of recent legislation, the following effluent limits are anticipated for the design of this facility.

BOD	3 mg/l
TSS	3 mg/l
Total Nitrogen	4 mg/l
Total Phosphorus	0.3 mg/l

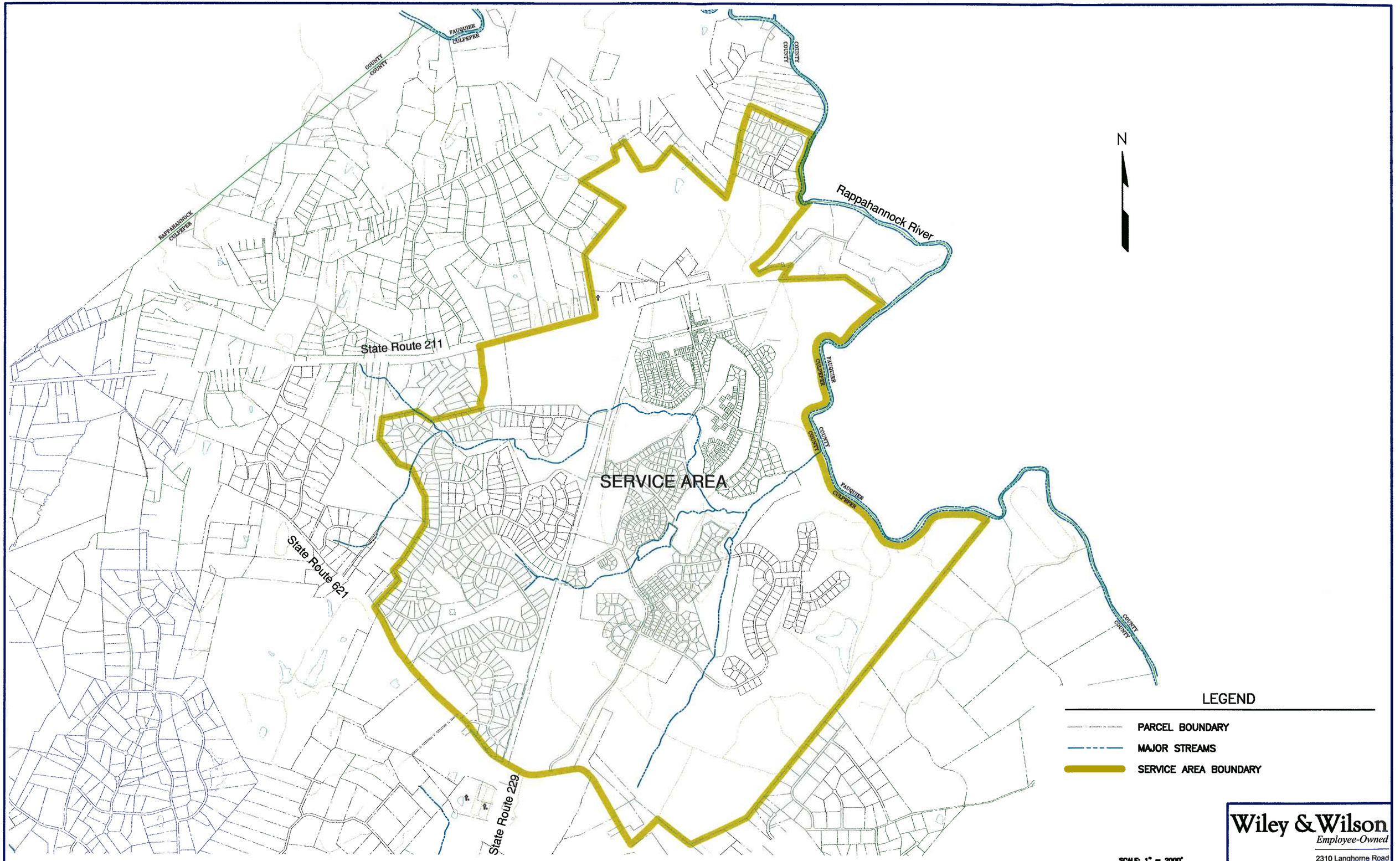


FIGURE 7-1 CLEVENGERS CORNER VILLAGE CENTER - SERVICE AREA

Wiley & Wilson
Employee-Owned
2310 Langhorne Road
Lynchburg, VA 24501-1547
www.wileywilson.com

12-19-05

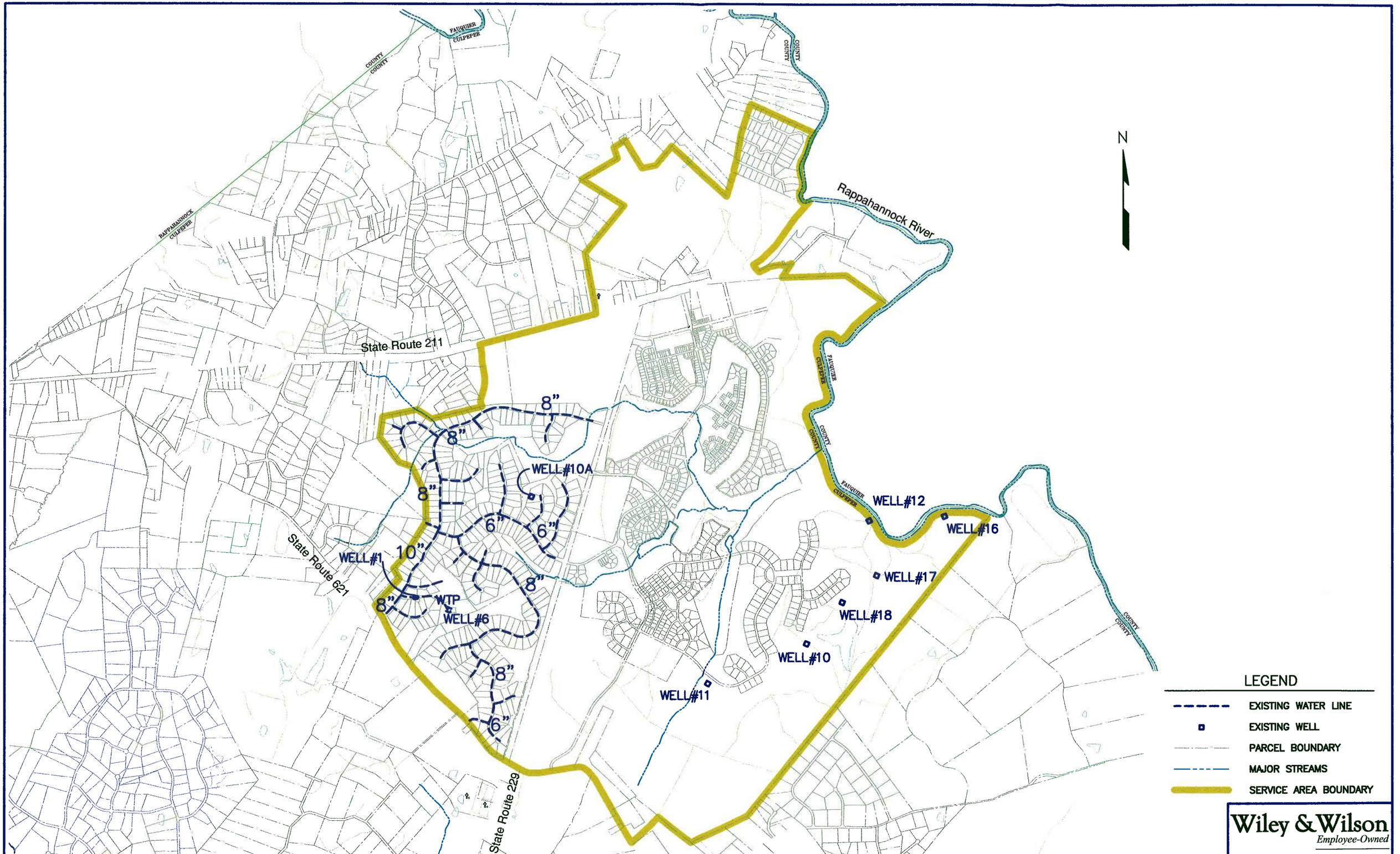


FIGURE 7-2 CLEVENGERS CORNER VILLAGE CENTER - EXISTING WATER FACILITIES

12-19-05

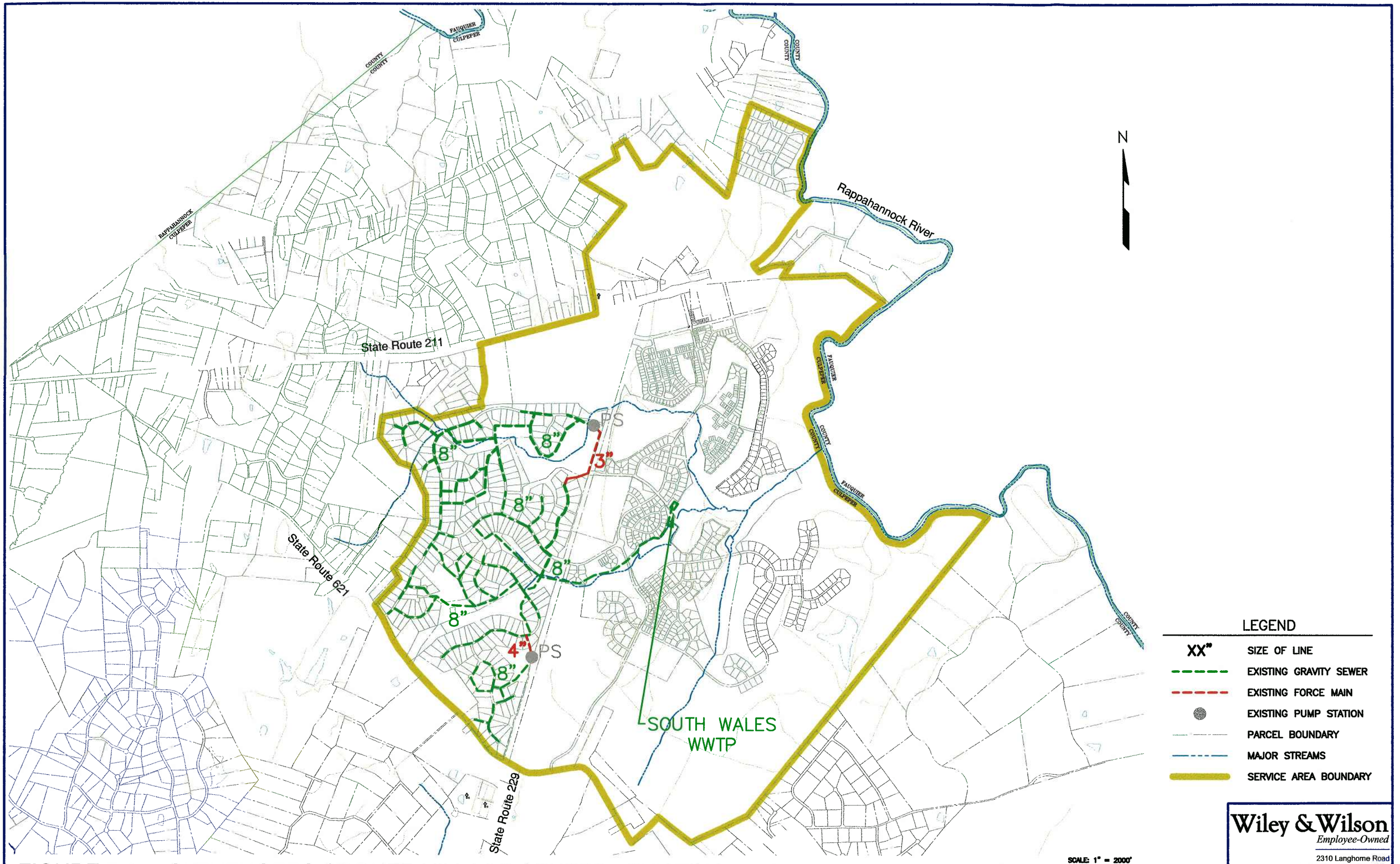


FIGURE 7-3 CLEVENGERS CORNER VILLAGE CENTER - EXISTING WASTEWATER FACILITIES

Wiley & Wilson
Employee-Owned
2310 Langhorne Road
Lynchburg, VA 24501-1547
www.wileywilson.com

12-19-05

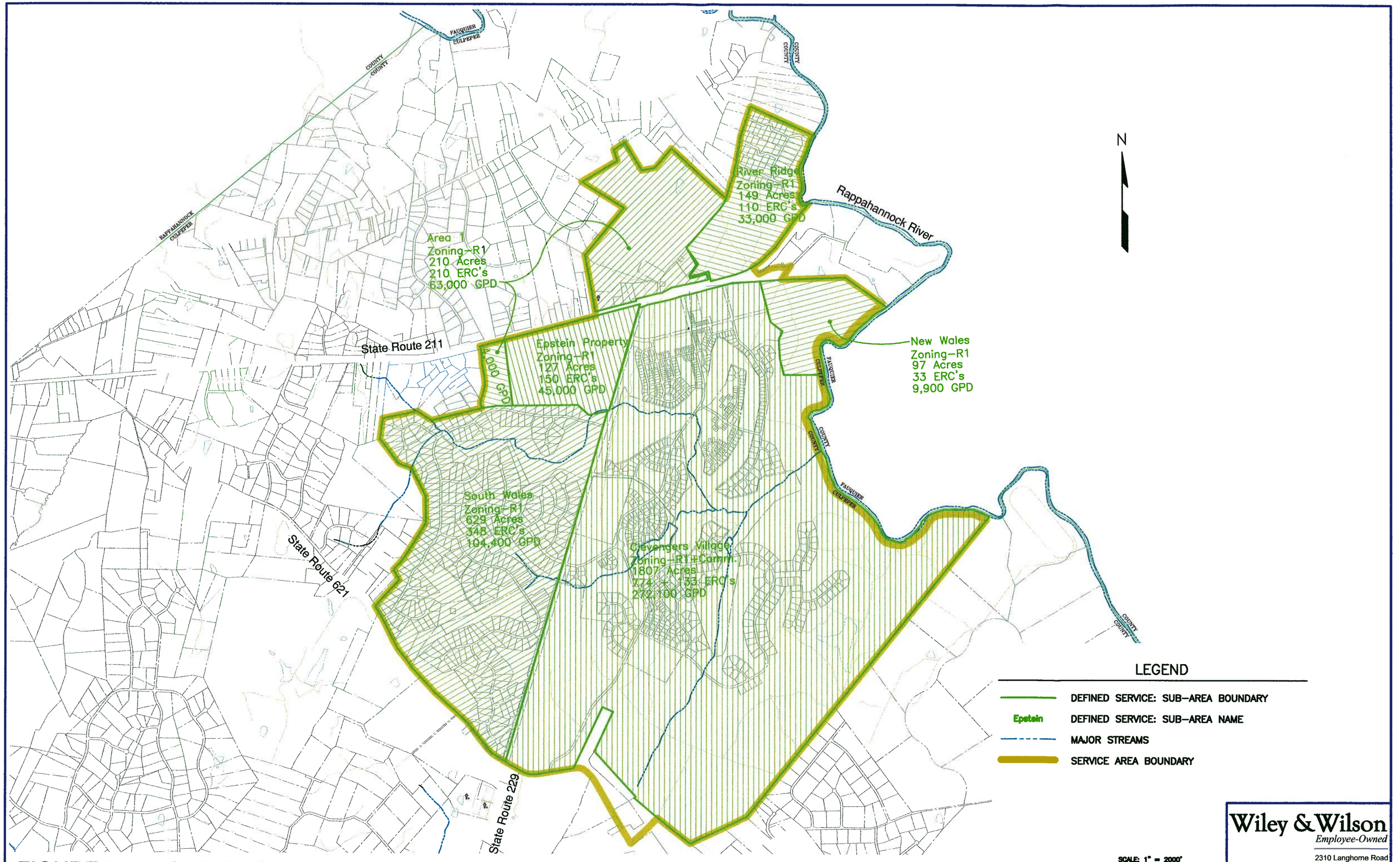


FIGURE 7-4 CLEVENGERS CORNER VILLAGE CENTER - LAND USE AND PROJECTED FLOWS

Wiley & Wilson
Employee-Owned
2310 Langhorne Road
Lynchburg, VA 24501-1547
www.wileywilson.com

12-19-05

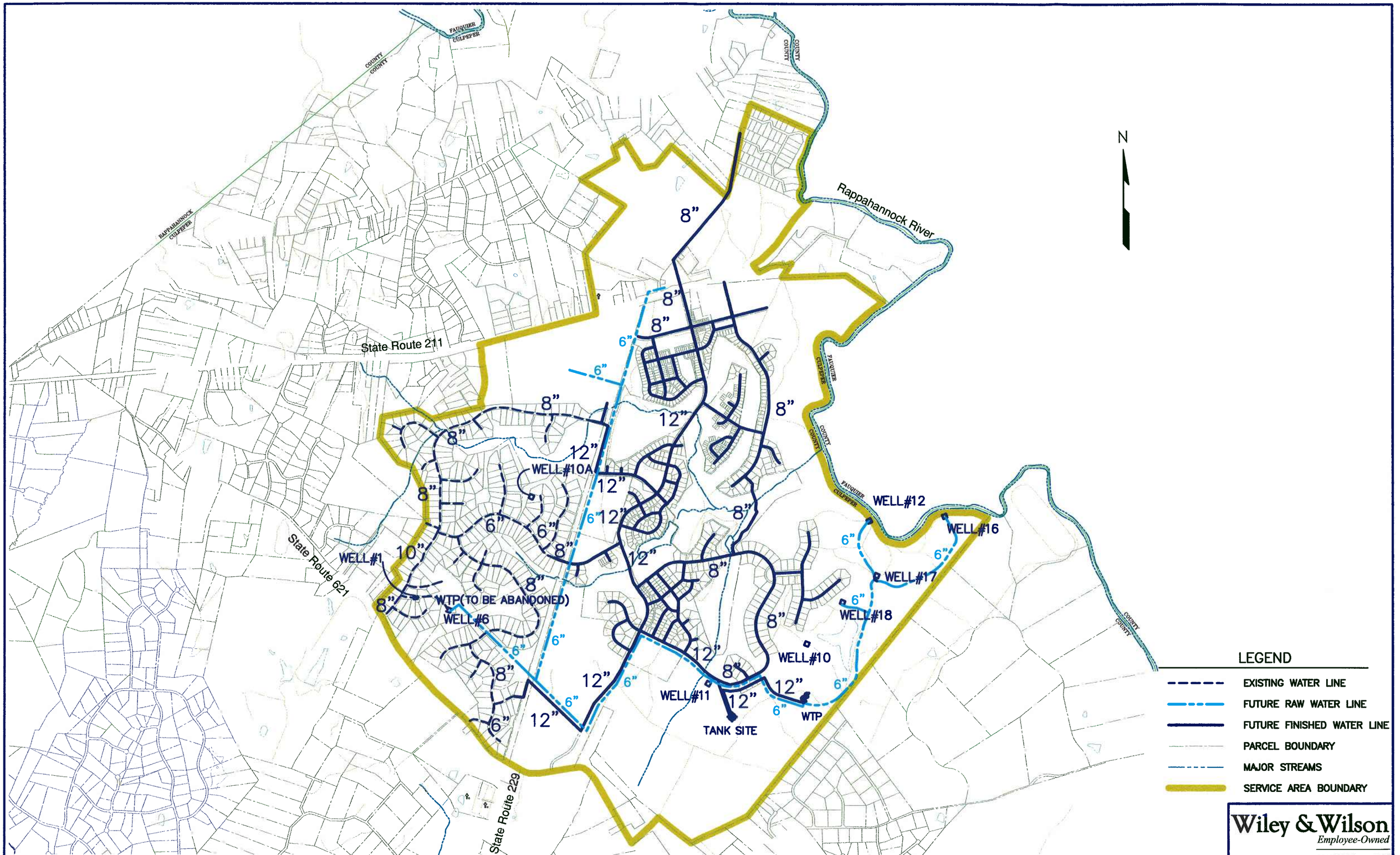


FIGURE 7-5 CLEVENGERS CORNER VILLAGE CENTER - FUTURE WATER FACILITIES

02-07-06

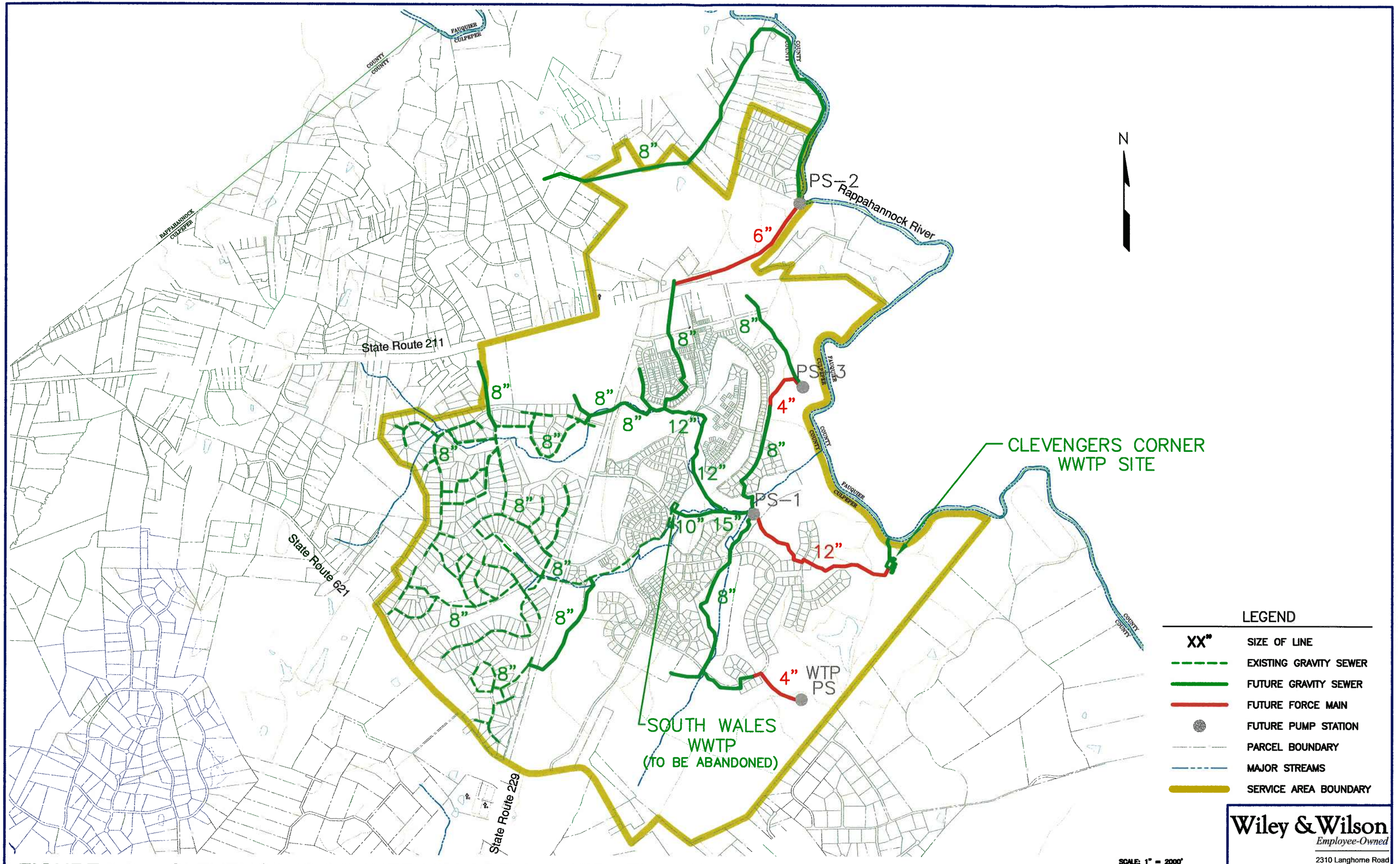
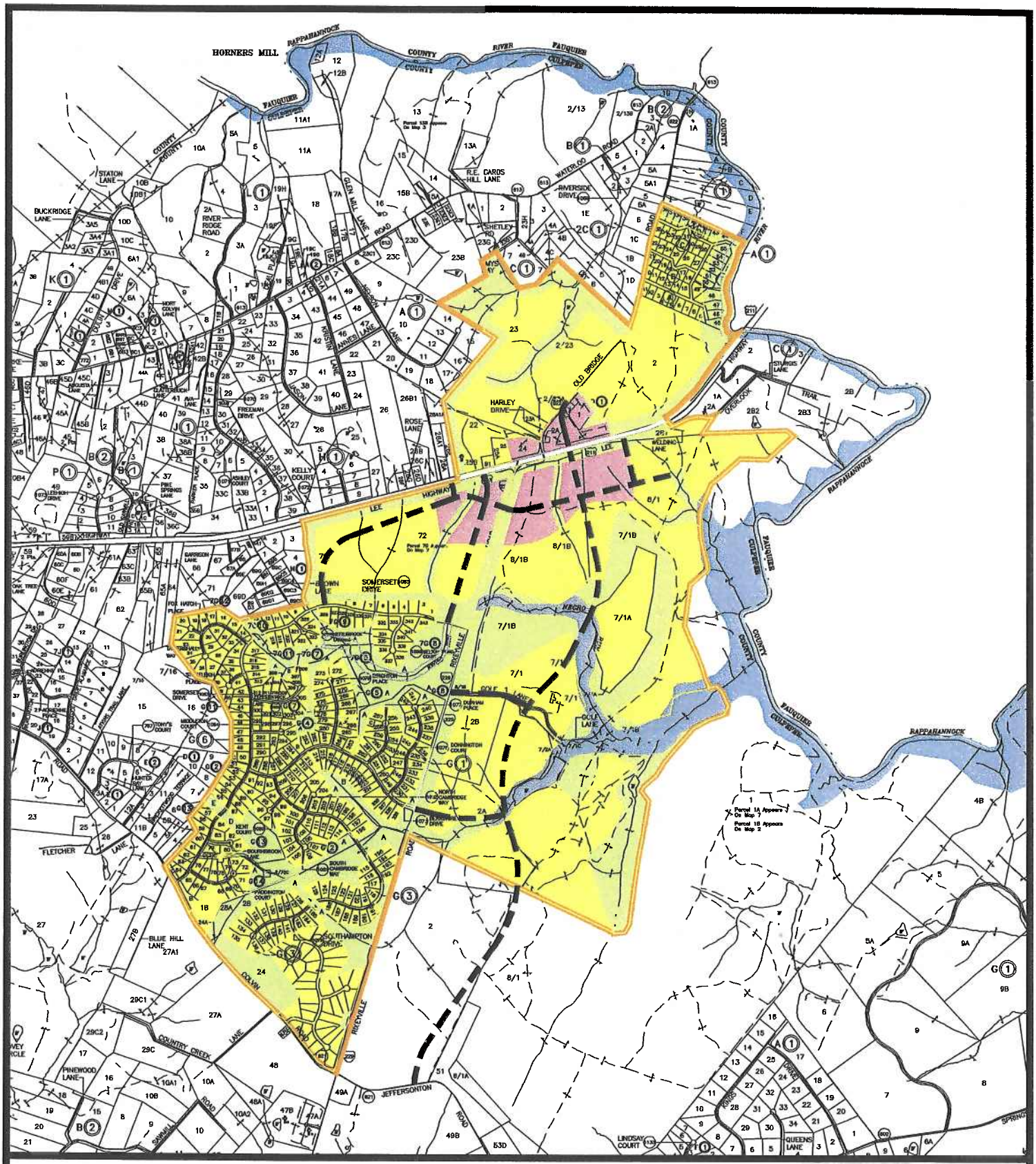


FIGURE 7-6 CLEVENGERS CORNER VILLAGE CENTER - FUTURE WASTEWATER FACILITIES

Wiley & Wilson
Employee-Owned
2310 Langhorne Road
Lynchburg, VA 24501-1547
www.wileywilson.com

12-19-05



12A.2: CLEVENGER'S CORNER VILLAGE CENTER PLAN

LAND USE

- COMMERCIAL/OFFICE/ EMPLOYMENT
- RESIDENTIAL
- OPEN SPACE/RECREATION
- POTENTIAL SERVICE AREA BOUNDARY
- APPROX. LOCATION 100 YEAR FLOOD PLAIN

NORTH

Figure 7-7

8.0 THE TOWN ENVIRONS

The Mountain Run Planning Area is an area located primarily to the south and east of the Town of Culpeper. It includes the drainage basin of Mountain Run, as well as portions of the Buck Run and Summerduck Run basins. The planning area encompasses approximately 26,000 acres including the Environs and the Village Centers of Brandy Station/Elkwood and Stevensburg. The lands between and directly adjacent to these Village Centers drain to Mountain Run and are also included in the planning area. The planning area is shown on Figure 8-7 at the end of this Chapter. Water and sewer facilities were sized to accommodate the potential demands of the planning area. However, the water and sewer master plan is written to support the growth outlined in the 2005 County Comprehensive Plan.

8.1 Introduction

The areas of the County adjacent to the Town of Culpeper corporate limits are known as the Environs. They have, in addition to the Village Centers of Brandy Station, Clevengers Corner, and Stevensburg, been identified through the future land use plan as areas of residential, industrial, and commercial growth. The Environs areas are located along Route 29 South, Route 15/29 Business to the east, Route 229 North, and to a lesser extent Route 522. Within these areas, developments are primarily concentrated along the existing road corridors such as U.S. Route 15/29 (Business), U.S. Route 522, and State Route 229 North. Residential growth is occurring, with more planned, in the area south of U.S. Route 29 as well.

Based on the latest population projections, there are several areas within the Environs where growth is anticipated. Using demographic information presented in the 2005 Comprehensive Plan, population estimates were calculated and are presented in Table 8-1 below.

Table 8-1 Population Projections - Environs

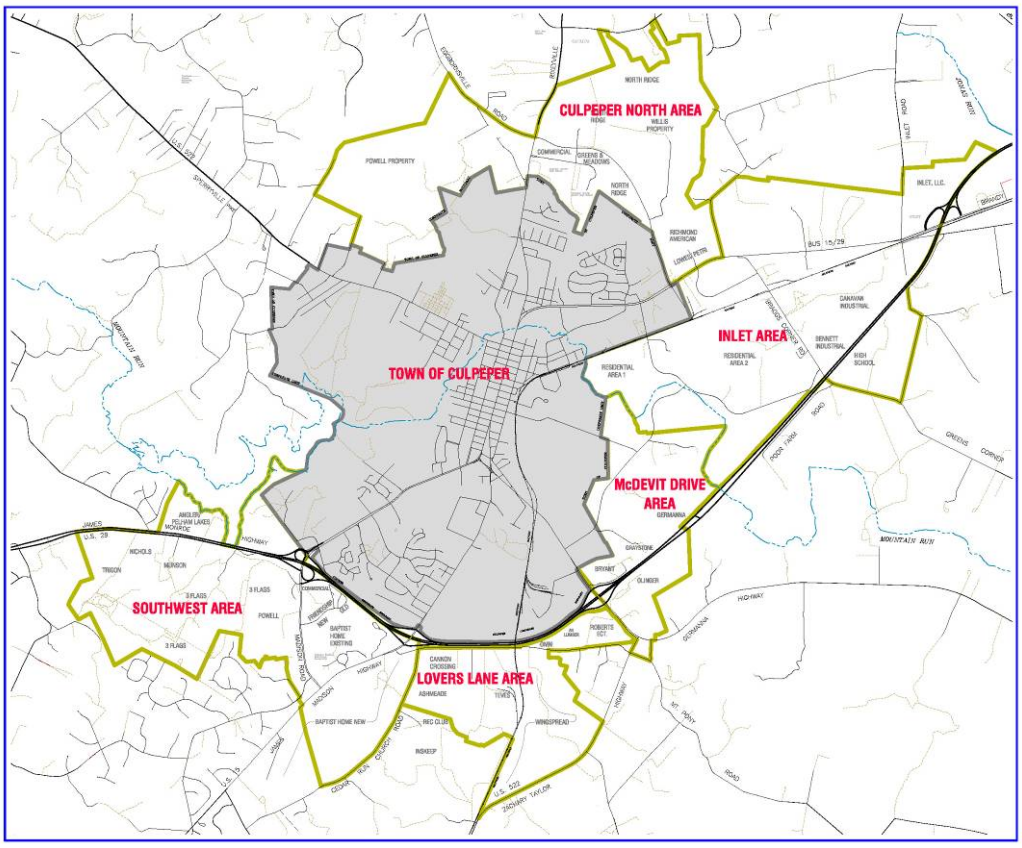
SUB-AREA	YEAR 2000	YEAR 2005	YEAR 2015	YEAR 2025	YEAR 2055
Lover's Lane	128	155	226	329	1,357
McDevitt	43	52	76	111	1,215
Inlet	259	313	457	667	2,967
Culpeper North	710	858	1,251	1,826	4,679
Southwest	1,417	1,712	2,497	3,644	8,211
TOTAL	2,557	3,090	4,507	6,577	18,429

The Environs encompass 6,650 acres of residential, industrial, and commercial property. Sanitary sewer and water distribution services are considered essential to support predicted growth in these areas. Table 8-2 lists the Environ sub-areas and their anticipated development based on the Future Land Use Plan. These sub-areas are shown on Figure 8-1 below.

Table 8-2 Environs Sub-areas and anticipated development

SUB-AREA	FUTURE DEVELOPMENT
Lover's Lane	Industrial/Commercial/Residential
McDevitt Area	Industrial/Commercial
Inlet Area	Industrial/Commercial/Rural Residential
Culpeper North	Low Density Residential
Southwest Area	Commercial/Medium Density Residential

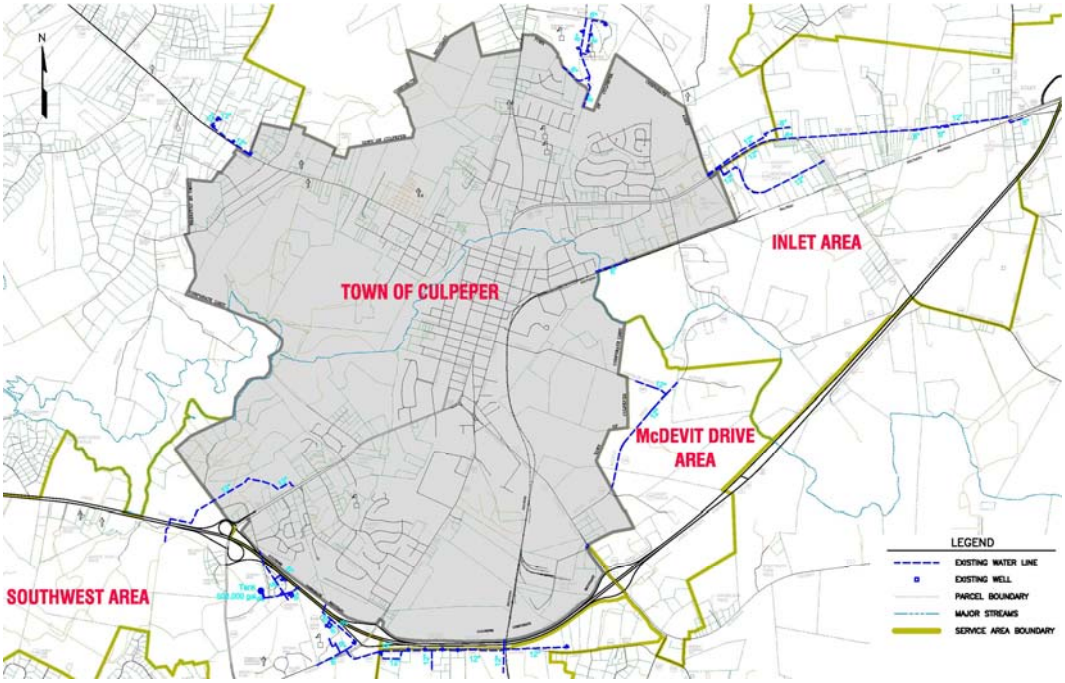
Figure 8-1 Environs Sub-areas



8.2 Existing Water Facilities

The County currently has limited utility services available within the Environs service area. The properties directly adjacent to the Town of Culpeper are currently served by the Town's water system. Figure 8-2 below illustrates the Town's water extensions into the County.

Figure 8-2 Existing Water – Environs

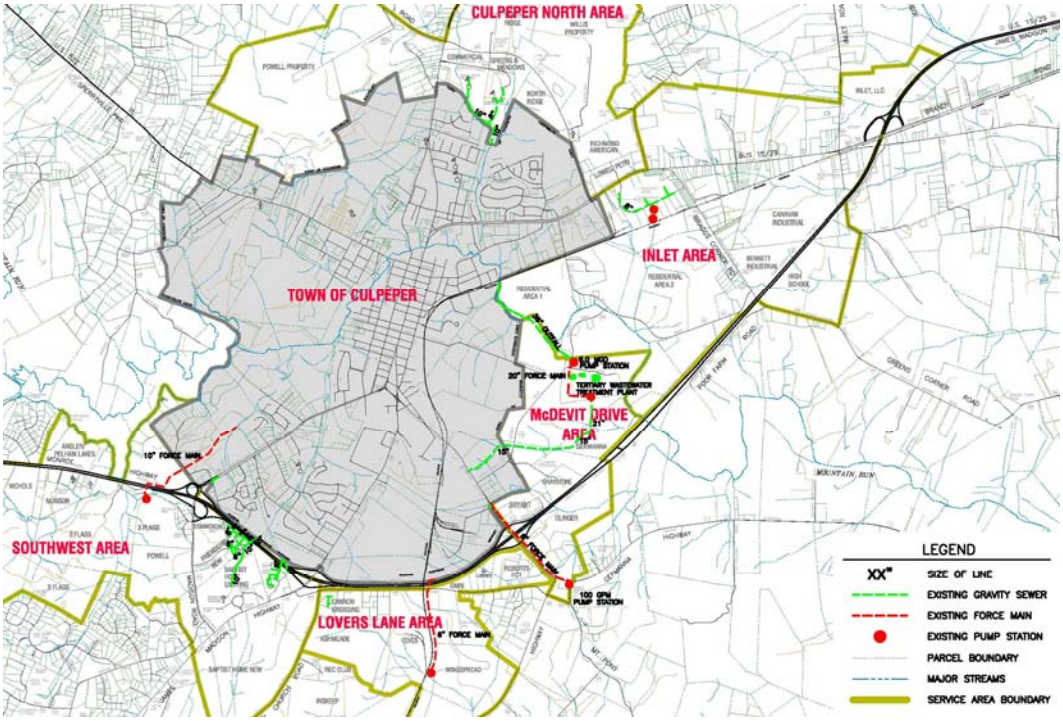


The extensions include a 12-inch main due south of the Town along the U.S. 15/29 corridor, 8-inch and 6-inch extensions clustered between U.S. 15 (James Madison Highway) and Route 299 (Madison Road), a 12-inch main east of Town along Route 799 (McDevitt Drive), two 12-inch mains northeast of Town along the Business 15/29 corridor, 8-inch extensions due north of Town, and a 12-inch extension to the west along State Route 522. They are generally 4,000 to 5,000-foot extensions, with the exception of, the 12-inch main along U.S. 15/29 south which is approximately 7,000 feet long.

8.3 Existing Wastewater Facilities

Much of the Environs are served by on-site drainfields or some other form of on-site treatment. There are no public sewer facilities in the area except for a small portion of the lands directly adjacent to the Town of Culpeper that are served by the Town's system. The areas of Culpeper North, McDevitt, and Southwest, as shown on Figure 8-1, are served by the Town of Culpeper. The existing force main and gravity sewer extensions are shown on Figure 8-3 below.

Figure 8-3 Existing Sewer – Environs



In the Southwest area, the Friendship Heights apartments and the surrounding area are served by an 8-inch gravity sewer. Additionally, the Culpeper Baptist Retirement Community is served by an existing 10-inch gravity sewer line. These lines combine, increasing to a 12-inch diameter gravity sewer just prior to going under U.S. Route 15/29 and into the Town corporate limits. Another 8-inch gravity sewer under U.S. Route 15/29 serves the properties around the Pearl Sample School.

The Culpeper County High School and Junior High School are located in the Culpeper North Area. A 10-inch gravity sewer line extension along Hidens Branch serves the school, as well as properties to the north. The Meadows and Greens townhome developments are served by an 8-inch gravity sewer that feeds into this 10-inch gravity sewer.

The McDevitt Area has several properties served by the Town system. A parcel, located at the intersection of State Route 3 (Germanna Highway) and U.S. Route 522 (Zachary Taylor Highway), is currently served by a pump station and 6-inch force main that discharges into the gravity system at the Town corporate limits. Additionally, the Town's Wastewater Treatment Plant (WWTP) is located in the McDevitt Drive Area. A 36-inch gravity interceptor conveys wastewater from the Town along Mountain Run to a 6.0-mgd pump station just north of the WWTP. The wastewater is then pumped through a 20-inch force main to the headworks of the wastewater treatment plant. The treated effluent is discharged to Mountain Run just north of U.S. Route 15/29.

The County presently owns a parcel of property on Mountain Run approximately 10,000 feet downstream of the Town Treatment Plant discharge point. The County purchased this property for the construction of a wastewater treatment facility. The 20-acre parcel, labeled as the High School Interim WWTP on Figure 8-6, is accessible from Greens Corner Road. The site has been permitted for wastewater discharge under the Virginia Pollution Discharge Elimination System (VPDES). The draft permit (No. VA0092002) includes the following discharge limitations:

Table 8-3 Effluent Discharge Limits for Mt. Run VDPES Permit Design Flow = 0.10MGD

Effluent Characteristic	Discharge Limitations				Instantaneous Limitations	
	Monthly Avg.		Weekly Avg.		Min.	Max.
Flow	None		None		N/A	N/A
CBOD5 (Dec-May)	12.0mg/l	4.5kg/day	18.0mg/l	6.8kg/day	N/A	N/A
CBOD5 (Jun-Nov)	8.0mg/l	3.0kg/day	12.0mg/l	4.5kg/day	N/A	N/A
TSS (Dec-May)	12.0mg/l	4.5kg/day	18.0mg/l	6.8kg/day	N/A	N/A
TSS (Jun-Nov)	8.0mg/l	3.0kg/day	12.0mg/l	4.5kg/day	N/A	N/A
TKN (Dec-May)	8.0mg/l	3.0kg/day	12.0mg/l	4.5kg/day	N/A	N/A
TKN (Jun-Nov)	3.0mg/l	1.1kg/day	4.5.0mg/l	1.7kg/day	N/A	N/A
pH	N/A		N/A		6.0 S.U.	9.0 S.U.
Dissolved Oxygen	N/A		N/A		6.5 mg/l	N/A

The use of this site and the discharge permit will be discussed later in the report under the section Future Wastewater Facilities.

8.4 Future Water Facilities

Water facilities for the Environs utility service area will include supply, treatment, distribution, and storage. The following includes a discussion of each system component and the recommended facilities. Figure 8-5 at the end of this chapter presents a conceptual layout of the future water supply system.

8.4.1 Supply

Water for the Environs utility service area will be supplied by groundwater wells located in the sub-areas they serve. This recommendation is based on the following considerations:

- A surface water supply would consist of a water reservoir and water treatment plant. The associated capital and operating cost for this type of water supply is much higher than groundwater systems.
- Groundwater with adequate water quality and quantity is available for this area.

- The development of groundwater sources can be staged incrementally with the phasing of land development projects. This reduces the initial capital required to develop the water supply system.

A groundwater availability assessment is being performed by Emery & Garrett Groundwater, Inc. to determine the availability and quantity of water in the area. The final report has not been compiled. Preliminary results of the investigation, however, show four primary and five secondary groundwater development zones in or within close proximity to the Environs. The preliminary results are shown on Emery & Garrett's Figure 1 at the end of Chapter 4. The safe yield of each zone has not yet been defined.

A previous groundwater availability assessment was performed for a portion of the Environs and is summarized in a report dated August 1998, entitled *Groundwater Exploration and Development Results of Phase I Investigation.* This assessment identifies five zones that are favorable for development of water resources. Well yield estimates within each selected zone are between 75 gpm and 150 gpm.

The Virginia Department of Health regulations state that a waterworks using well water must calculate the system supply capacity with the largest well out of service. Additionally, the source supply must be able to provide 0.5 gpm per equivalent residential connection. The Culpeper County standards state that a source water supply utilizing only groundwater must have a safe yield of 1.0 gpm per connection. The most stringent standard would apply.

A summary of water demands within the utility service area is included in Table 8-4 below. A detailed list of flows can be found in Appendix A and on Figure 8-4 at the end of this Chapter.

Table 8-4 Projected Average Daily Flow Rate

Sub-area Name	Drainage Basin	Connections	Flow rate (gpd)
Southwest	Hungry Run	1,096	328,800
	Gaines Run	917	275,100
	Buck Run	282	84,600
	Summerduck Run	69	20,700
	Mountain Run	320	96,000
Lovers Lane	Summerduck Run	428	128,400
	Mt. Run - Trib. 1	270	81,000
McDevitt Drive	Mt. Run - Trib. 1	288	86,400
	Mountain Run	256	76,800
Inlet	Mountain Run	838	251,400
	Jonas Run - Trib. 1	240	72,000
	Jonas Run - Trib. 2	436	130,800
	Jonas Run - Trib. 3	269	80,700
Culpeper North	Mountain Run	184	55,200
	Jonas Run	328	98,400
	Hiden Branch	771	231,300
	Balds Run	227	68,100

The connections and flow rates include residential, commercial, and industrial uses. Connections will increase incrementally over a number of years. An estimate of the cumulative connection phasing has been provided in Table 8-5 below.

Table 8-5 Projected Connection Phasing

Year	Cumulative connections					
	Southwest	Lovers Lane	McDevitt Dr.	Inlet	Culp. North	Total
FY 2006	0	0	0	0	0	0
FY 2007	0	0	0	0	0	0
FY 2008	300	0	0	85	301	686
FY 2009	400	0	0	185	401	986
FY 2010	517	75	5	185	436	1,218
FY 2011	1,097	165	5	335	856	2,458
FY 2012	1,643	305	102	350	1,189	3,589
FY 2013	2,004	305	142	400	1,242	4,093
FY 2014	2,154	445	155	440	1,242	4,436
FY 2015	2,154	445	258	640	1,283	4,780
FY 2020	2,404	595	333	1,096	1,333	5,761
FY 2025	2,404	595	408	1,626	1,510	6,543
Later	2,684	698	544	1,783	1,510	7,219

Based on this phasing projection, well sources will be required in 2008. However, if development occurs at a reduced rate, the new well supply could be delayed. Further monitoring of development trends should be performed to more accurately determine the phasing of new groundwater sources. Based on County standards, a total of 7,219 gpm safe yield will be required if the predicted growth occurs. At an average yield of 200 gpm per well, 36 wells will be required to meet this need.

8.4.2 Treatment

The treatment system required for the Environs utility service area will be based on results of sampling performed as new groundwater wells are developed. Design of water treatment processes will be based on concentrations of contaminants including, but not limited to, radon, arsenic, iron, manganese, and radium. The pH of the treated water may also require adjustment to prevent corrosion of the distribution system piping and to avoid violations of the Lead and Copper Rule. In addition, it is recommended that all new groundwater supplies be provided with a disinfection system.

The primary contaminants of concern for groundwater in the Culpeper County region are iron, manganese, and total dissolved solids. These contaminants are considered secondary contaminants by the Virginia Waterworks Regulations. By definition, secondary contaminants are substances involving aesthetics, such as color, staining, taste, and odor. Treatment for removal of excess secondary contaminant concentrations is recommended to insure that aesthetic considerations are satisfied, thereby minimizing customer complaints. Secondary maximum contaminant levels for iron, manganese, and total dissolved solids are presented in Table 8-6.

Table 8-6 Secondary Drinking Water Contaminant Standards

Contaminant	MCL	Units
Iron	0.3	mg/L
Manganese	0.05	mg/L
Total Dissolved Solids	500	mg/L

The 1996 Safe Drinking Water Act (SDWA) amendments direct the Environmental Protection Agency to issue regulations requiring disinfection as necessary for groundwater systems. The Groundwater Rule (GWR) has been developed in response to this regulatory requirement. The regulatory goal of the GWR will be to prevent infective fecal contamination from reaching the consumer. EPA published the Ground Water Rule in the Federal Register on November 8, 2006 with a correction to the table on Analytical Methods for Source Water Monitoring published November 21, 2006. The published regulation promotes a risk-based strategy including periodic evaluation to determine risks, monitoring if risks are found, corrective action if deficiencies are found, and compliance monitoring to ensure viral removal. Disinfection of the groundwater sources may be required to satisfy this regulation and prevent re-growth within the distribution network. Treatment systems would be installed at each groundwater well location to effectively treat the contaminants present at each well. Alternatively, if several wells are within close proximity to each other, they could be piped to a central treatment location. Once well locations, yields, and water quality are determined a more detailed plan of treatment can be established.

8.4.3 Distribution

Figure 8-5 shows the primary water system improvements required to provide the projected water system demands within the Environs service area. The primary distribution lines in the system consist of 8-inch, 12-inch, and 16-inch lines. The pressure zone will match the overflow elevation of the Town of Culpeper at approximately the 620 MSL elevation. All areas of the Environs including Culpeper

North, Southwest, Lovers Lane, McDevitt Drive, and Inlet, generally north of U.S. Route 15/29 and west of State Route 3 (Germanna Highway), will be included in this pressure zone. The ground elevation south of U.S. Route 15/29 and east of State Route 3 (Germanna Highway) is generally below the 400 elevation. A future lower pressure zone could be created for this area to more closely match the topography and support growth.

The proposed improvements to the Environs include a 12-inch loop around the Southwest service area through residential developments and along U.S. Route 15/29. A 12-inch loop around Lover's Lane through industrial properties and along U.S. Route 15/29 will also be constructed. Additionally, a 12-inch transmission main will be installed along State Routes 522 and 615 to serve the Coffeewood Correctional Facility and the Mitchells area. A 16-inch main through the McDevitt Drive area will connect the south and southwestern areas of the Environs to the remaining system including Inlet and Culpeper North. A network of 12-inch lines will serve the Inlet area of the Environs, while a 12-inch and 16-inch line along State Route 694 (Ira Hoffman Lane) will serve the Culpeper North area. An interconnection of the Environs and Brandy Station/Elkwood utility service areas could be installed along Business 15/29 and State Route 684 (Bel Pre Road). This interconnection would provide better system reliability for domestic and fire flow conditions.

8.4.4 Storage

The Virginia Water Works Regulations specify that a water system must have enough storage for a minimum of 200 gallons per equivalent residential connection plus fire flow. Fire flow requirements are dependant on zoning and land use. The Culpeper County Water and Sewer Authority Design Standards specify the storage requirement for domestic and fire flow usage as 400 gallons per equivalent residential connection. These two standards produce different volume requirements; therefore, the larger volume was specified when selecting the tank size. Calculations have been included in the Appendix.

To satisfy the requirements, three elevated water storage tanks are required. The conceptual locations of these tanks are shown on Figure 8-5 and include a 750,000 gallon tank along Route 299 (Madison Road) (ground elevation 490), a 750,000 gallon tank along Route 694 (Ira Hoffman Lane) (ground elevation 530), and a 1,000,000 gallon tank on the western slope of Mt. Pony just off route 658 (Mt. Pony Road) (ground elevation 560). With an overflow at elevation 620, all location below the 550 elevation will be provided the minimum 30 psi pressure requirement. All areas within the Environs utility service area fall below this elevation. With an overflow elevation of 620, the North tank (Ira Hoffman Lane) would have a height of 90 feet, the Southwest tank (Madison Road) would have a height of 130 feet, and the Lovers Lane tank (Mt. Pony Road) would have a height of 60 feet. Initially, the Southwest and North tanks would be constructed with the Lovers Lane tank being installed when demand dictates.

8.5 Future Wastewater Facilities

The collector sewer, interceptor, and treatment facility locations are shown on Figure 8-6. The following is description of the necessary collection and conveyance lines and the required treatment facilities.

8.5.1 Collection and Conveyance

The Environs utility service area is composed of several sewersheds and sub-areas as indicated on Figure 8-4. Wastewater flows have been calculated and facilities sized for each area in accordance with the Culpeper County Water and Sewer Authority design and construction standards.

Within the Southwest area are portions of the Hungry Run, Gaines Run, and Buck Run drainage basins along with small areas draining to the Town and Summerduck Run. Wastewater from the Hungry Run and Gaines Run drainage basin will be pumped via a 16-inch force main to a gravity sewer at U.S. 15 (James Madison Highway). An 18-inch gravity sewer will convey the wastewater across the Lovers Lane area collecting additional flows from industrial users along the route. The gravity sewer will end at the Meadowbrook Interim WWTP

located along U.S. 522 (Zachary Taylor Highway). The interim package wastewater treatment plant will be used to treat all wastewater flows from the southwest and Lovers Lane areas until the Mountain Run Regional WWTP and Mountain Run interceptor are constructed. Once these facilities are built, the Meadowbrook Run Interim Plant will be converted to a wastewater pump station. A force main from the pump station will follow U.S. 522 to its intersection with Germanna Highway. The flow will then enter a 24-inch gravity sewer north of the intersection of U.S. 522 and Germanna Highway. The gravity sewer will connect to the Mountain Run interceptor.

The Culpeper North area contains portions of three drainage basins. Wastewater flows from these basins will be collected and then pumped through an 8-inch diameter force main to a section of gravity sewer along Business 15/29 in the Inlet area. The gravity sewer will discharge to a pump station just north of U.S. Route 15/29 in the basin shown as Jonas Run – Tributary 2 on Figure 6. A 10-inch diameter force main will convey the flow to the Jonas Run – Tributary 1 drainage basin, ultimately being received at the High School Interim WWTP location. The interim or temporary plant will be constructed on a portion of property purchased by the County for a wastewater treatment facility. The property is generally located due south of the intersection of Greens Corner Road and Poor Farm Road. The interim plant will treat all wastewater flows from the Culpeper North and Inlet areas until the Mountain Run Regional WWTP and Mountain Run interceptor are constructed. Once these facilities are in place, the High School Interim WWTP will be removed and the force main connected directly to the Mountain Run interceptor.

Wastewater flows from the northwestern portion of the Inlet area and McDevitt Drive area will be collected by a series of 8-inch to 12-inch diameter gravity sewers. The gravity sewer main will be constructed along Mountain Run, flowing south and east along the stream and under U.S. 15/29. This line will serve as the upper portion of the Mountain Run interceptor.

Town Service

If agreements are made with the Town, it is possible that the Mountain Run interceptor could capture wastewater flow from the Town of Culpeper system. In lieu of the town wastewater plant expansions, the Town could place some or all of their wastewater flow into the Mountain Run interceptor. Calculations have been preformed to determine the effect of this additional flow on the size of the interceptor. Generally, the interceptor north of U.S. 15/29 would increase to 30-inch for 3.0 million gallons per day (MGD) of Town flow, 36-inch for 4.5 MGD, and 36-inch for 6.0 MGD. The interceptor size south of U.S. 15/29 will vary depending on the inflows from contributing sewers. Generally, 3.0 MGD of Town flow will increase this section of interceptor from 30-inch to 42-inch; 4.5 MGD will increase the size from 30-inch to 42-inch with the last several thousand feet having to upsize to 48-inch. An additional flow of 6.0 MGD would require most of the interceptor south of U.S. 15/29 to be upsized to 48-inch diameter. If the Town of Culpeper elects to purchase capacity in the interceptor, the negotiations should take place prior to design and construction of the gravity sewer. Once the interceptor is constructed, future upgrades to increase the interceptor capacity is less feasible, requiring costly parallel lines.

8.5.2 Treatment

The new regional WWTP will discharge directly to Mountain Run, a tributary of the Rappahannock River. Therefore, it will be subject to the requirements of the Chesapeake Bay Tributary Strategy. The VDEQ enacted regulations that placed a cap on waste load allocations and concentration limits for nutrients that are discharged from wastewater treatment plants within the Chesapeake Bay Watershed, classified as significant dischargers. The Mountain Run Regional WWTP is classified as a significant discharger. It has been assigned a Total Nitrogen (TN) allocation of 30,456 pounds per year (4.0 mg/l of TN at 2.5 mgd) and Total Phosphorus (TP) allocation of 2,284 pounds per year (0.30 mg/l TP at 2.5 mgd). However, the allocation is based on the County having a certificate to operate no later than December 31, 2010. The plant will have to meet, as a minimum, a TN limit of 4.0 mg/l and a TP limit of 0.30 mg/l. These limits will

require state-of-the-art enhanced biological nutrient removal. To address these requirements, a set of preliminary screening alternatives were developed. These alternatives were compared in terms of cost, reliability, and ease of operation.

Based on review of existing permit conditions, along with nutrient limits defined in recent legislation, the following effluent limits are anticipated for the design of this facility.

BOD	3 mg/l
TSS	3 mg/l
Total Nitrogen	4 mg/l
Total Phosphorus	0.3 mg/l

A site has been identified for the new Mountain Run Regional WWTP. The site is located due south of Brandy Station approximately 2,500 feet downstream of the confluence of Jonas Run and Mountain Run. It is located in a bend of the stream, on a primarily wooded parcel. The wooded parcel will provide screening and buffering for the surrounding area. The site is shown on Figure 6-6 at the end of Chapter 6 of this report. The County purchased approximately 78 acres for the facility and buffer requirements.

Because of development demand, several interim wastewater treatment facilities will be required until the regional plant can be constructed. These interim plants will treat wastewater from the currently planned development in the Environs and Brandy Station/Elkwood areas. The package plants will be located as previously stated; along U.S. Route 522 (Zachary Taylor Highway) in the Lovers Lane area (Meadowbrook Run Interim WWTP), along Mountain Run, approximately 7,000 feet downstream of U.S. Route 15/29 on the western shore of Mountain Run (High School Interim WWTP). VPDES permits have been requested for the High School and Meadowbrook Interim plant sites. The County is awaiting final approval from the VDEQ concerning these discharge permits.

The Meadowbrook Run Interim Plant could serve the southwest area in addition to industrial flows in the Lovers Lane area. Property for this site has not been obtained. Approximately 2 acres will be required. Design of the site and system components should consider that this interim plant site will be converted to a pump station in the near future. The High School Interim plant will serve the new high school, Inlet area, and Culpeper North area of the Environs. Brandy Station itself will not have sanitary sewer service until after the Mountain Run regional plant and connecting interceptors have been constructed.

The interim plants will consist of skid mounted modular components. They are anticipated to use membrane filter technology to achieve the required nutrient and total suspended solids (TSS) removal. Currently, the criteria for construction of the package plants have been developed. Fabrication of the units can begin when the discharge permits have been obtained from the Department of Environmental Quality. After the Mountain Run regional plant and interceptors are completed, these interim plants can be moved to other unsewered areas, converted to gray water treatment facilities, or sold.

FIGURE 8-4 TOWN ENVIRONS - PROJECTED FLOWS

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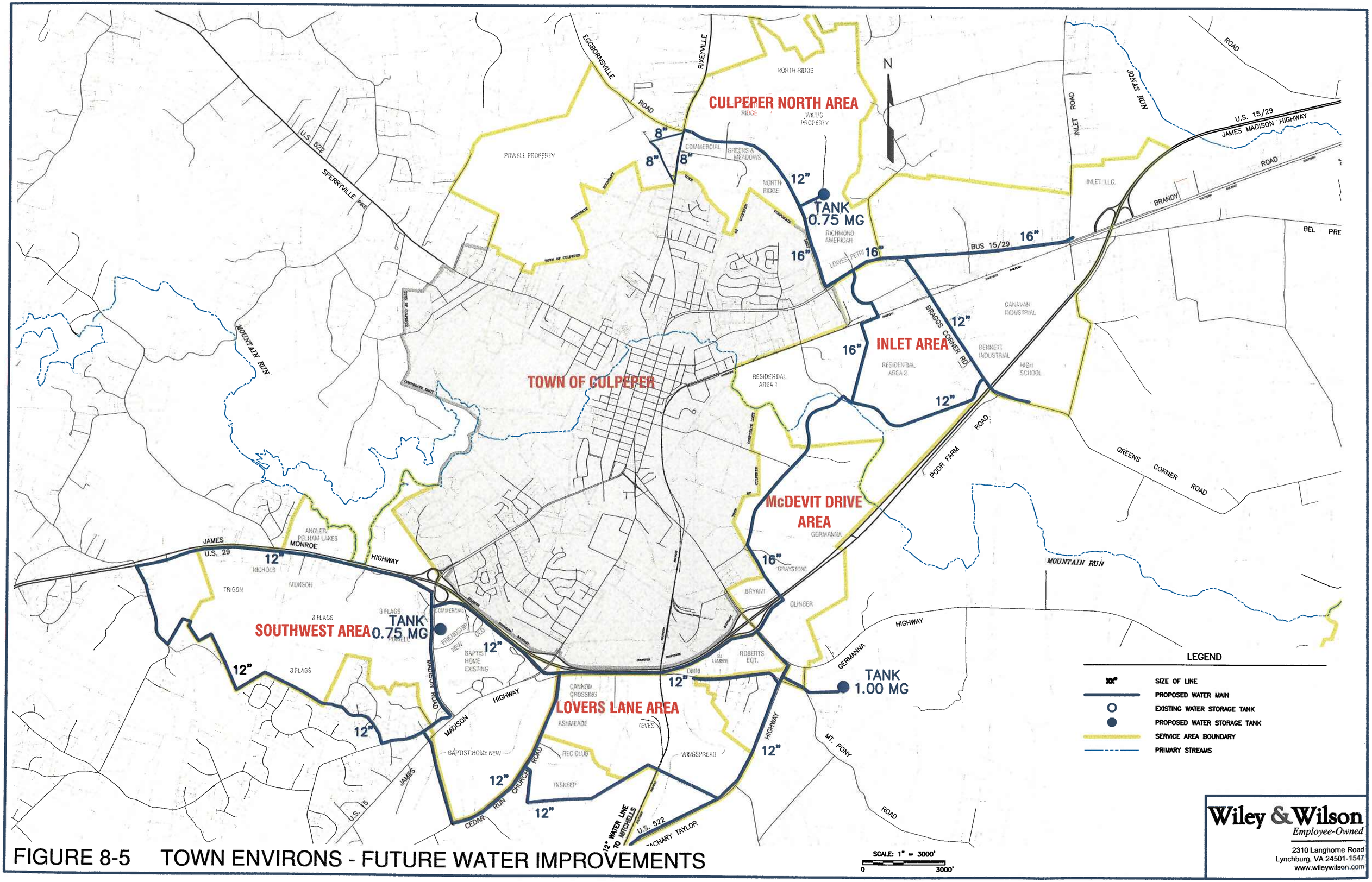

FIGURE 8-5 TOWN ENVIRONS - FUTURE WATER IMPROVEMENTS

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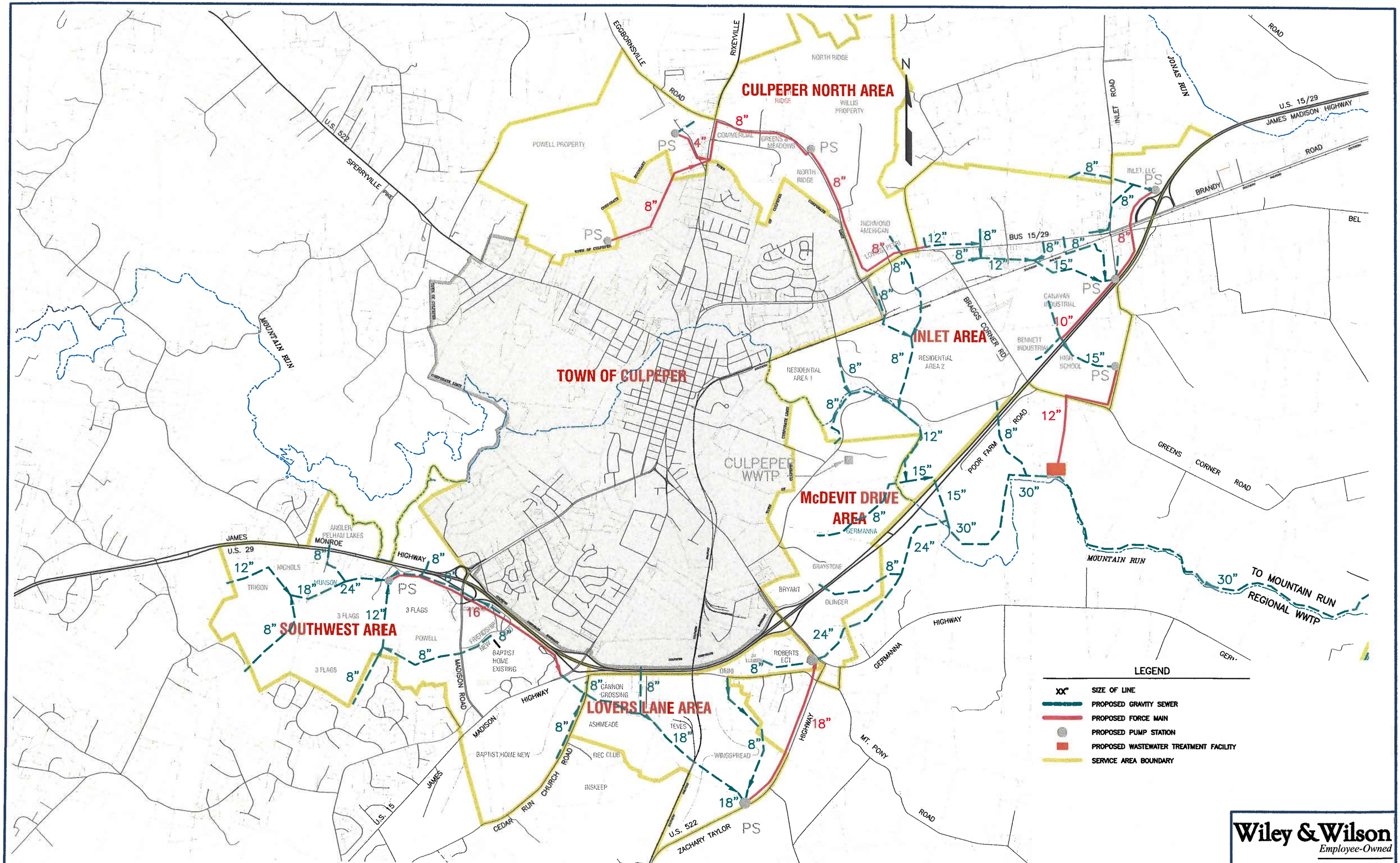

FIGURE 8-6 TOWN ENVIRONS - FUTURE SEWERAGE IMPROVEMENTS

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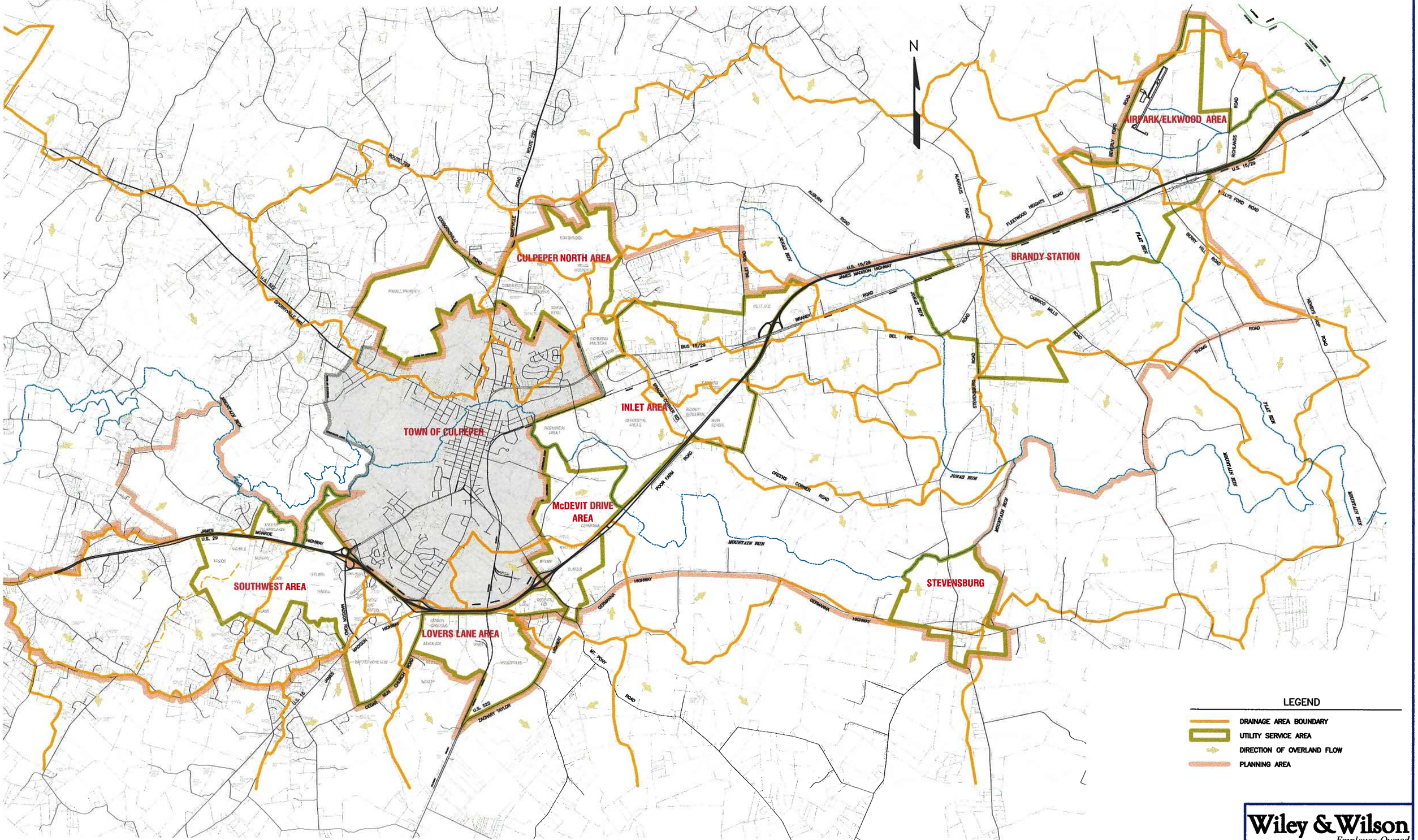

FIGURE 8-7 WATER AND SEWER MASTER PLAN - PLANNING AREA

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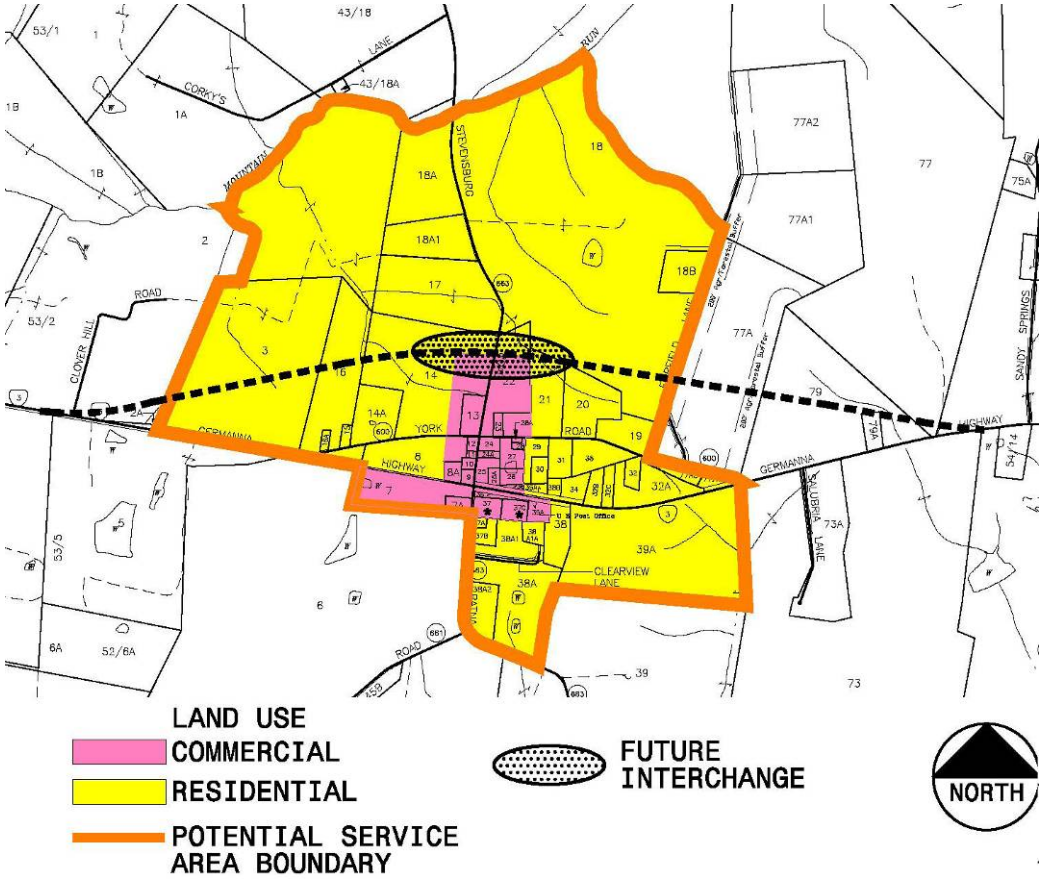
9.0 STEVENSBURG

9.1 Introduction

The Stevensburg Village Center is located approximately 4.5 miles southeast of the Town of Culpeper along Route 3. It is convenient to Fredericksburg and I-95, both accessible by Route 3. The village center includes approximately 625 acres and primarily serves as a residential community with some minor commercial support services. The Stevensburg utility service area corresponds with the village center outline. The heart of this service area is located near the intersection of Route 3 (Germanna Highway) and Route 663 (Stevensburg Road) as shown on Figure 9-1. This intersection is also the location of the commercial development.

The 2005 Comprehensive Plan projects an ultimate equivalent population of 1,540 persons, with 92 percent being residential and 8 percent being commercial. Most of the growth will be focused north of Route 3. However, a four-lane highway bypass planned around the heart of Stevensburg will significantly affect the development plans and patterns. In order to restrict development to a small geographic area, the Comprehensive Plan suggests higher density development within the village center. Water and sewer service are considered essential to support the Comprehensive Plan development. Figure 9-1 presents the village center plan as shown in the Comprehensive Plan.

Figure 9-1 Stevensburg Village Center Plan



When considering utility routes and infrastructure improvements it is necessary to identify their impact on existing historical resources. Chapter 9 of the County Comprehensive Plan lists the historic resources found throughout the County. As listed within this chapter, two significant historical sites can be found in the Stevensburg area. The first site is a Civil War encampment which was located in the northeastern portion of the service area on Hansborough Ridge. The second historic site is a home named Salubria, built in the mid 1740's. It is thought to be the oldest brick house in Culpeper. In addition to these specific sites, the entire crossroads area (intersection of Route 663 and Route 3) of Stevensburg has been listed as an area of historic interest. Further review of these areas may be required if impacted by infrastructure projects.

9.2 Existing Water Facilities

The Stevensburg area is not currently supplied by a public water system. Residents and commercial establishments have individual wells to supply their daily water usage. Increased development and densities require development of a public groundwater well system. Tank storage for water source reliability and fire flow service are also required. The installation of a publicly-owned system will be discussed later in this chapter.

9.3 Existing Wastewater Facilities

The Stevensburg utility service area, as shown on Figure 9-1, is located in three drainage areas. The area north of Route 3 drains into the Mountain Run drainage area, the area south of Route 3 and west of Route 663 drains into the Potato Run drainage area, and the area south of Route 3 and east of Route 663 drains into the Brook Run drainage area. Mountain Run is a tributary of the Rappahannock River and the other streams are tributaries of the Rapidan River. The soil conditions in most of these areas are not considered adequate for the proper operation of septic tank/drainfield systems. This is due to expansive clay soils, 3 to 4 feet deep, overlaying bedrock.

9.4 Future Water Facilities

Water facilities for the Stevensburg utility service area will include supply, treatment, distribution, and storage. The following includes a discussion of each system component and the recommended facilities. Figure 9-3 presents a conceptual layout of the future water supply system.

9.4.1 Supply

Water for the Stevensburg utility service area will be supplied by a groundwater wells system. This recommendation is based on the following considerations:

- A surface water supply would consist of a water reservoir and water treatment plant. The associated capital and operating cost for this type of water supply is much higher than groundwater systems.

- Groundwater with adequate water quality and quantity is available for this area.
- The development of groundwater sources can be staged incrementally with the phasing of land development projects. This reduces the initial capital required to develop the water supply system.

A groundwater availability assessment is being performed by Emery & Garrett Groundwater, Inc. to determine the quantity and availability of groundwater in the Environs and Brandy Station/Elwood service areas. Although outside of this groundwater study area, preliminary results indicate favorable groundwater zones in close proximity to Stevensburg. Preliminary results of the investigation show 2 primary groundwater development zones near the Stevensburg service area. However, the final report has not been compiled and the safe yield of each zone has not been defined.

A previous groundwater availability assessment was performed for this area and is summarized in a report dated August 1998, entitled *Groundwater Exploration and Development Results of Phase I Investigation.* This assessment identifies zones that are favorable for development of water resources. Based on this preliminary investigation, a total yield of 700 gpm could be obtained from a series of wells.

The Virginia Department of Health regulations state that a waterworks using well water must calculate the system supply capacity with the largest well out of service. Additionally, the source supply must be able to provide 0.5 gpm per equivalent residential connection. The Culpeper County standards state that a source water supply utilizing only groundwater must have a safe yield of 1.0 gpm per connection. The most stringent standard would apply.

A summary of water demands within the utility service area is included in Table 9-1 below. A detailed list of flows can be found in Appendix A and on Figure 9-2 at the end of this Chapter.

Table 9-1 Projected Average Daily Flow Rate

Drainage Basin	Connections	Flow rate (gpd)
Mountain Run	503	150,900
Potato Run	71	21,300
Broad Run	51	15,300

The connections and flow rates include residential, commercial, and industrial uses. Connections will increase incrementally over a number of years. An estimate of the cumulative connection phasing has been provided in Table 9-2 below.

Table 9-2 Projected Connection Phasing

Year	Cumulative connections
FY 2006	0
FY 2007	0
FY 2008	0
FY 2009	0
FY 2010	0
FY 2011	0
FY 2012	75
FY 2013	75
FY 2014	150
FY 2015	150
FY 2020	250
FY 2025	250
Later	625

Based on this phasing projection, well sources will be required in 2012. However, if development occurs at a reduced rate, the new well supply could be delayed. Further monitoring of development trends should be performed to more accurately determine the phasing of new groundwater sources. Based on County standards, a total of 625 gpm safe yield will be required if the predicted growth occurs. At an average yield of 200 gpm per well, four wells will be required to meet this need.

9.4.2 Treatment

The treatment system required for the Stevensburg utility service area will be based on results of sampling performed as new groundwater wells are developed. Design of water treatment processes will be based on concentrations of contaminants including, but not limited to, radon, arsenic, iron, manganese, and radium. The pH of the treated water may also require adjustment to prevent corrosion of the distribution system piping and to avoid violations of the Lead and Copper Rule. In addition, it is recommended that all new groundwater supplies be provided with a disinfection system.

The primary contaminants of concern for groundwater in the Culpeper County region are iron, manganese, and total dissolved solids. These contaminants are considered secondary contaminants by the Virginia Waterworks Regulations. By definition, secondary contaminants are substances involving aesthetics, such as color, staining, taste, and odor. Treatment for removal of excess secondary contaminant concentrations is recommended to insure that aesthetic considerations are satisfied, thereby minimizing customer complaints. Secondary maximum contaminant levels for iron, manganese, and total dissolved solids are presented in Table 9-3.

Table 9-3

Secondary Drinking Water Contaminant Standards

Contaminant	MCL	Units
Iron	0.3	mg/L
Manganese	0.05	mg/L
Total Dissolved Solids	500	mg/L

The 1996 Safe Drinking Water Act (SDWA) amendments direct the Environmental Protection Agency to issue regulations requiring disinfection as necessary for groundwater systems. The Groundwater Rule (GWR) has been developed in response to this regulatory requirement. The regulatory goal of the GWR will be to prevent infective fecal contamination from reaching the

consumer. EPA published the Ground Water Rule in the Federal Register on November 8, 2006 with a correction to the table on Analytical Methods for Source Water Monitoring published November 21, 2006. The published regulation promotes a risk-based strategy including periodic evaluation to determine risks, monitoring if risks are found, corrective action if deficiencies are found, and compliance monitoring to ensure viral removal. Disinfection of the groundwater sources may be required to satisfy this regulation and prevent re-growth within the distribution network. Treatment systems would be installed at each groundwater well location to effectively treat the contaminants present at each well. Alternatively, if several wells are within close proximity to each other, they could be piped to a central treatment location. Once well locations, yields, and water quality are determined a more detailed plan of treatment can be established.

9.4.3 Distribution

Figure 9-3 shows the primary water system improvements required to provide the projected water system demands within the Stevensburg utility service area. The primary distribution lines in the system consist of 8-inch and 12-inch lines. The Stevensburg system is shown as an independent water system. However, an extension along Stevensburg Road could connect the Brandy Station and Stevensburg systems if desired. This interconnection would provide backup water supply for both systems and better system reliability. This is recommended if adequate well sources cannot be identified.

9.4.4 Storage

The Virginia Water Works Regulations specify that a water system must have enough storage for a minimum of 200 gallons per equivalent residential connection plus fire flow. Fire flow requirements are dependant on zoning and land use. The Culpeper County Water and Sewer Authority Design Standards specify the storage requirement for domestic and fire flow usage as 400 gallons per equivalent residential connection. These two standards produce different

volume requirements; therefore, the larger volume was specified when selecting the tank size. Calculations have been included in the Appendix.

To satisfy the requirements, a 500,000-gallon elevated water storage tank is required. The conceptual location along Fairfield Lane is shown on Figure 9-3 at the end of this chapter. With an overflow at elevation 490, all location below the 420 elevation will be provided the minimum 30 psi pressure requirement. All areas within the Stevensburg utility service area fall below this elevation. With an overflow elevation of 490, the tank would have a height of 70 feet. A storage tank will be required during the initial development of the water supply system.

9.5 Future Wastewater Facilities

Wastewater generation will be spread across the Stevensburg service area but will be more concentrated near the intersection of Route 3 (Germanna Highway) and Route 663 (Stevensburg Road). Approximately 625 connections are expected at buildout with each connection generating, on average, 300 gallons per day of sewerage. Using these assumptions, the total estimated average daily wastewater flow will be 187,500 gallons per day. The service area will utilize gravity sewers, pump stations, and force mains to convey the wastewater flow to the new Mountain Run Interceptor. Collection and conveyance systems are shown on Figure 9-4. The following is description of the necessary collection and conveyance lines and the required treatment facilities.

9.5.1 Collection and Conveyance

The Stevensburg area contains portions of three drainage basins. The Mountain Run basin consists primarily of lands north of Route 3. Gravity sewers collecting wastewater flows within this basin flow directly to the Mountain Run interceptor. The Potato Run basin is located in the southwestern corner of Stevensburg, south of Route 3 and west of Route 663. Development within that basin will flow by gravity to a wastewater pump station along State Route 663. The pump station will convey the wastewater through a 4-inch diameter force main to a gravity sewer along State Route 3. The Brooke Run basin includes properties

south of Route 3 and east of Route 663. Development within this basin will require a wastewater pump station and force main (not shown). Because only one parcel lies within this basin, the pump station and force main will likely be a private system. The gravity sewer along State Route 3 will convey the wastewater north and west to a gravity sewer flowing to the Mountain Run interceptor.

9.5.2 Treatment

Sewerage from Stevensburg will flow through the Mountain Run interceptor to the new regional WWTP. The new regional WWTP will discharge directly to Mountain Run, a tributary of the Rappahannock River. Therefore, it will be subject to the requirements of the Chesapeake Bay Tributary Strategy. The VDEQ enacted regulations that placed a cap on waste load allocations and concentration limits for nutrients that are discharged from wastewater treatment plants within the Chesapeake Bay Watershed, classified as significant dischargers. The Mountain Run Regional WWTP is classified as a significant discharger and has been assigned a Total Nitrogen (TN) allocation of 30,456 pounds per year (4.0 mg/l of TN at 2.5 mgd) and Total Phosphorus (TP) allocation of 2,284 pounds per year (0.30 mg/l TP at 2.5 mgd). However, the allocation is based on the County having a certificate to operate no later than year 2010. The plant will have to meet, as a minimum, a TN limit of 4.0 mg/l and a TP limit of 0.30 mg/l. These limits will require state-of-the-art enhanced nutrient removal. To address these requirements, a set of preliminary screening alternatives were developed. These alternatives were compared in terms of cost, reliability, and ease of operation.

Based on review of existing permit conditions, along with nutrient limits defined in recent legislation, the following effluent limits are anticipated for the design of this facility.

BOD	3 mg/l
TSS	3 mg/l
Total Nitrogen	4 mg/l
Total Phosphorus	0.3 mg/l

A site has been identified for the new Mountain Run Regional WWTP. The site is located due south of Brandy Station approximately 2,500 feet downstream of the confluence of Jonas Run and Mountain Run. It is located in a bend of the stream, on a primarily wooded parcel. The wooded parcel will provide screening and buffering for the surrounding area. The site is shown on Figure 6-6 at the end of Chapter 6 of this report. The County purchased approximately 78 acres for the facility and buffer requirements.

CORNER ROAD

MOUNTAIN RUN

MOUNTAIN RUN SEWERSHED

MOUNTAIN RUN SEWERSHED

OL
TP

GERMANNA HIGHWAY

Mountain Run
Zoning–R1
503 Acres
503 ERC's
150,900 GPD

Mountain Run
Zoning–Commercial
32 Acres
64,000 GPD
213 ERC's

Potato Run
Zoning–Commercial
18 Acres
36,000 GPD
120 ERC's

Potato Run
Zoning–R1
71 Acres
71 ERC's
21,300 GPD

Brook Run
Zoning–R1
51 Acres
51 ERC's
15,300 GPD

POTATO RUN SEWERSHED

BROOK RUN SEWERSHED

N

LEGEND

- SEWERSHED BOUNDARY LINES
- SERVICE AREA BOUNDARY
- SUB–AREA & FLOW PROJECTION

SCALE: 1" = 1500'
0 1500'

FIGURE 9-2 STEVENSBURG - PROJECTED FLOWS

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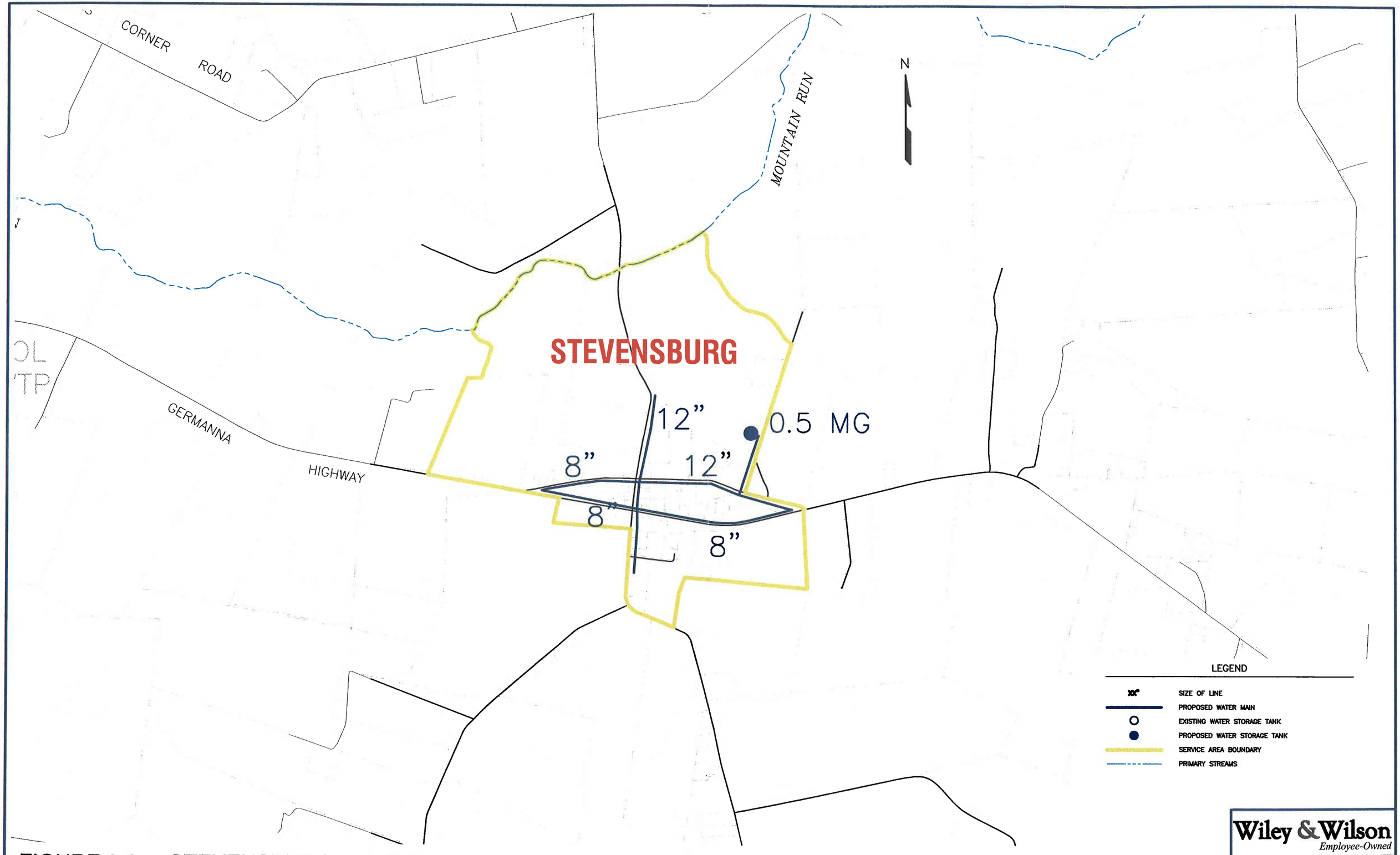

FIGURE 9-3 STEVENSBURG - FUTURE WATER IMPROVEMENTS

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CORNER ROAD

FROM TOWN ENVIRONS

30"

TO MOUNTAIN RUN REGIONAL WWTP

MOUNTAIN RUN

36"

N

36"

8"

STEVENSBURG

8"

8"

8"

8"

4"

8"

8"

OL

TP

GERMANNA HIGHWAY

LEGEND

XX"	SIZE OF LINE
	PROPOSED GRAVITY SEWER
	PROPOSED FORCE MAIN
	PROPOSED PUMP STATION
	PROPOSED WASTEWATER TREATMENT FACILITY
	SERVICE AREA BOUNDARY

SCALE: 1" = 1500'

0 1500'

FIGURE 9-4 STEVENSBURG - FUTURE SEWERAGE IMPROVEMENTS

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10.0 MITCHELLS

10.1 Introduction

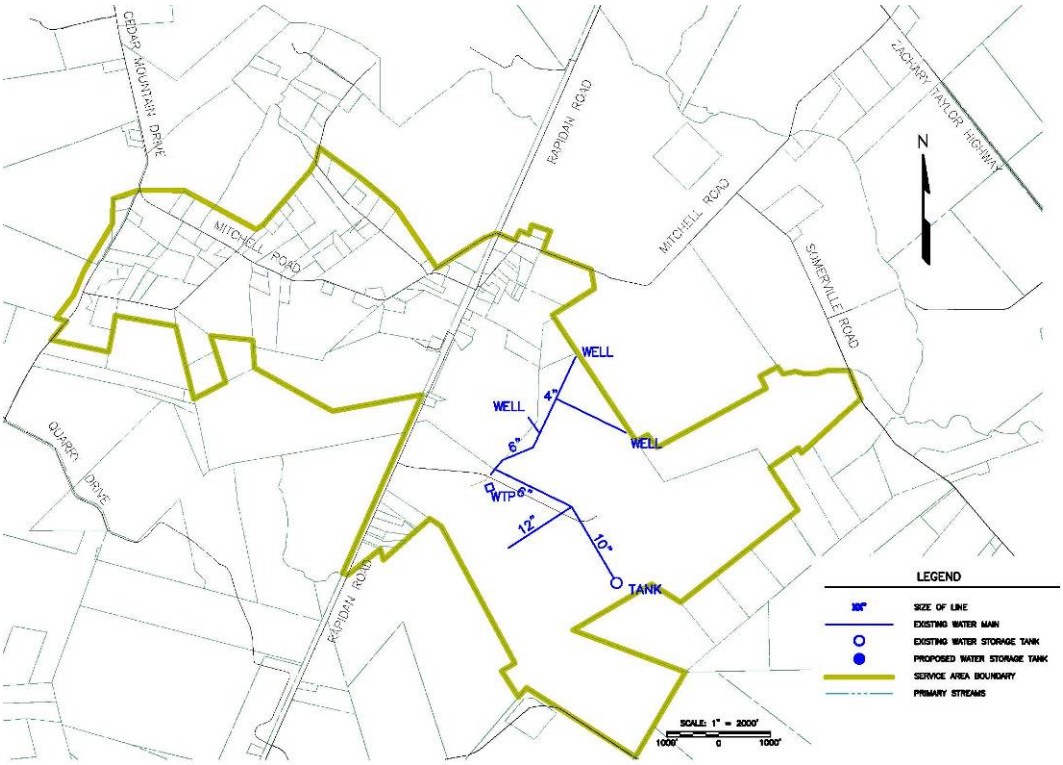
The Mitchells utility service area is defined by the community of Mitchells and the correctional facility to the south and includes approximately 1,000 acres. The area drains almost entirely to Cedar Run, a tributary of the Rapidan River. The Mitchells area is located approximately 5.5 miles south of the Town of Culpeper at the intersection of State Route 615 (Rapidan Road) and State Route 652 (Mitchell Road). It began as a rail stop for the Orange Alexandria Railroad in 1854.

The area has been classified as a convenience center in the 2005 County Comprehensive Plan. The convenience center classification allows for limited local convenience services for rural residents, neighborhood, and community areas. The Coffeewood Correctional Facility located 3/4 miles south of the Mitchells community is a large employer in the area, with nearly 300 employees. Additional convenience services may be added to the Mitchells community to serve this employee base as well as the neighboring areas. Poor soils and existing industrial uses, however, will likely eliminate additional residential growth in this area.

10.2 Existing Water Facilities

The Mitchells service area does not currently have a residential public water system. Residents and commercial establishments have individual wells to supply their daily water usage. The correctional facility does have a community type water system consisting of three wells, a water treatment facility, an elevated water storage tank, and distribution system. This system is capable of supplying the average demand of 156,000 gallons per days and serves the correctional facility only. Figure 10-1 shows the layout of the existing system. The installation of a publicly-owned water supply system will be discussed in greater detail later in this report.

Figure 10-1 Mitchells – Existing water system

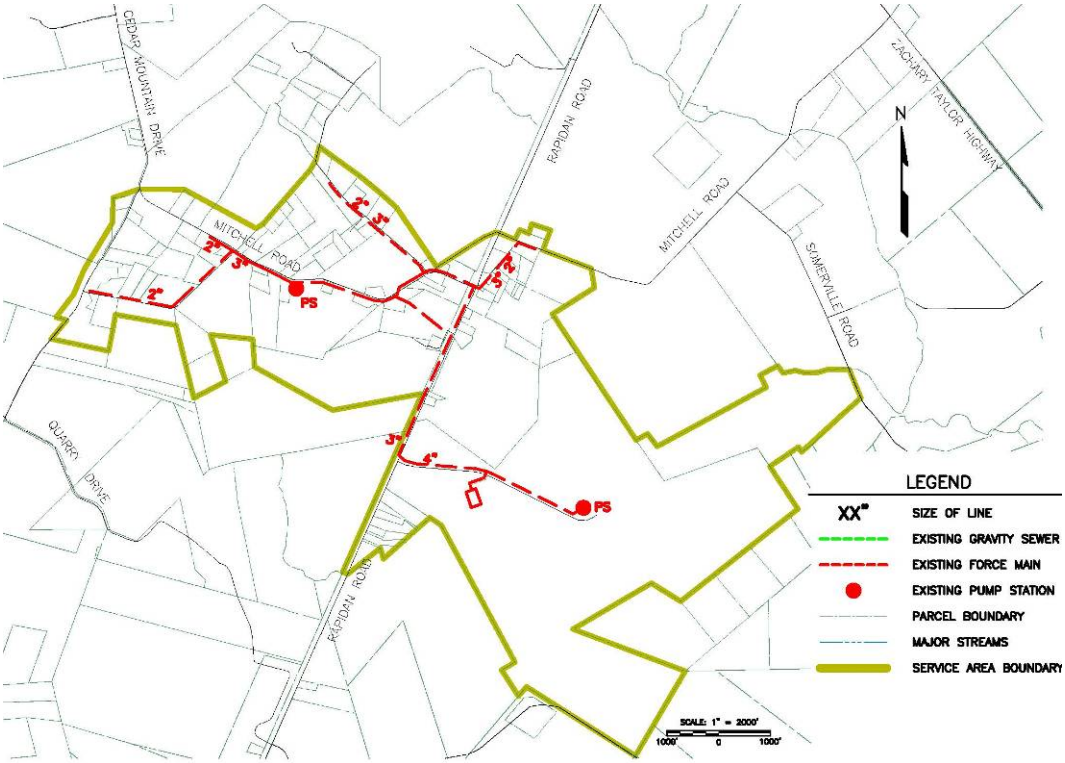


10.3 Existing Wastewater Facilities

The Mitchells service area has limited public sewer availability. Sewer service has been made available to the community through a 20,000 gpd excess capacity at the Coffeewood correctional facility's wastewater treatment plant. Wastewater service was initially made available to alleviate problems with failing drainfields. No new construction will be allowed to connect to the sewer. However, all existing structures are eligible for connection. This policy encourages restoration of existing buildings.

The existing sewer system in Mitchells consists primarily of a pump station and force main. After the sewerage from each connected structure is collected, it is pumped through a force main along Rapidan Road to the correctional facility where is treated at their WWTP. A map of the existing system is shown in Figure 10-2 below.

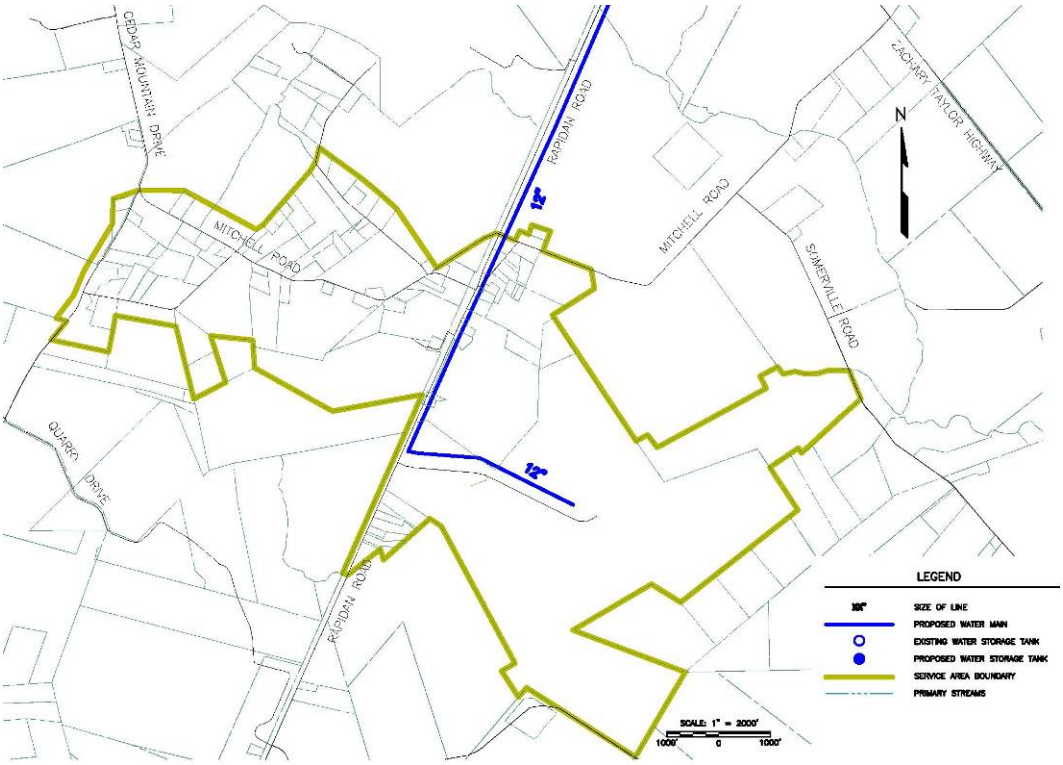
Figure 10-2 Mitchells – Existing sewer system



10.4 Future Water Facilities

Water facilities for the Mitchells Service area will only include distribution improvements. The finished water will be supplied by the Town of Culpeper or County of Culpeper water supply system from the Town Environs area. Therefore, supply sources and treatment will not be developed for this service area. The necessary storage capacity for the area will be achieved through the Department of Corrections elevated tank with a backup supply from the Town or County system. No additional water storage will be required within the service area. Figure 10-3 below presents a conceptual layout of the future water improvements.

Figure 10-3 Mitchells – Future water improvements



10.4.1 Distribution

A 12-inch water main will connect to the existing Town of Culpeper water line located on State Route 686 (Lovers Lane) or a County system from the Town Environs area. The line will follow Route 686 to its intersection with U.S. Route 522, then along Route 522 and State Route 615 to Mitchells, the Coffeewood Correctional Facility, and the new County Jail site.

10.5 Future Wastewater Facilities

No additional wastewater facilities are planned for the Mitchells service area. The current pump station and force main will serve the existing structures.

11.0 FINANCIAL ALTERNATIVES

11.1 Introduction

The next, or subsequent, element to project implementation resulting from the Water and Sewer Master Planning effort is the development of a Capital Improvement Plan (CIP) in order to define the costs of individual projects and their implementation schedule. A crucial extension of the CIP process is the development of a "financing plan" to evaluate the County's financial needs and evaluate potential sources of revenue.

It is extremely important for the County to evaluate funding sources in a manner that not only looks at revenue needed to cover pending expenses, pending debt service, and its operation and maintenance costs, but also its support of a user service fee structure that optimizes its potential for grant and low interest loan assistance from the various agencies and state aid programs. While some of the State's assistance programs are designed to maintain a low service fee or connection charge structure based on the program's benefit function, most assistance programs support the establishment of a "Reasonable and Affordable" User Rates structure for the area.

The County should also evaluate the project's proposed ability to demonstrate how it satisfies the underlying principles and benefit objectives of the various governmental funding programs. While the funding agencies identified in the following segments of this chapter are all geared to assist with the financing of municipal water and/or wastewater improvements, they all operate under a specific governmental service objective or primary benefit focus area. For example:

DEQ's Program(s)	Emphasis on Water Quality Improvements
VDH's Program(s)	Emphasis on Drinking Water and Resolving Public Health Issues
RD's Program(s)	Emphasis on Utility Service Improvement in

	Rural Area
DHCH's Program(s)	Emphasis on LMI Benefit
Tobacco Money	Emphasis on Economic Development in Specific Areas
Bond Pool(s)	Emphasis on Financing – Sufficient Revenue Projections
STAG Program	Emphasis on Water Supply and Wastewater Improvement Benefit Factors

While the CIP is designed to determine project cost and implementation schedule, it also becomes the primary guide to the County as it evaluates the potential financing sources. The CIP/financing plan efforts looks at the potential aid and assistance programs available and evaluates the ability to potentially segment the financing side into different and/or distinct potential project funding arenas. This financial planning effort can be accomplished without potential modification or impact to the County's overall projected schedules, service area need, and project implementation plans.

The financial plan can also identify critical and unique upfront-type requirements that the County must satisfy in order to pursue funding from a specific agency or program. While all the State's aid programs are designed to partner with each other to avoid unnecessary duplication of effort, many carry program specific pre-application type requirements that must be satisfied while the project is in the planning stage. The CIP and financial plan can evaluate the County's efforts required and the degree of probability in satisfying these program specific requirements. This effort will avoid unnecessary project implementation delays when the project is ready to proceed to the construction phase and will allow the County to modify or change its financial resource planning course quickly and efficiently as any future revenue need arises.

As the County evaluates the funding options identified, it is also important to note that many of the agency programs identified do also offer “special assistance” carve-off type grants and loans under a sub-program’s technical assistance initiative where money is potentially available just for the project’s planning and/or design effort. These special types of carve-off grant and loan sub-program initiatives are not included or listed in the following section. Most of the State’s financial aid programs operate in a ready-to-proceed to construction mode, and all generally reimburse the cost for a project’s planning and design effort at the beginning of the construction phase.

As stated, several methods for financing public utility services are available to Virginia’s units of local government. In general, funds to facilitate construction need to be budgeted by the County and are made available through Local Government Bonds, Bond Pools, or through Government Assistance Programs, and/or a combination of these sources.

Establishing user fee rates should also be part of the CIP/financial plan. A detailed rate study should be performed to determine the monthly fee and annual cost and fee escalation. According to the 2006 Virginia Water and Sewer Rate Report, the average combined water and sewer rate in Virginia is $42.77 with a max of $78.25 and minimum of $18.11. Additionally, the Town of Culpeper has an average combined monthly rate of approximately $47.55 as shown in the Rate Report. Boston and Clevengers Corner will consist of developer financed improvements and will therefore be of no significant financial effect to the County. Operation and maintenance costs only will be required of the County and will be paid by user fees in those areas.

11.2 Local Government

Several forms of bonds are available, such as General Obligation Bonds, Revenue Bonds, or a Combination Bond to facilitate water and/or sewer related construction. Revenue must be sufficient to cover debt service, operation and maintenance cost, and allow for normal and routine repairs and replacement costs, or required upgrades to the local infrastructure.

The type of financing arrangement will vary based on budget needs and also vary specific to the type of unit of local government, i.e., city, town, county, or quasi-local governing body such as a Sanitary District or Public Service Authority. The Code of Virginia and its Acts relevant to local government financing set forth certain legal aspects for public financing by these different government bodies and all applicable statutes should be reviewed by specialized legal counsel prior to establishing the type of bond(s) to be marketed.

General Obligation Bonds

Perhaps the best known method of financing water and sewer projects is the General Obligation Bond. These bonds are based on government credit and are backed by the taxing power of the unit of government issuing the bonds. The loan becomes a general obligation of the County and must be repaid without regard to any special fund. The amount of bonds which can be sold varies depending on the issuing body. Towns and cities cannot issue bonds or other interest bearing obligations in an amount greater than 10 percent of the assessed valuation of real estate subject to taxation. Counties have no limitation on the amount as long as the issue is approved by a majority of the voters.

Revenue Bonds

Revenue Bonds are used to finance water and sewer facility construction where the utility service operates as a self-supporting enterprise. Revenue Bonds do not constitute a debt against the borrowing limits of the County. Revenue bonds are viable financing options when projected revenue from connection and service fees are sufficient to meet the total financial obligations of the project.

Sanitary Districts may be further limited by restrictions set forth in its articles of incorporation or formation.

11.3 GOVERNMENT ASSISTANCE PROGRAMS

Several sources of grant and/or loan funding are available to local government for the implementation of a project(s) are discussed hereafter. Many of the financial aid programs discussed are not considered standalone financial initiatives and are dependent on the project size, projected cost, project scope, and local objectives. Most of Virginia's financial aid programs are designed to partner with local revenue and other available assistance programs.

VIRGINIA RESOURCES AUTHORITY (VRA)

Water and Wastewater Facility Improvements

The Virginia Resources Authority manages a Pool Financing Program to issue long-term bonds in the national municipal bond market and lends the proceeds to local government for water and wastewater facility improvements. VRA's Pool Program combines the County's water and/or sewer improvement proposal with other County requests, resulting in reduced issuance cost, competitive interest rates, and loan structuring flexibility. The benefits are subsequently passed on to the recipients in the Pool package. The loan is secured by the moral obligation of the Commonwealth.

VRA offer a year-round application period and provides access to potential interim financing through a VRA Interim Loan Program.

See Table 1 of this chapter for program contact information.

VIRGINIA MUNICIPAL LEAGUE / VIRGINIA ASSOCIATION OF COUNTIES (VML/VaCO)

Water and Wastewater Improvements

The Virginia Municipal League and the Virginia Association of Counties also offer Virginia's local government a Pooled Bond Initiative, providing financing for water and or wastewater improvements. It combines County financial needs with other

projects and issues bonds on a pooled basis, resulting in competitive project interest rates, volume type discounts, shared issuance cost, and an insured AAA rating.

VML/VaCO receives applications throughout the year and offers interim financing through its Commercial Paper Program.

See Table 1 of this chapter for program contact information.

VIRGINIA REVOLVING LOAN FUND (VRLF)

Wastewater Facility Improvements

The Department of Environmental Quality (DEQ) administers a loan fund to assist local government with the implementation of needed wastewater treatment improvements and the construction of related sewer facilities. This financial assistance program is commonly referred to as Virginia's Wastewater Revolving Loan Fund. Eligible local initiatives for funding include any needed plant or sewer conveyance expansion, upgrade, extension, replacement, repair, rehabilitation and/or addition/improvements to a publicly-owned wastewater treatment facility.

Money from this Fund is provided in the form of 20-year low interest loans to local governments for wastewater treatment improvement projects. Proceeds from the Fund are loaned to local government at rates below existing bond market. The Fund's ceiling rate is adjusted at closing to remain at least 1 percent below current market conditions. Lower interest rates, down to a zero percent, or no interest loans, are available to qualifying "financial hardship" recipients and where a major portion of a project is driven by the need to upgrade treatment levels, address a critical, severe, or urgent existing public health hazard or address a wastewater problem which is non-growth related.

This financial aid program operates on a yearly application solicitation cycle. Funding availability is not contingent upon appropriations. A high funding priority is given to projects or proposals that remediate an existing pollution problem, remediate a public health concern, or prevent a future environmental problem.

See Table 1 of this chapter for program contact information.

VIRGINIA WATER SUPPLY REVOLVING LOAN FUND (VWSRLF)

Water Facility Improvements

The Virginia Department of Health (VDH) administers a loan fund to assist local governments with the implementation of water and water supply improvements.

USDA-RURAL DEVELOPMENT (RD)

Water and Wastewater Facility Improvements

The U. S. Department of Agriculture, Office of Rural Development Administration offers loans and/or loan/grants to local government for the construction and/or expansion of water treatment facilities, water supply, storage and water distribution systems. Grant and loan funds are also available for new or expanded wastewater treatment facilities, sewer conveyance infrastructure, and sewer line rehabilitation projects. RD loans and/or grants are available to local government where the proposed service area population or the proposed service district population does not exceed 10,000 persons.

The fund operates with a 3-tiered interest rate structure tied to market conditions based on income levels of the proposed service area and can extend the loan repayment period to 40 years. Grant funding is also available in conjunction with a RD loan. Grants, ranging from 25 percent to 75 percent of a project's eligible cost, are considered where the monthly residential user rates for drinking water and sewer service exceed 1.5 percent of the medium household income (MHI) for the service area and at different thresholds as income levels of the service area are compared to the State Non-Metropolitan Medium Household Income (SNMHI) level. Grant availability is contingent upon appropriation levels.

This financial aid program operates on a yearly appropriation cycle; however, applications are received by RD continuously throughout the year. High funding priority is considered where a local proposal meets the public utility service and

rural development objectives.

See Table 1 of this chapter for program contact information.

VIRGINIA DEPARTMENT OF HEALTH DRINKING WATER FUNDING

The Virginia Department of Health (VDH) has two funding programs for a waterworks owner. The Financial and Construction Assistance Programs (FCAP) consists of the Virginia Drinking Water State Revolving Fund (DWSRF) Program and the Water Supply Assistance Grant (WSAG) Fund Program.

VDH announces funding availability in January of each year.

DRINKING WATER STATE REVOLVING FUND (DWSRF)

Water Facility Improvements

The Virginia Department of Health (VDH) administers a loan fund and offers grant assistance to local governments (waterworks owner) for the implementation of drinking water and water supply improvement projects. Any drinking water project, new and expansion improvements are eligible for assistance through the Department's revolving loan program. Dam construction and associated reservoir proposals are not eligible components of the Department's drinking water loan initiative.

Loans carry an interest rate from 3 percent to program ceiling for a maximum term of 20 years. The programs ceiling rate is generally set at 1 percent below municipal 20 year bond market rates. Disadvantaged loan/grant funding is considered at lower rates and at longer terms, up to 30 years, based on the department's disadvantage community criteria. Factors include cost, MHI of the area and service population. Limited grant assistance under another VDH funding initiative may also be available for surface source water development or improvement type projects.

Applications are received on a year round basis, and funding is authorized yearly. Applications are ranked and prioritized considering resolutions of public

health problems, regulatory noncompliance issues and project affordability. See Table 1 of this chapter for program contact information.

WATER SUPPLY ASSISTANCE GRANT (WSAG) PROGRAM

The Water Supply Assistance Grant Program offers all grant dollars to community waterworks with a successful application.

Construction Assistance

Grants are available for 1) Surface source water development or improvement up to $200,000 and 2) Small construction projects costing no more than $50,000. In addition, Self-Help Construction projects are allowed and are completed with non-contractor related labor.

Non Construction Assistance

Planning/Design Grants are available up to $60,000 per project to be awarded annually.

WATER QUALITY IMPROVEMENT FUND (WQIF)

WWTP Upgrades and Expansions

The Department of Environmental Quality (DEQ) administers a special purpose grant program available to local government to implement wastewater treatment upgrades to achieve nutrient reduction goals of the Chesapeake Bay "Tributary Strategy Plans" or to achieve other water quality restoration, protection, or enhancement benefits. The fund's focus is to assist eligible facility owners with compliance with applicable regulatory requirements for reducing nutrient discharges to the Chesapeake Bay Watershed. Grant participation is limited to an eligible portion of the project cost relating to the design and installation cost of nutrient removal technology. The applicable grant is established at four different percentage thresholds, ranging from 35 percent to 75 percent of eligible cost, as the local government's existing annual sewer charges is compared to guidelines adopted by the State Water Control Board to establish an area's reasonable and affordable sewer user fee.

A small portion of the funds appropriated to create the WQIF is available to Non-Bay related sewer improvement projects and activities.

This financial aid program operates on a State fiscal year appropriation cycle, and applications are solicited from impacted local governments twice a year. High funding priority is given to proposals that clearly demonstrate the likelihood of achieving measurable and specific water quality improvements.

See Table 1 of this chapter for program contact information.

VIRGINIA TOBACCO COMMISSION INDEMNIFICATION FUND

Water and Sewer Facilities

The Virginia Tobacco Indemnification and Community Revitalization Commission administers a grant program aimed at compensating certain localities for the adverse economic effects resulting from the loss of tobacco production opportunities and promotes the revitalization of tobacco dependent communities. Grant funds are available through the Commission primarily to Virginia's Southwest and Southside local governments and public service authority's for new and expanded water and/or sewer facility where the water and/or sewer project scope also achieves or supports the area's economic development or economic revitalization effort.

This program awards grants from the State's Annual Master Settlement Agreement Endowment and application/proposals are considered throughout the year. High priority is given to a proposal where the improved water and sewer infrastructure also creates new employment opportunities for the region.

See Table 1 of this chapter for program contact information.

COMMUNITY DEVELOPMENT BLOCK GRANTS

Water and Sewer Facilities

The Department of Housing and Community Development (DHCD) offers grant funds to local government in a competitive nature to facilitate construction of needed water and/or sewer facilities. The Department's Community Facility Improvement grant initiative is limited to $1,000,000. The scope of work must benefit a low-to-moderate income (LMI) area or LMI residents of the County. The project must serve an area where 51 percent or more of the residents are LMI or where 51 percent or more of the project beneficiaries are LMI residents. Low to moderate income persons are defined as families or individuals whose family income is less than 80 percent of the county or town median family income or 80 percent of the median income of the entire non-metropolitan area of the State, whichever is higher.

This segment of DHCD's financial grant program is contingent upon appropriations, and applications are solicited annually. Funding considerations are competitive. High priority is given to proposals that focus on community facility service improvements to its existing residents and where proposal exceeds the minimum 51 percent LMI benefit factor.

Beginning in fiscal year 2008, DHCD will administer a Special Purpose grant initiative from funds carved out of DEQ's WQIF appropriation and stated for Non-Bay entities and projects. Details of this program aid package are not available at this time.

See Table 1 of this chapter for program contact information.

STATE AND TRIBAL ASSISTANCE GRANTS

Water and Wastewater Facilities

The Environmental Protection Agency (EPA) may provide grant funds to Virginia's local government to facilitate improvements to water and/or wastewater infrastructure. This funding initiative is commonly referred to as a "Federal or

Congressional Earmark Assistance Grant". Money is made available through Federal appropriations identified in the STAG authorization account and designated or budgeted to a specific County/project for a specific task or tasks. Funding is made available and authorized through Congressional sponsorship.

Funding availability is contingent upon the Federal appropriation/budget authorization process. An application for assistance is required. It is, however, processed after the jurisdiction has been named, the Congressional intent is clarified and the amount of the grant has been identified and included in the Federal budget. Higher priority is given to those projects that have attempted to obtain funding from other sources and where access has been denied or deferred, and where project implementation remains critical to a public utility service need or objective of the Community.

The community's contact in this assistance effort is its Congressional representative(s).

Table 11-1 Program Contact Information

Agency	Aid Possible	Purpose	Contact Person	Phone Number
VRA	Loan	Drinking Water & Wastewater	Mr. Mary Barnes	804.644.3331
VML/VaCo	Loan	Drinking Water & Wastewater	Mr. Will Turnage	804.648.0635
VRLF/DEQ	Loan	Wastewater Facilities	Mr. Walter Gills	804.698.4133
WQIF/DEQ	Grant	WWTP Upgrades	Mr. John Kennedy	804.698.4312
VDH	Loan/Grant	Drinking Water Facilities	Mr. Dale Kitchen, P.E.	804.864.7501
RD/USDA	Loan/Grant	Drinking Water & Wastewater	Ms. Carrie Schmidt	804.287.1600
DHCD	Grants	Drinking Water & Wastewater	Ms. Denise Ambrose	804.371.7029
Tobacco Fund	Grants	Drinking Water & Wastewater	Mr. Neal Noyes	804.225.2027

12.0 SYSTEM MANAGEMENT

12.1 Introduction

Although an authority has been established which can manage the proposed improvements discussed in this Water and Sewer Master Plan, other alternatives do exist for system management. This chapter attempts to list the more common means available. However, because legal statutes do change periodically, the information contained in this chapter may or may not be current. Legal advice should be obtained prior to initiating any change in system management and governance. Legal counsel will be able to verify current legal statues and requirements for system operation and management.

Virginia law provides several alternative methods for a political subdivision of the State to acquire, own, and operate systems for the delivery of public utilities. Such public utilities are most often supplied by a utility department under the administrative branch of a given political subdivision. In more rural areas, where only a part of the citizens benefit from the public utilities, one of the other alternatives is often utilized.

There are six basic alternatives authorized by the Code of Virginia that allow one or more political subdivisions to provide public utilities. These alternatives are:

- Service Authorities.
- Sanitary Districts.
- Sanitation Districts.
- Service Districts.
- Multi-Jurisdictional Service Contracts.
- Utilities Departments.

Each of these alternatives has unique features that make it appropriate, or inappropriate, for a given set of circumstances. The apparent "ideal" arrangement provided by a given alternative may well be politically unfeasible

and necessitate some difficult choices for the governing body of a political subdivision.

Narratives provided hereafter, outline general information about each alternative regarding how it is established, the membership involved, the powers associated with it, the financing methods available, and some of the advantages and disadvantages of the alternative. Again, an alternative that may seem technically "ideal" may not be politically feasible.

Several key issues that should be addressed and resolved by Culpeper County in establishing the appropriate operational alternative that provides the desired system management include the following:

- How much direct control and involvement does the Board of Supervisors wish to exercise over the detailed day-to-day operations of county utilities?
- Does the Board desire to be directly involved in each situation of rate setting, fee adjustments, line extensions, budgeting, debt issuance, management issues as would be accomplished through a County Utilities Department, or would it prefer to be less directly involved through the utilization of an Authority Board or a Sanitary District Advisory Group?
- Does the Board prefer to have utility debt count against the County general obligation debt or would it prefer revenue bond financing?
- If revenue bonds are preferred, will the Board be willing to provide start-up funding in the form of low-interest loans or direct grants?
- Will the Board impose mandatory connections?
- Will the Board view the utility as a mechanism to control growth?
- Will the Board view the utility as a self-sustaining, cost-effective, and financially feasible operation?

12.2 Service Authorities

Establishment

Service Authorities are authorized under The Virginia Water and Sewer Authorities Act, Title 15.1-1239 to 15.1-1270, Chapter 28 of the Code of Virginia of 1950 as amended.

Embraced in the concept of a Service Authority is the philosophy that a separate, non-private entity, but one that is political and corporate, could best manage and operate service systems.

One or more political subdivisions may initiate creation of a Service Authority by advertising for public hearing the intent to create such an Authority by ordinance or resolution. If substantial opposition to the creation of the Authority is heard, or if 10 percent of the qualified voters in the political subdivision(s) petition the governing body(ies), then the political subdivision(s) involved must separately and concurrently hold a referendum to consider adoption of the ordinance or resolution to form an Authority. Once approval has been obtained, articles of incorporation must be filed with the State Corporation Commission (SCC) which will issue a certificate of incorporation.

Membership

The governing board of the Service Authority must be composed of at least five members with at least one member from each jurisdiction. The members are chosen by the governing bodies of the jurisdictions who are members of the Authority. Local officials may be members of the Authority Board. Terms of office shall not exceed 4 years.

Once a jurisdiction joins an Authority, it cannot withdraw after the Authority incurs any financial obligation.

Powers

A Service Authority has the power to:

- Exist for 50 years.
- Purchase, lease, construct, acquire, and operate any water system, sewer system, or garbage collection and disposal system, or any combinations of such systems.
- Combine any systems into a single system for the purpose of operation and finance.
- Exercise power of eminent domain (same as is used with the Virginia Department of Transportation - VDOT).
- Contract with owners of other facilities to meet the purposes of the Authority.
- Fix, charge, and collect rates, fees, and charges. If revenue bonds are outstanding, rates are to be fixed and revised only after a public hearing.
- Issue revenue bonds.
- Borrow money.
- Require mandatory connections.
- Impose a lien on real estate if service fees and charges are unpaid.

Financing

A Service Authority can generate local revenue by:

- Borrowing.
- Contracting for services.
- Establishing service charges.
- Issuing revenue bonds.

Revenue bonds may be issued at the discretion of the Authority and neither the Authority nor the proceeds of the bonds, except profit therefrom, are taxable by the State. Although no public hearing is necessary for an Authority to issue revenue bonds, a hearing is necessary to establish or revise service charge rates.

Advantages

- A Service Authority does not depend on a referendum of all the jurisdictions and is not restricted by local debt limits.
- An Authority is permanently binding, once financial obligations are incurred on each of the member jurisdictions, and it has independent power of raising revenue.
- An Authority should make utilities self-sufficient without local government political involvement and interaction on day-to-day operations.
- Capital financing is tax exempt.
- An Authority may have area-wide coverage if several jurisdictions are members.
- An Authority is flexible in the types of services it can offer and the area it covers.
- An Authority is autonomous from the budgetary and administrative constraints of local governments.
- An Authority is a well-known and well-accepted legal and financial entity with major New York bonding agencies.

Disadvantages

- A Service Authority cannot be dissolved as long as any revenue bonds or other debts are outstanding.
- An Authority must exist within the revenues generated by the utility operation and must be self sufficient.
- Where a conflict of boundaries exist between a new Authority and an existing Authority, the two Authorities must amend charters to prevent

duplication of services to the same territory.

- The initial system start up for an Authority is difficult without direct loan or grant assistance from the County.
- If a referendum were called, all the County's voters would have to vote on joining the Authority despite the fact that only a small portion of the jurisdiction's territory may be in the service area of the Authority.
- Financing of an Authority is complex. Interest rates for Authority revenue bonds are higher than general obligation bonds, usually 1/2 to 1 percent. However, Virginia Resources Authority financing rates would be closer to general obligation bond rates. (See Section 11.)
- A Service Authority Board sometimes holds different attitudes toward growth management policies and objectives than would the County Board of Supervisors.
- The governing board of an Authority, once appointed, can become remote from public control and planning guidance.
- An Authority may not respond to requests for service extensions/connections that are considered to be financially unfeasible or have marginal payout projections.

Representative Examples of Authorities:

- Albemarle County Service Authority
- Appomattox River Water Authority
- Bedford County Service Authority
- Blacksburg-Christiansburg-VPI Water Authority
- Campbell County Public Service Authority
- Fairfax County Water Authority
- Fauquier County Water & Sanitation Authority
- Frederick County Service Authority
- Frederick-Winchester Service Authority
- Harrisonburg-Rockingham County Service Authority
- Prince William County Service Authority

- Rapidan Service Authority
- Rappahannock Service Authority
- Rivanna Water and Sewer Authority
- Rockbridge County Service Authority
- Upper Occoquan Service Authority

12.3 Sanitary Districts

Establishment

Sanitary Districts are authorized under Title 21, Chapter 2, Code of Virginia, 1950 as amended.

A Sanitary District is embodied solely within a county although not necessarily comprising the entire county.

To create a Sanitary District, 50 qualified voters of a proposed Sanitary District (or 50 percent of the qualified voters if the proposed district contains less than 100 voters) must petition the circuit court of the county in which the proposed Sanitary District will be established. The court will then fix an appropriate date for a public hearing. After a proper petition and hearing, the court will then confirm or deny creation of the proposed Sanitary District.

A referendum is not required nor can a referendum determine the creation of a Sanitary District.

Membership

Jurisdiction of the Sanitary District is placed under the county's Board of Supervisors.

Powers

A Sanitary District has power to:

- Construct, maintain, and operate water supply; drainage; sewerage; garbage removal and disposal; heat; light; fire fighting systems; power and gas systems; curbs, gutters, sidewalks, and streets; as well as mosquito control for the use and benefit of the public in the Sanitary District.
- Acquire by gift, condemnation, purchase, lease, or otherwise the systems listed above.
- Contract for the above services.
- Require owners or tenants in the district to connect with any system.
- Fix and prescribe user charges and collect fees.
- Levy and collect an annual tax on all property within the Sanitary District that is subject to local taxation.

Financing

A Sanitary District, through its governing body, can generate local revenues by:

- Establishing service charges.
- Levying an annual tax on the property within the district that is subject to local taxation.
- Issue bonds (general obligation or revenue).

A Sanitary District becomes a special taxing district, and the governing body of a Sanitary District can establish service charges at its discretion.

The governing body may also levy an annual tax upon all property in the district subject to local taxation to pay interest on bonds and to make payments into the sinking fund established for paying off the bonds.

A Sanitary District, through its governing body, can issue general obligation bonds, following voter approval, not to exceed a total of 18 percent of the assessed value of real estate within the District. However, the District's governing body can issue revenue bonds not restricted to the 18 percent rate for specific or insufficiently financed projects, following approval of the qualified voters in the District.

Advantages

- A Sanitary District is suitable for a single county or portion of a county. Those served are a distinct group of residents, not scattered bond holders.
- A Sanitary District can provide service for a remote area of a county that has a Utility Department or an Authority.
- A Sanitary District is flexible in regard to bonding and debt limits.
- Taxes of a Sanitary District are imposed on those that benefit directly from services.
- No referendum is required nor is a referendum binding.
- A Sanitary District is subject to the authority of the County Board of Supervisors, thus protecting local interests.
- General obligation bonds usually have a lower interest rate than revenue bonds or Authority bonds.

Disadvantages

- Ever-increasing EPA and State environmental regulations, and demands for building and operating more expensive and complex treatment systems, make the functions of a Sanitary District much more difficult than in past years.
- Fixed boundaries restrict expansion of the Sanitary District, as growth occurs, which requires modification of the Sanitary District boundaries.
- A Sanitary District offers no potential for multi-county use.
- The powers granted a Sanitary District are limited by State statute.

- A Sanitary District creates an additional unit of government.
- Voter approval of a bond referendum is required to issue bonds.
- Sanitary Districts are not as efficient as other management structures when considering economy of scale of the utility operation. If Sanitary Districts are operated with one staff, cost accounting becomes cumbersome (share in pro rata costs for each).
- Sanitary Districts can rely on volunteer citizen advisory groups who could develop a political power base and can become at odds with the policy of other Sanitary Districts or the County government. However, such advisory groups hold no legal standing.
- More than one Sanitary District in a county usually creates different rate structures sometimes causing dissatisfaction with county government.

Representative Examples of Sanitary Districts:

- Amelia Sanitary District - Amelia County
- Colonial Beach and King George Courthouse Sanitary Districts - King George County
- Henrico County Sanitary Districts - Henrico County
- Loudoun County Sanitary Districts - Loudoun County
- Madison Heights Sanitary District - Amherst County
- Milford Sanitary District - Caroline County
- Prince William County Sanitary Districts - Prince William County
- Bull Run Mountain Sanitary District
- Occoquan Forest Sanitary District
- Stoney Creek Sanitary District - Shenandoah County
- York County Sanitary Districts - York County

12.4 Sanitation Districts

Establishment

Sanitation Districts are authorized under two acts depending on the type(s) of bodies of water encompassed:

Sanitation Districts Law of 1938 - Tidal Waters - Title 21, Chapter 3 of the Code of Virginia of 1950 as amended.

Sanitation Districts Law of 1946 - Non-Tidal Waters - Title 21, Chapter 4 of the Code of Virginia of 1950 as amended.

One type of Sanitation District is appropriate where waters within the boundaries of the district are affected by the ebb and flow of the tide, and the other type of Sanitation District is appropriate to free-flowing streams and adjoining land not affected by the ebb and flow of the tide.

The most distinctive difference between the two types of Sanitation Districts, however, is that a Sanitation District Commission formed under the Sanitation District Law of 1938 - Tidal Waters becomes a political subdivision of the State, whereas a Sanitation District Commission formed under the Sanitation Districts Law of 1946 - Non-Tidal Waters, does not become a political subdivision of the State.

To create Sanitation Districts, not less than 200 qualified voters from the proposed Sanitation District nor less than 50 qualified voters of each town, city, or county which would be partially or completely embraced in the proposed Sanitation District must sign a petition to be presented to the appropriate court of any political subdivision partially or completely embraced in the proposed Sanitation District. Upon completion of these requirements, the court will set an appropriate date for a hearing to consider the benefit of the proposed Sanitation District. If the proceedings of the hearing favor creation of the Sanitation District, then the court will order an election. If the election favors creation of the

Sanitation District then the court will appropriately so order and the District will thereby be created.

Membership

Sanitation Districts are governed by a commission of seven members who are residents of the District. The members are appointed by the State Health Commissioner based on one to five recommendations from each local government involved. There must be proportional representation on the governing body, but each component jurisdiction must have at least one representative on the board. The terms are staggered, and last from 1 to 4 years. A Sanitation District can encompass any number of jurisdictions.

Powers

A Sanitation District has the following powers:

- To acquire, construct, maintain, and operate sewer systems.
- To collect, treat, and dispose of sewage from all public systems.
- To acquire treatment facilities by voluntary sale or condemnation.
- To contract with local governments outside its jurisdiction for treatment and disposal of waste.

Financing

A Sanitation District can generate revenues by:

- Borrowing.
- Accepting gifts (or money).
- Establishing service charges.
- Contracting for services.
- Issuing revenue bonds.

A Sanitation District can, without public hearing, establish service charge rates; but, it must hold a public hearing to revise such rates.

Revenue bonds may be issued by a Sanitation District after a successful referendum involving a majority of the qualified voters of the districts.

The bonding limit for a district is $10 million, with a term of 40 years and maximum interest of 6 percent. Such bonds are not a liability of state or local governments; however, there is no legal restriction preventing an individual jurisdiction from assuming the obligations as its own debt.

Advantages

- Sanitation Districts can be used on an area basis.
- Sanitation Districts can be created by special legislation that can provide flexibility to suit the locality.
- The referendum, by which an area joins a Sanitation District, needs to take place only in the area to be served rather than in the entire jurisdiction.

Disadvantages

- Sanitation Districts can be formed only after voter approval.
- The governing body of a Sanitation District is appointed by the State Health Commission.
- Sanitation Districts must operate within a $10 million debt limit.
- Services are limited to the collection, treatment, and disposal of wastewater.
- Sanitation Districts are not political subdivisions of the State. While they do have the power of eminent domain, they do not have the power to levy and collect taxes.
- A referendum is required before a bond issue can be floated.
- A public hearing is required for rate revisions.

Representative Example

- Hampton Roads Sanitation District

12.5 Service Districts

Establishment

Service Districts are authorized under Title 15.1, Chapter 34, Code of Virginia 1950, as amended.

The Service District is the most recent development in institutional arrangements in Virginia. The concept was adopted by the Legislature on the basis of Virginia's need for a mechanism for political subdivisions of the Commonwealth to solve complex urban problems on an integrated basis.

Each Planning District Commission is authorized to prepare a plan for the creation of a Service District within 1 year after requests by two or more governmental subdivisions. The plan must include two or more governmental subdivisions which are members of the Planning District Commission. The Service District plan must include such items as boundaries of election districts, services and functions to be performed, methods of financing, terms of agreements, and a schedule and procedure for presentation of the plan to the governmental subdivisions. The plan must show that the services to be provided will be beneficial to the Service District as a whole.

The plan is submitted to the State for comments and to the governmental subdivisions in the Service District for approval. After approval by all subdivisions, the charter and an informative summary of the plan must be published in newspapers in the Service District. This announcement must be certified by the newspaper for the circuit court judge, who will then order election of officers by the citizens of the governmental subdivisions involved at the next regular November election or at a special election. If a majority of the votes in each governmental subdivision is affirmative, the charter will be adopted.

Membership

The governing board of the Service District is established in the same manner as the governing board of the Planning District Commission. The majority of members are elected by the voters from the governmental subdivisions that comprise the Service District. The number of members is apportioned on the basis of population. These elected members must be qualified voters and residents of the Service District. The remaining official members are members of the governing bodies of the governmental subdivisions. Each county, city, and town of more than 3,500 population has at least one official member appointed by the governing bodies. The qualifications of the elected members shall be the same as those for members of the Senate of Virginia.

Powers

A Service District has the power to:

- Pursuant to Title 25 of the Code of Virginia, property (real or personal) or any estate or interest therein, and for any of the purposes of the District, acquire by purchase, gift, device, or condemnation and to hold, improve, sell, lease, mortgage, pledge, or dispose of them. A Service District is not authorized to acquire by condemnation any public works of political subdivisions which have not adopted the Service District Plan.
- Contract and be contracted with.
- Within the limitations imposed upon cities by the Virginia Constitution, contract debts, borrow money, and make and issue bonds and other evidences of indebtedness.
- Make and enforce all ordinances, rules, and regulations necessary to implement the powers conferred upon the District, and to provide and impose suitable penalties for the violation of these ordinances, rules, and regulations, by fine, not exceeding $1,000; and/or imprisonment in jail, not exceeding 12 months. The District may maintain a suit to restrain by injunction the violation of any ordinance.

Financing

A Service District may finance its operations through:

- Receipt of gifts and grants.
- Levy of an annual assessment operated among its governmental subdivisions on the basis of true value of taxable real estate.
- Collecting rents, fees, or charges for services provided.
- Issuance of bonds.

The Service District is authorized to issue bonds to pay for acquiring, purchasing, constructing, reconstructing, improving, or extending any project and acquiring necessary land and equipment. The Service District may issue many types of bonds including bonds payable as to principal and interest from its revenues generally, exclusively from the income and revenues of a particular project, or exclusively from the income and revenues of certain designated projects. Bonds issued by the District are not the liability of any members, the Commonwealth, or any political subdivision. Bonds are authorized by resolution, mature within 40 years, and bear interest at an annual rate not to exceed 6 percent.

Advantages

- Provides area coverage through a regional governmental entity.
- Eliminates overlap or duplication of services.

Disadvantages

- Service Districts must be approved by a majority of the voters in each jurisdiction in a referendum.
- Service Districts are essentially regional governments which replace the functions of existing local governments.
- Service Districts assume the functions of the Planning District Commissions within the Districts, and the PDCs are terminated.
- No city or town within a Service District has the power to annex territory

within the District without the concurrence of each jurisdiction within the District except in the case of annexation upon the petition by voters.

- The possibility of selling bonds at 6 percent in today's market is limited.

Representative Examples

- None known at this time

12.6 Multi-Jurisdictional Service Contracts

Establishment

There are multiple sources of authority for joint services among jurisdictions. The Joint Powers Act permits counties, cities, or towns to jointly provide any services that are normally provided by each.

A political subdivision may at its own discretion provide public services by:

- Operating such system itself.
- Contracting a private business to operate such system.
- Contracting with another political subdivision for public services.
- Establish a joint services board with one or more political subdivisions for the provision of services.

Any contract between political subdivisions must be entered into voluntarily through the governing bodies involved and must set forth, as nearly as possible, the amount of money necessary as the proportionate part to be provided by each political subdivision to finance the project.

Membership

Virginia law provides authority for cities, towns, and counties to establish a board, commission, or other supervision and management of public improvements projects. Geographic jurisdiction depends upon the number of governmental units party to the service contracts.

Powers

The law provides the following powers:

- Any two or more of the counties, cities, and/or towns of this state, through their respective governing bodies may enter into such contracts and agreements as they may deem proper for or concerning the acquisition, construction, maintenance, and operation of such sewers, pumping stations, ventilation stations, treatment plants, or works.
- The law further provides that the amount of money for these operations and the proportional part to be provided by each contract party shall be set forth in the contract.

Financing

Local governments can utilize any means available under their respective charters to meet obligations under the contract. Specific revenue sources include:

- Borrowing.
- Receipt of gifts.
- Establishment of service charges.
- Issuance of revenue bonds.
- Issuance of general obligation bonds.

Bonds of either type issued by local governments provide for the construction and operating funds, while the service charges constitute the primary source of continuing revenue. Both types of bonds are subject to public approval.

Advantages

- Benefits of a regional system may be readily realized while providing a flexible and enforceable method of cooperation.
- Ownership and accrued equity in existing facilities is maintained within the political subdivisions.

- Basic governmental structures are not changed.
- The responsibility for the operation of the system within a political subdivision lies more closely with the local government.
- The services are provided without adding an additional layer of government.
- The contractees are spared the necessity of using their bonding capacity and credit to develop their own facilities which may be less efficient and duplicative.
- Multi-governmental agreements can often be implemented more quickly and easily than other types of multi-jurisdictional methods.

Disadvantages

- The contractee may be, or feel, at the mercy of the contractor.
- The contractee, to some extent, depends on the contractor's good will and performance when additional facilities or additional services are needed.
- The contractor may be motivated by annexation possibilities which undermine the contractual intent and performance.
- A contractual situation may result in an adverse situation, which would inhibit multi-jurisdictional cooperation. If contracts are not carefully written, misunderstandings may arise.
- Response to expansion needs may be slow or neglected, resulting in frustration and hostility, if the intent of the contract does not promptly satisfy public needs.
- Changing circumstances may create dissatisfaction.
- If each community must borrow, it sometimes may be difficult to raise capital for a particular project.

Representative Examples of Multi-Jurisdictional Service Contracts:

- City of Martinsville Water and Sewer Service to: the Henry County Public Service Authority.

- City of Lynchburg Water and Sewer Service to: the Bedford County Public Service Authority, Amherst County, and the Campbell County Utilities and Service Authority.
- City of Roanoke Sewer Services to: the City of Salem, Roanoke County, and the Town of Vinton.
- City of Petersburg Sewer Services to: the City of Colonial Heights, Dinwiddie County, and Prince George County.
- City of Bristol Sewer Services to: the Washington County Service Authority.
- City of Covington Sewer Services to: Alleghany County.
- Town of Warrenton Water and Sewer Services to: the Fauquier County Public Service Authority.
- Town of Farmville Water and Sewer Services to: Prince Edward County.
- Town of Blacksburg Water and Sewer Services to: the Montgomery County Public Service Authority.

12.7 County Utilities Department

Utility services are provided by many counties, towns, or cities through a Department of Public Utilities or Department of Public Works. A county has the right to develop water and sewer systems and to perform administrative functions such as the collection of fees, service charges, taxes, or other funds required to operate the facilities. The county can also borrow money and issue bonds as prescribed under the Code of Virginia, which is discussed more fully in Section 13 of this report. Under the Code of Virginia Title 15.1-320, Counties are granted specific authority to establish and operate sewage disposal systems.

Features

A Department of Public Utilities is similar to other functional departments of a County in the following ways:

- The Director reports to the County Administrator.

- The Department may borrow money, issue bonds, purchase and condemn property, fix rates, and collect charges.
- The Department may regulate water and sewer services and those functions associated with such services.
- The Department may establish an exclusive service area for water or sewer systems.
- The Department may enter into agreements with other local government entities for water and sewer services.

Advantages

- The county can maintain the maximum control regarding the services to be provided, the area to be served, and the basis for such services.
- The county can provide the "up front" financing so necessary in getting services started for a given area.
- The county can potentially enjoy more favorable interest rates through the use of general obligation bonds.
- The county can provide necessary services to those areas not economically feasible, if it so desires, in order to provide for the health, safety, and welfare of its citizens or for such other reasons as it deems appropriate such as overall planning for potential economic development.
- The county can coordinate utility services with other county departments and public utility service delivery functions.

Disadvantages

- A Department of Public Utilities is dependent on bond issues for its major financing and is restricted by local debt limits if the bonds are of the general obligation type.
- Voter approval of a bond referendum is required for the issuance of general obligation bonds.
- The citizens of various areas often have difficulty appreciating different rates for services for different areas depending on the many factors that

influence votes but are different from area to area.

- The county governing body has decidedly greater responsibilities and accountability when providing water and sewer services through a Department of Public Utilities.

Representative Examples of County Utilities Departments

- Boutetourt County
- Chesterfield County
- Hanover County
- Henrico County
- Roanoke County
- Rockingham County
- Spotsylvania County
- Stafford County

EQUIVALENT RESIDENTIAL CONNECTIONS

Equivalent Residential Connection (ERC's)
for Town Environs Sevice Areas and Sewersheds

Service Areas/ Sewersheds:	Acres	Calculation Method	ERC's	Flow Rate
Southwest/				
Hungry Run				
Comp. Plan Zoning				
Hungry Run	511	Known developments	1030	309000
Hungry Run (C)	66	1.0 ERC per Acre	66	19800
Total Comp. Plan	**577**		**1096**	**328800**
Additional Potential flows				
Hungry Run - Add 1	1008	1.0 ERC per Acre	1008	302400
Hungry Run - Add 2	944	1.0 ERC per Acre	944	283200
Total Additonal	**1952**		**1952**	**585600**
Total of Sewershed	**2529**		**3048**	**914400**
Gaines Run				
Comp. Plan Zoning				
Gaines Run	411	Known developments	600	180000
Gaines (C)	17	1.0 ERC per Acre	17	5100
Gaines R3	75	Known developments	300	90000
Total Comp. Plan	**503**		**917**	**275100**
Additional Potential flows				
Gaines Run - Add 1	432	1.0 ERC per Acre	432	129600
Total Additonal	**432**		**432**	**129600**
Total of Sewershed	**935**		**1349**	**404700**
Buck Run				
Comp. Plan Zoning				
Buck Run	282	1.0 ERC per Acre	282	84600
Total Comp. Plan	**282**		**282**	**84600**
Additional Potential flows				
No additional serice areas	0		0	0
Total Additonal	**0**		**0**	**0**
Total of Sewershed	**282**		**282**	**84600**
Summerduck Run				
Comp. Plan Zoning				
Summerduck R1	69	1.0 ERC per Acre	69	20700
Total Comp. Plan	**69**		**69**	**20700**
Additional Potential flows				
No additional serice areas	0		0	0
Total Additonal	**0**		**0**	**0**
Total of Sewershed	**69**		**69**	**20700**
Mountain Run				
Comp. Plan Zoning				
Angler's	105	1.0 ERC per Acre	105	31500
Town R3	75	2.5 ERC's per Acre	188	56400
Town (C)	27	1.0 ERC per Acre	27	8100
Total Comp. Plan	**207**		**320**	**96000**
Additional Potential flows				
Upper Mt. Run	745	1.0 ERC per Acre	745	223500
Total Additonal	**745**		**745**	**223500**
Total of Sewershed	**952**		**1065**	**319500**

Total of Comp. Plan Service Area	**1638**	**2684**	**805200**
Total of All Sewershed Development	**4767**	**5813**	**1743900**

Sewersheds:	Acres	Calculation Method	ERC's	Flow Rate
Lover's Lane/				
Summerduck Run				
Comp. Plan Zoning				
Lovers Lane Industrial	575	Known developments	403	120900
LL (R1)	25	1.0 ERC per Acre	25	7500
Total Comp. Plan	**600**		**428**	**128400**
Additional Potential flows				
No additional serice areas	0		0	0
Total Additonal	**0**		**0**	**0**
Total of Sewershed	**600**		**428**	**128400**
Mt. Run (Trib. 1)				
Comp. Plan Zoning				
Roberts (C)	85	Known developments	270	81000
Total Comp. Plan	**85**		**270**	**81000**
Additional Potential flows				
No additional serice areas	0		0	0
Total Additonal	**0**		**0**	**0**
Total of Sewershed	**85**		**270**	**81000**
Total of Comp. Plan Service Areas	**685**		**698**	**209400**
Total of All Sewersheds	**685**		**698**	**209400**
McDevitt Drive/				
Mt. Run (Trib. 1)				
Comp. Plan Zoning				
McDevitt 1(C)	93	1.0 ERC per Acre	93	27900
McDevitt 2(C)	113	Known dvlpmnts + 1 ERC/Ac	195	58500
Total Comp. Plan	**206**		**288**	**86400**
Additional Potential flows				
No additional serice areas	0		0	0
Total Additonal	**0**		**0**	**0**
Total of Sewershed	**206**		**288**	**86400**
Mountain Run				
Comp. Plan Zoning				
McDevitt Industrial	366	1.0 ERC per Acre	256	76800
Total Comp. Plan	**366**		**256**	**76800**
Additional Potential flows				
No additional serice areas	0		0	0
Total Additonal	**0**		**0**	**0**
Total of Sewershed	**366**		**256**	**76800**
Total of Comp. Plan Service Area	**572**		**544**	**163200**
Total of All Sewershed Development	**572**		**544**	**163200**

Sewersheds:	Acres	Calculation Method	ERC's	Flow Rate
Inlet/				
Mountain Run				
Comp. Plan Zoning				
Inlet Res. 1	76	2.5 ERC's per Acre	190	57000
Inlet Res. 2	316	1.0 ERC per Acre	316	94800
Inlet Indstrl. 1	431	0.7 ERC's per Acre	302	90600
Inlet Comm.	30	1.0 ERC per Acre	30	9000
Total Comp. Plan	**853**		**838**	**251400**
Additional Potential flows				
Mt. Run Comm.	115	1.0 ERC per Acre	115	34500
Mt. Run 3	650	1.0 ERC per Acre	650	195000
Mt. Run 2	785	1.0 ERC per Acre	785	235500
Mt. Run 1	825	1.0 ERC per Acre	825	247500
Total Additonal	**2375**		**2375**	**712500**
Total of Sewershed	**3228**		**3213**	**963900**
Jonas Run - Tributary 1				
Comp. Plan Zoning				
Inlet Indstrl. 2	173	0.7 ERC's per Acre	121	36300
Inlet - School	186	1.0 ERC/Ac + Scat Reg's	119	35700
Total Comp. Plan	**359**		**240**	**72000**
Additional Potential flows				
Tributary 1 Res. 1	621	1.0 ERC per Acre	621	186300
Tributary 1 Res. 2	496	1.0 ERC per Acre	496	148800
Total Additonal	**1117**		**1117**	**335100**
Total of Sewershed	**1476**		**1357**	**407100**
Jonas Run - Tributary 2				
Comp. Plan Zoning				
Inlet Res. 3	83	1.0 ERC per 3 Acres	28	8400
Inlet Comm. 2	203	1.0 ERC per Acre	203	60900
Inlet Indstrl. 3	293	0.7 ERC per Acre	205	61500
Total Comp. Plan	**579**		**436**	**130800**
Trib. 2 Res. 1	210	1.0 ERC per Acre	210	63000
Trib. 2 Res. 2	327	1.0 ERC per Acre	327	98100
Jonus Run Comm. 2	130	1.0 ERC per Acre	130	39000
Total Additonal	**667**		**667**	**200100**
Total of Sewershed	**1246**		**1103**	**330900**
Jonas Run - Tributary 3				
Comp. Plan Zoning				
Inlet Res. 4	84	1.0 ERC per 3 Acres	28	8400
Inlet Comm. 3	241	1.0 ERC per Acre	241	72300
Total Comp. Plan	**325**		**269**	**80700**
Additional Potential flows				
Tributary 3 Res.	647	1.0 ERC per 3 Acres	216	64800
Jonus Run Comm. 1	355	1.0 ERC per Acre	355	106500
Total Additonal	**1002**		**571**	**171300**
Total of Sewershed	**1327**		**840**	**252000**

Total of Comp. Plan Service Area	**2116**	**1783**	**534900**
Total of All Sewershed Development	**7277**	**6513**	**1953900**

Sewersheds:	Acres	Calculation Method	ERC's	Flow Rate
North Culpeper/				
Mountain Run				
Comp. Plan Zoning				
North 1 Res.	57	Known developments	93	27900
North 1 (C)	91	1.0 ERC per Acre	91	27300
Total Comp. Plan	**148**		**184**	**55200**
Additional Potential flows				
No additional serice areas	0		0	0
Total Additonal	**0**		**0**	**0**
Total of Sewershed	**148**		**184**	**55200**
Jonas Run				
Comp. Plan Zoning				
North 2 Res.	328	1.0 ERC per Acre	328	98400
Total Comp. Plan	**328**		**328**	**98400**
Additional Potential flows				
No additional serice areas	0		0	0
Total Additonal	**0**		**0**	**0**
Total of Sewershed	**328**		**328**	**98400**
Hidens Branch				
Comp. Plan Zoning				
North 3 Residential	293	1.0 ERC per Acre	293	87900
North 2 (C)	23	Known developments	33	9900
North 4 Res.	164	Known developments	445	133500
Total Comp. Plan	**480**		**771**	**231300**
No additional serice areas	0		0	0
Total Additonal	**0**		**0**	**0**
Total of Sewershed	**480**		**771**	**231300**
Balds Run				
Comp. Plan Zoning				
North 5 Res.	682	1.0 ERC per 3 Acres	227	68100
Total Comp. Plan	**682**		**227**	**68100**
Additional Potential flows				
No additional serice areas	0		0	0
Total Additonal	**0**		**0**	**0**
Total of Sewershed	**682**		**227**	**68100**

Total of Comp. Plan Service Area	**1638**	**1510**	**453000**
Total of All Sewershed Development	**1638**	**1510**	**453000**

Equivalent Residential Connection (ERC's)
for Brandy Station/Elkwood Sewersheds

Sewersheds:	Acres	Calculation Method	ERC's	Flow Rate
Hubbard Run				
Comp. Plan Zoning				
Airpark & Industrial	727	0.7 ERC per Acre	509	152700
Elkwood Commercial	145	1.0 ERC per Acre	145	43500
Commercial & Residential	130	Possible developments	3500	1050000
Total Comp. Plan	**1002**		**4154**	**1246200**
Additional Potential flows				
East Industrial	313	0.7 ERC per Acre	200	60000
Total Additonal	**313**		**200**	**60000**
Total of Sewershed	**1315**		**4354**	**1306200**
Flat Run				
Comp. Plan Zoning				
Elkwood Industrial	251	0.7 ERC per Acre	180	54000
Brandy Station (R1)	330	1.0 ERC per Acre	330	99000
Mt. Dumpling (R1)	300	1.0 ERC per Acre	350	105000
Total Comp. Plan	**881**		**860**	**258000**
Additional Potential flows				
North Flat Run	667	1.0 ERC per Acre	667	200100
North Central Flat Run	900	1.0 ERC per Acre	900	270000
South Central Flat Run	693	1.0 ERC per Acre	693	207900
South Flat Run	642	1.0 ERC per Acre	942	282600
Total Additonal	**2902**		**3202**	**960600**
Total of Sewershed	**3783**		**4062**	**1218600**
Jonas Run				
Comp. Plan Zoning				
Brandy Commercial	65	1.0 ERC per Acre	65	19500
West Brandy Industrial	180	0.7 ERC per Acre	126	37800
West Brandy Residential	145	1.0 ERC per Acre	145	43500
Total Comp. Plan	**390**		**336**	**100800**
Additional Potential flows				
Jonas Run Industrial	173	0.7 ERC per Acre	121	36300
Jonas Run Residential	438	1.0 ERC per Acre	438	131400
Total Additonal	**611**		**559**	**167700**
Total of Sewershed	**1001**		**895**	**268500**
Mountain Run				
Comp. Plan Zoning				
South Brandy Station (R1)	87	1.0 ERC per Acre	87	26100
Total Comp. Plan	**87**		**87**	**26100**
Additional Potential flows				
Mountain Run East	600	1.0 ERC per Acre	600	180000
Mountain Run West	593	1.0 ERC per Acre	593	177900
Total Additonal	**1193**		**1193**	**357900**
Total of Sewershed	**1280**		**1280**	**384000**

Total of Comp. Plan Service Areas	**2360**	**5437**	**1631100**
Total of All Sewersheds	**7379**	**10591**	**3177300**

Equivalent Residential Connection (ERC's)
for Stevensburg Sewersheds

Sewersheds:	Acres	Calculation Method	ERC's	Flow Rate
Mountain Run				
Comp. Plan Zoning				
Residential (R1)	471	1.0 ERC per Acre	471	141300
Commercial (C)	32	1.0 ERC per Acre	32	9600
Total Comp. Plan	**503**		**503**	**150900**
Total of Sewershed	**503**		**503**	**150900**
Potato Run				
Comp. Plan Zoning				
Residential (R1)	53	1.0 ERC per Acre	53	15900
Commercial (C)	18	1.0 ERC per Acre	18	5400
Total Comp. Plan	**71**		**71**	**21300**
Total of Sewershed	**71**		**71**	**21300**
Broad Run				
Comp. Plan Zoning				
Residential (R1)	51	1.0 ERC per Acre	51	15300
Total Comp. Plan	**51**		**51**	**15300**
Total of Sewershed	**51**		**51**	**15300**
Total of Comp. Plan Service Areas	**625**		**625**	**187500**
Total of All Sewersheds	**625**		**625**	**187500**

SIZING CALCULATIONS

Service Area	Basin	Block name	Projected flow (gpd)	Peak factor from CCWSA	Peak flow (gpd)	Slope (%)	Theoretical size (in)	Planned Size (in)	80% Capacity (MGD)	80% Velocity (ft/s)
	Jonas Run - Tributary 2	Inlet Res. 3	8,400							
		Inlet Comm. 2	60,900							
		Inlet Indstrl. 3	61,500							
		Sum + North PS flow	**395,100**	4	**1,580,400**	0.3	14.8	15	2.241	3.295
		Pump Station to Jonas, Trib. 1	**540,600**	2.5	**1,351,500**	**PS**		10" FM		
		Trib. 2 Res. 1	63,000	- to Jonas Run Interceptor if built						
		Trib. 2 Res. 2	98,100	- to Jonas Run Interceptor if built						
		Jonus Run Comm. 2	39,000	- to Jonas Run Interceptor if built						
	For gravity line option-no pumped flow, all tributary flow only		595,200	3.35	**1,993,920**	0.45	15	15	2.745	4.036
	Jonas Run Interceptor - Trib. 2 & Trib. 3 Combined flow		**847,200**	2.9	**2,456,880**	0.2	18.9	18	2.976	3.038
	Jonas Run - Tributary 1	Inlet Indstrl. 2	36,300							
		Inlet - School	35,700							
		Sum + Trib 2 PS flow	**612,600**	3.35	**2,052,210**	0.3	16.3	15	2.241	3.295
		Pump Station to High School Interim		2.5	**1,531,500**	**PS**		12" FM		
		Tributary 1 Res. 1	186,300	- to Jonas Run Interceptor if built						
		Tributary 1 Res. 2	148,800	- to Jonas Run Interceptor if built						
	For gravity line option-no pumped flow, all tributary flow only		**407,100**	4	**1,628,400**	0.45	13.9	15	2.745	4.036
	Mt. Run Interceptor - McDevit Int. to High School Interim		**2,423,100**	2.5	**6,057,750**	0.11	29.6	30	8.617	3.167
	Mt. Run Interceptor - at High School Interim		**3,265,200**	2.5	**8,163,000**	0.11	33	30	8.617	3.167
	Pump Station Alternative Option to WWTP			2.5	**8,163,000**	**PS**		20" FM		
	Mt. Run Interceptor - at Stevensburg connection		**3,935,700**	2.5	**9,839,250**	0.11	35.4	36	14.012	3.577
Brandy Station/Elkwood										
	Jonas Run	Brandy Commercial	19500							
		West Brandy Industrial	37800							
		West Brandy Residential	43500							
		Jonas Run Industrial	36300							
		Jonas Run Residential	131400							
	Pump Station -Jonas to Flat Run basin (Brandy Station)		**137,100**	2.5	**342,750**	**PS**		8" FM		
	Jonas Run Int. - lower reach w/upper trib flow pumped to Mt. Run		**910,200**	2.8	**2,548,560**	0.2	19.1	18	2.976	3.038
	Jonas Run Interceptor - lower reach w/all trib gravity flow		**1,522,800**	2.5	**3,807,000**	0.2	22.2	21	4.488	3.367
	****Mt. Run Interceptor - at Jonas Run connection**		**4,845,900**	2.5	**12,114,750**	0.11	38.3	36	14.012	3.577
	Hubbard Run	Airpark & Industrial	152700							
		Elkwood Commercial	43500							
		Commercial & Residential	1050000							
		East Industrial	60000							
			1,306,200	2.55	**3,330,810**	0.2	21.1	21	4.488	3.367
		Pump Station to Flat Run basin		2.5	**3,265,500**	**PS**		16" FM		
	Flat Run	Elkwood Industrial	54000							
		Flat Run Interceptor	**1,560,300**	2.5	**3,900,750**	0.15	23.7	24	5.55	3.187
		Brandy Station (R1)	99000							
		Gravity from Brandy Station	**236,100**	4	**944,400**	0.3	12.2	12	1.236	2.84
		Mt. Dumpling (R1)	105000	- will flow to gravity sewer above WWTP						
		North Flat Run	200100							
		North Central Flat Run	270000							
		South Central Flat Run	207900							
		South Flat Run	282600							
		Pump Station to gravity above WWTP	**2,757,000**	2.5	**6,892,500**	**PS**		20" FM		
	Mountain Run	South Brandy Station (R1)	26100	- gravity flow to WWTP						
		Mountain Run East	180000	- gravity and pump back to WWTP						
		Mountain Run West	177900	- gravity flow to WWTP						
		Brandy Station Interceptor	**2,862,000**	2.5	**7,155,000**	0.75	22	21	8.691	6.519

Service Area	Basin	Block name	Projected flow (gpd)	Peak factor from CCWSA	Peak flow (gpd)	Slope (%)	Theoretical size (in)	Planned Size (in)	80% Capacity (MGD)	80% Velocity (ft/s)
Mountain Run Interceptor with 3.0 MGD from Town										
		Mt. Run Interceptor - north of US 15/29	3,383,400	2.5	8,458,500	0.15	31.6	30	10.062	3.698
		Mt. Run Interceptor - McDevit Int. to High School Interim	5,423,100	2.5	13,557,750	0.11	40	36	14.012	3.577
		Mt. Run Interceptor - at High School Interim	6,265,200	2.5	15,663,000	0.11	42.2	42	21.136	3.964
		Pump Station Alternative Option to WWTP		2.5	15,663,000	PS				
		Mt. Run Interceptor - at Stevensburg connection	6,935,700	2.5	17,339,250	0.11	43.8	42	21.136	3.964
		**Mt. Run Interceptor - at Jonas Run connection	7,845,900	2.5	19,614,750	0.11	45.9	42	21.136	3.964
Mountain Run Interceptor with 4.5 MGD from Town										
		Mt. Run Interceptor - north of US 15/29	4,883,400	2.5	12,208,500	0.15	36.3	36	16.363	4.176
		Mt. Run Interceptor - McDevit Int. to High School Interim	6,923,100	2.5	17,307,750	0.11	43.8	42	21.136	3.964
		Mt. Run Interceptor - at High School Interim	7,765,200	2.5	19,413,000	0.11	45.7	42	21.136	3.964
		Pump Station Alternative Option to WWTP		2.5	19,413,000	PS				
		Mt. Run Interceptor - at Stevensburg connection	8,435,700	2.5	21,089,250	0.11	47.2	42	21.136	3.964
		**Mt. Run Interceptor - at Jonas Run connection	9,345,900	2.5	23,364,750	0.11	49	48	30.175	4.332
Mountain Run Interceptor with 6.0 MGD from Town										
		Mt. Run Interceptor - north of US 15/29	6,383,400	2.5	15,958,500	0.15	40.1	36	16.363	4.176
		Mt. Run Interceptor - McDevit Int. to High School Interim	8,423,100	2.5	21,057,750	0.11	47.1	42	21.136	3.964
		Mt. Run Interceptor - at High School Interim	9,265,200	2.5	23,163,000	0.11	48.8	48	30.175	4.332
		Pump Station Alternative Option to WWTP		2.5	23,163,000	PS				
		Mt. Run Interceptor - at Stevensburg connection	9,935,700	2.5	24,839,250	0.11	50.1	48	30.175	4.332
		**Mt. Run Interceptor - at Jonas Run connection	10,845,900	2.5	27,114,750	0.11	51.8	48	30.175	4.332

Master Plan - Line sizing (Town serving Southwest and Culpeper North)

Service Area	Basin	Block name	Projected flow (gpd)	Peak factor from CCWSA	Peak flow (gpd)	Slope (%)	Theoretical size (in)	Planned Size (in)	80% Capacity (MGD)	80% Velocity (ft/s)
Southwest										
	Hungry Run (to PS)	Hungry Run	309,000							
		Hungry Run (C)	19,900							
		Hungry Run - Add 1	302,400							
		Hungry Run - Add 2	283,200							
			914,400	2.80	**2,560,320**	0.14	20.5	21	3.755	2.847
	Gaines Run (to PS)	Gaines Run	180,000							
		Gaines (C)	5,100							
		Gaines R3	90,000							
		Gaines Run - Add 1	129,600							
			404,700	4.00	**1,618,800**	0.6	13.1	12	1.748	4.016
	Mountain Run (to PS)	Angler's	31,500							
		Town R3	56,400							
		Town (C)	6,100							
		Upper Mt. Run	223,500							
			319,500							
	Hungry Run Pump Station -to Lovers Lane area		**1,638,600**	2.5	**4,096,500**	**PS**		16" FM		
	Buck Run (to LL Int)	Buck Run	**84600**							
	Summerduck Run (to LL Int)	Summerduck R1	**20700**							
Lovers Lane										
	Summerduck Run (to LL Int)	Lovers Lane Industrial	120,900							
		LL (R1)	7,500							
			128,400							
	Lovers Lane Interceptor		**233,700**	4	**934,800**	0.8	10.1	10	1.241	4.106
	Meadowbrook Pump Station -to McDevit		**233,700**	2.5	**584,250**	**PS**		8" FM		
	Mt. Run (Trib. 1) (to McD Int)	Roberts (C)	81,000							
McDevit Drive										
	Mt. Run (Trib. 1) (to McD Int)	McDevit 1(C)	27,900							
		McDevit 2(C)	58,500							
	McDevit Interceptor		**401,100**	4	**1,604,400**	0.4	14.1	15	2.588	3.805
	Mountain Run (to Mt Run Int)	McDevit Industrial	76,800	4	**307,200**	1.5	6	8	0.938	4.845
North Culpeper										
	Balds Run (to PS)	North 5 Res.	68,100	2.5	**170,250**	**PS**		6" FM		
	Hidens Branch (to PS)	North 3 Residential	87,900							
		North 2 (C)	9,900							
		North 4 Res.	133,500	- Going to Town currently						
			97,800							
	Jonas Run (to PS)	North 2 Res.	98,400							
	North Pump Station (to Jonus, Trib 2)		**264,300**	2.5	**660,750**	**PS**		8" FM		
	Mountain Run (to Mt. Run Int)	North 1 Res.	27,900							
		North 1 (C)	27,300							
Inlet										
	Mountain Run (to Mt Run Int)	Inlet Res. 1	57,000							
		Inlet Res. 2	94,800							
		Inlet Indstrl. 1	90,600							
		Inlet Comm.	9,000							
	Mt. Run Interceptor - north of US 15/29		**383,400**	4	**1,533,600**	0.15	16.7	15	1.585	2.33
		Mt. Run Comm.	34,500	- added to Mt. Run interceptor sizing below						
		Mt. Run 3	195,000	- added to Mt. Run interceptor sizing below						
		Mt. Run 2	235,500	- added to Mt. Run interceptor sizing below						
		Mt. Run 1	247,500	- added to Mt. Run interceptor sizing below						
	Jonas Run - Tributary 3 (to PS)	Inlet Res. 4	8,400							
		Inlet Comm. 3	72,300							
		Tributary 3 Res.	64,800							
			145,500	2.5	**363,750**	**PS**		8" FM		
		Jonus Run Comm. 1	106,500	- to Jonas Run Interceptor if built						
	For gravity line option-no pumped flow, all tributary flow only		252,000	4	**1,008,000**	0.2	13.5	12	1.009	2.318

Service Area	Basin	Block name	Projected flow (gpd)	Peak factor from CCWSA	Peak flow (gpd)	Slope (%)	Theoretical size (in)	Planned Size (in)	80% Capacity (MGD)	80% Velocity (ft/s)
	Jonas Run - Tributary 2	Inlet Res. 3	8,400							
		Inlet Comm. 2	60,900							
		Inlet Indstrl. 3	61,500							
		Sum w/o North PS flow	**130,800**	4	**523,200**	0.3	9.8	10	0.76	2.515
		Pump Station to Jonas, Trib. 1	**276,300**	2.5	**690,750**	**PS**		8" FM		
		Trib. 2 Res. 1	63,000	- to Jonas Run Interceptor if built						
		Trib. 2 Res. 2	98,100	- to Jonas Run Interceptor if built						
		Jonus Run Comm. 2	39,000	- to Jonas Run Interceptor if built						
	For gravity line option-no pumped flow, all tributary flow only		330,900	4	**1,323,600**	0.45	12.9	12	1.514	3.478
	Jonas Run Interceptor - Trib. 2 & Trib. 3 Combined flow		**582,900**	3.35	**1,952,715**	0.2	17.3	18	2.976	3.038
	Jonas Run - Tributary 1	Inlet Indstrl. 2	36,300							
		Inlet - School	35,700							
		Sum + Trib 2 PS flow	**348,300**	4	**1,393,200**	0.3	14.1	15	2.241	3.295
		Pump Station to High School Interim		2.5	**870,750**	**PS**		10" FM		
		Tributary 1 Res. 1	186,300	- to Jonas Run Interceptor if built						
		Tributary 1 Res. 2	148,800	- to Jonas Run Interceptor if built						
	For gravity line option-no pumped flow, all tributary flow only		407,100	4	**1,628,400**	0.45	13.9	15	2.745	4.036
	Mt. Run Interceptor - McDevit Int. to High School Interim		**784,500**	3	**2,353,500**	0.11	20.7	21	3.374	2.531
	Mt. Run Interceptor - at High School Interim		**1,362,300**	2.5	**3,405,750**	0.11	23.8	24	4.753	2.729
	Pump Station Alternative Option to WWTP			2.5	**3,405,750**	**PS**		16" FM		
	Mt. Run Interceptor - at Stevensburg connection		**2,032,800**	2.5	**5,082,000**	0.11	27.7	30	8.617	3.167
Brandy Station/Elkwood										
	Jonas Run	Brandy Commercial	19500							
		West Brandy Industrial	37800							
		West Brandy Residential	43500							
		Jonas Run Industrial	36300							
		Jonas Run Residential	131400							
	Jonas Run Int. - lower reach w/upper trib flow pumped to Mt. Run		**910,200**	2.8	**2,548,560**	0.2	19.1	18	2.976	3.038
	Jonas Run Interceptor - lower reach w/all trib gravity flow		**1,258,500**	2.5	**3,146,250**	0.2	20.7	21	4.488	3.367
	****Mt. Run Interceptor - at Jonas Run connection**		**2,943,000**	2.5	**7,357,500**	0.11	31.8	30	8.617	3.167
	Hubbard Run	Airpark & Industrial	152700							
		Elkwood Commercial	43500							
		Commercial & Residential	1050000							
		East Industrial	60000							
			1,306,200	2.55	**3,330,810**	0.2	21.1	21	4.488	3.367
		Pump Station to Flat Run basin		2.5	**3,265,500**	**PS**		16" FM		
	Flat Run	Elkwood Industrial	54000							
		Flat Run Interceptor	**1,360,200**	2.5	**3,400,500**	0.15	22.5	21	3.887	2.916
		Brandy Station (R1)	99000							
		Mt. Dumpling (R1)	105000	- will flow to gravity sewer above WWTP						
		North Flat Run	200100							
		North Central Flat Run	270000							
		South Central Flat Run	207900							
		South Flat Run	282600							
		Pump Station to gravity above WWTP	**2,419,800**	2.5	**6,049,500**	**PS**		20" FM		
	Mountain Run	South Brandy Station (R1)	26100	- gravity flow to WWTP						
		Mountain Run East	180000	- gravity and pump back to WWTP						
		Mountain Run West	177900	- gravity flow to WWTP						
		Brandy Station Interceptor	**2,524,800**	2.5	**6,312,000**	0.75	21	21	8.691	6.519

Service Area	Basin	Block name	Projected flow (gpd)	Peak factor from CCWSA	Peak flow (gpd)	Slope (%)	Theoretical size (in)	Planned Size (in)	80% Capacity (MGD)	80% Velocity (ft/s)
Mountain Run Interceptor with 3.0 MGD from Town										
		Mt. Run Interceptor - north of US 15/29	3,383,400	2.5	8,458,500	0.15	31.6	30	10.062	3.698
		Mt. Run Interceptor - McDevit Int. to High School Interim	3,784,500	2.5	9,461,250	0.11	34.9	36	14.012	3.577
		Mt. Run Interceptor - at High School Interim	4,362,300	2.5	10,905,750	0.11	36.8	36	14.012	3.577
		Pump Station Alternative Option to WWTP		2.5	10,905,750	PS				
		Mt. Run Interceptor - at Stevensburg connection	5,032,800	2.5	12,582,000	0.11	38.9	36	14.012	3.577
		Mt. Run Interceptor - at Jonas Run connection	5,943,000	2.5	14,857,500	0.11	41.4	42	21.136	3.964
Mountain Run Interceptor with 4.5 MGD from Town										
		Mt. Run Interceptor - north of US 15/29	4,883,400	2.5	12,208,500	0.15	36.3	36	16.363	4.176
		Mt. Run Interceptor - McDevit Int. to High School Interim	5,284,500	2.5	13,211,250	0.11	39.6	36	14.012	3.577
		Mt. Run Interceptor - at High School Interim	5,862,300	2.5	14,655,750	0.11	41.1	42	21.136	3.964
		Pump Station Alternative Option to WWTP		2.5	14,655,750	PS				
		Mt. Run Interceptor - at Stevensburg connection	6,532,800	2.5	16,332,000	0.11	42.8	42	21.136	3.964
		Mt. Run Interceptor - at Jonas Run connection	7,443,000	2.5	18,607,500	0.11	45	42	21.136	3.964
Mountain Run Interceptor with 6.0 MGD from Town										
		Mt. Run Interceptor - north of US 15/29	6,383,400	2.5	15,958,500	0.15	40.1	36	16.363	4.176
		Mt. Run Interceptor - McDevit Int. to High School Interim	6,784,500	2.5	16,961,250	0.11	43.5	42	21.136	3.964
		Mt. Run Interceptor - at High School Interim	7,362,300	2.5	18,405,750	0.11	44.8	42	21.136	3.964
		Pump Station Alternative Option to WWTP		2.5	18,405,750	PS				
		Mt. Run Interceptor - at Stevensburg connection	8,032,800	2.5	20,082,000	0.11	46.3	42	21.136	3.964
		Mt. Run Interceptor - at Jonas Run connection	8,943,000	2.5	22,357,500	0.11	48.2	48	30.175	4.332

Master Plan - Line sizing (potential flows)

Service Area	Basin	Block name	Projected flow (gpd)	Peak factor from CCWSA	Peak flow (gpd)	Slope (%)	Theoretical size (in)	Planned Size (in)	80% Capacity (MGD)	80% Velocity (ft/s)
Southwest										
	Hungry Run (to PS)	Hungry Run	309,000							
		Hungry Run (C)	19,800							
		Hungry Run - Add 1	302,400							
		Hungry Run - Add 2	283,200							
			914,400	2.80	**2,560,320**	0.14	20.5	21	3.755	2.817
	Gaines Run (to PS)	Gaines Run	180,000							
		Gaines (C)	5,100							
		Gaines R3	90,000							
		Gaines Run - Add 1	129,600							
			404,700	4.00	**1,618,800**	0.6	13.1	12	1.748	4.016
	Mountain Run (to PS)	Angler's	31,500							
		Town R3	56,400							
		Town (C)	8,100							
		Upper Mt. Run	223,500							
			319,500							
	Hungry Run Pump Station -to Lovers Lane area		**1,638,600**	2.5	**4,096,500**	**PS**		16" FM		
	Buck Run (to LL Int)	Buck Run	**84600**							
	Summerduck Run (to LL Int)	Summerduck R1	**20700**							
Lovers Lane										
	Summerduck Run (to LL Int)	Lovers Lane Industrial	120,900							
		LL (R1)	7,500							
			128,400							
	Lovers Lane Interceptor		**1,872,300**	2.5	**4,680,750**	0.8	18.5	18	5.951	6.076
	Meadowbrook Pump Station -to McDevit		**1,872,300**	2.5	**4,680,750**	**PS**		18" FM		
	Mt. Run (Trib. 1) (to McD Int)	Roberts (C)	81,000							
McDevit Drive										
	Mt. Run (Trib. 1) (to McD Int)	McDevit 1(C)	27,900							
		McDevit 2(C)	58,500							
	McDevit Interceptor		**2,039,700**	2.5	**5,099,250**	0.4	21.8	21	6.347	4.761
	Mountain Run (to Mt Run Int)	McDevit Industrial	76,800	4	**307,200**	1.5	6	8	0.938	4.845
North Culpeper										
	Balds Run (to PS)	North 5 Res.	68,100	2.5	**170,250**	**PS**		6" FM		
	Hidens Branch (to PS)	North 3 Residential	87,900							
		North 2 (C)	9,900							
		North 4 Res.	133,500	- Going to Town currently						
			97,800							
	Jonas Run (to PS)	North 2 Res.	98,400							
	North Pump Station (to Jonus, Trib 2)		**264,300**	2.5	**660,750**	**PS**		8" FM		
	Mountain Run (to Mt. Run Int)	North 1 Res.	27,900							
		North 1 (C)	27,300							
Inlet										
	Mountain Run (to Mt Run Int)	Inlet Res. 1	57,000							
		Inlet Res. 2	94,800							
		Inlet Indstrl. 1	90,600							
		Inlet Comm.	9,000							
	Mt. Run Interceptor - north of US 15/29		**383,400**	4	**1,533,600**	0.15	16.7	15	1.585	2.33
		Mt. Run Comm.	34,500	- added to Mt. Run interceptor sizing below						
		Mt. Run 3	195,000	- added to Mt. Run interceptor sizing below						
		Mt. Run 2	235,500	- added to Mt. Run interceptor sizing below						
		Mt. Run 1	247,500	- added to Mt. Run interceptor sizing below						
	Jonas Run - Tributary 3 (to PS)	Inlet Res. 4	8,400							
		Inlet Comm. 3	72,300							
		Tributary 3 Res.	64,800							
			145,500	2.5	**363,750**	**PS**		8" FM		
		Jonus Run Comm. 1	106,500	- to Jonas Run Interceptor if built						
	For gravity line option-no pumped flow, all tributary flow only		252,000	4	**1,008,000**	0.2	13.5	12	1.009	2.318

WATER STORAGE REQUIREMENTS

Water Storage Requirements

Area	ERC's	Residential Storage	Fire flow	Total storage for area	County standard	Storage tanks required			
		ERC's x 200gal/Conn	2000gpm for 2hr-residential 4000gpm for 3hr-industrial		ERC's x 400gal/Conn	Quantity	Size	Location	Approx. height
Southwest	2684	540000	240,000	780,000	1,073,600	1	0.75 MG	Lake Vista	120 ft
Lovers Lane	698	140000	720,000	860,000	279,200				
McDevitt Lane	544	110000	720,000	830,000	217,600	1	1.00 MG	Mt. Pony	70 ft
Inlet	1783	360000	240,000	600,000	713,200				
Culpeper North	1510	310000	240,000	550,000	604,000	1	0.75 MG	Cleveland Lane	100 ft
Brandy Station/Elkwood	5437	1090000	720,000	1,810,000	2,174,800	1	1.00 MG	Airpark	160 ft
						1	0.75 MG	Mt. Dumpling	100 ft
Stevensburg	625	130000	240,000	370,000	250,000	1	0.50 MG	Stevensburg	100 ft

UNIT COSTS

Wiley & Wilson
Employee-Owned

DESIGN CALCULATIONS

1. Gravity Sewer Unit Costs

8-inch gravity sewer

8" PVC Sewer	$37.60	
Manholes with Frame and Cover, 1/250 ft, 8 vft	$9.35	
Extra Depth trench excavation (8-16 ft) 0.12 cy/ft	$1.80	
Rock Excavation by Hoeramming 0.05 cy/ft	$4.38	
Clearing and Grubbing 6.88 X 10^{-4} ac/ft	$1.66	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$3.45	
Sub-total:	$65.72	
Project Markup (25%)	$16.43	
Sub-total:	$82.15	
Contingency (15%)	$12.32	
Total:	$94.47	Use $95.00

10-inch gravity sewer

10" PVC Sewer	$48.10	
Manholes with Frame and Cover, 1/250 ft, 8 vft	$7.60	
Extra Depth trench excavation (8-16 ft) 0.14 cy/ft	$2.10	
Rock Excavation by Hoeramming 0.06 cy/ft	$5.28	
Clearing and Grubbing 6.88 X 10^{-4} ac/ft	$1.66	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$3.45	
Sub-total:	$75.67	
Project Markup (25%)	$18.92	
Sub-total:	$94.59	
Contingency (15%)	$14.19	
Total:	$108.78	Use $109.00

12-inch gravity sewer

12" PVC Sewer	$52.50	
Manholes with Frame and Cover, 1/250 ft, 8 vft	$7.60	
Extra Depth trench excavation (8-16 ft) 0.14 cy/ft	$2.10	
Rock Excavation by Hoeramming 0.06 cy/ft	$5.28	
Clearing and Grubbing 6.88 X 10^{-4} ac/ft	$1.66	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$3.45	
Sub-total:	$80.07	
Project Markup (25%)	$20.02	
Sub-total:	$100.09	
Contingency (15%)	$15.01	
Total:	$115.10	Use $115.00

15-inch gravity sewer

15" PVC Sewer	$55.70	
Manholes with Frame and Cover, 1/250 ft, 8 vft	$7.60	
Extra Depth trench excavation (8-16 ft) 0.16 cy/ft	$2.40	
Rock Excavation by Hoeramming 0.06 cy/ft	$5.28	
Clearing and Grubbing 9.18 X 10^{-4} ac/ft	$2.21	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 4.44 sy/ft	$4.60	
Sub-total:	$85.27	
Project Markup (25%)	$21.32	
Sub-total:	$106.59	
Contingency (15%)	$15.99	
Total:	$122.58	Use $123.00

18-inch gravity sewer

18" Class III RCP	$68.90	
Manholes with Frame and Cover, 1/250 ft, 8 vft	$7.60	
Extra Depth trench excavation (8-16 ft) 0.16 cy/ft	$2.40	
Rock Excavation by Hoeramming 0.06 cy/ft	$5.28	
Clearing and Grubbing 9.18 X 10^{-4} ac/ft	$2.21	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 4.44 sy/ft	$4.60	
Sub-total:	$98.47	
Project Markup (25%)	$24.62	
Sub-total:	$123.09	
Contingency (15%)	$18.46	
Total:	$141.55	Use $142.00

24-inch gravity sewer

24" Class III RCP	$84.00	
Manholes with Frame and Cover, 1/250 ft, 8 vft	$7.60	
Extra Depth trench excavation (8-16 ft) 0.18 cy/ft	$2.70	
Rock Excavation by Hoeramming 0.08 cy/ft	$7.04	
Clearing and Grubbing 11.48 X 10^{-4} ac/ft	$2.77	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 5.55 sy/ft	$5.75	
Sub-total:	$117.34	
Project Markup (25%)	$29.34	
Sub-total:	$146.68	
Contingency (15%)	$22.00	
Total:	$168.68	Use $169.00

Wiley & Wilson
Employee-Owned

DESIGN CALCULATIONS

30-inch gravity sewer

30" Class III RCP	$99.80	
Manholes with Frame and Cover, 1/250 ft, 8 vft	$7.60	
Extra Depth trench excavation (8-16 ft) 0.2 cy/ft	$3.00	
Rock Excavation by Hoeramming 0.09 cy/ft	$7.92	
Clearing and Grubbing11.48 X 10^{-4} ac/ft	$2.77	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 5.55 sy/ft	$5.75	
Sub-total:	$134.32	
Project Markup (25%)	$33.58	
Sub-total:	$167.90	
Contingency (15%)	$25.19	
Total:	$193.09	Use $193.00

36-inch gravity sewer

36" Class III RCP	$120.75	
Manholes with Frame and Cover, 1/250 ft, 8 vft	$7.60	
Extra Depth trench excavation (8-16 ft) 0.2 cy/ft	$3.00	
Rock Excavation by Hoeramming 0.09 cy/ft	$7.92	
Clearing and Grubbing11.48 X 10^{-4} ac/ft	$2.77	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 5.55 sy/ft	$5.75	
Sub-total:	$155.27	
Project Markup (25%)	$38.82	
Sub-total:	$194.09	
Contingency (15%)	$29.11	
Total:	$223.20	Use $223.00

Project Markup (25%):

1. Survey
2. Design
3. Easement procurement (assume 30-foot width)
4. Construction administration
5. Shopdrawing review
6. Authority inspection
7. As-built drawing preparation

Contingency (15%):

1. Design contingency
2. Construction contingency

2. Force Main Sewer Unit Costs

24-inch force main sewer

24" DIP force main	$93.50	
Clearing and Grubbing 11.48 X 10^{-4} ac/ft	$2.77	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 5.55 sy/ft	$5.75	
Sub-total:	$109.50	
Project Markup (25%)	$27.38	
Sub-total:	$136.88	
Contingency (15%)	$20.53	
Total:	$157.41	Use $158.00

20-inch force main sewer

20" DIP force main	$73.50	
Clearing and Grubbing 11.48 X 10^{-4} ac/ft	$2.77	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 5.55 sy/ft	$5.75	
Sub-total:	$89.50	
Project Markup (25%)	$22.38	
Sub-total:	$111.88	
Contingency (15%)	$16.78	
Total:	$128.66	Use $129.00

18-inch force main sewer

18" DIP force main	$65.10	
Clearing and Grubbing 9.18 X 10^{-4} ac/ft	$2.21	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$4.60	
Sub-total:	$79.39	
Project Markup (25%)	$19.85	
Sub-total:	$99.24	
Contingency (15%)	$14.89	
Total:	$114.12	Use $114.00

16-inch force main sewer

16" DIP force main	$58.80	
Clearing and Grubbing 9.18 X 10^{-4} ac/ft	$2.21	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 4.44 sy/ft	$4.60	
Sub-total:	$73.09	
Project Markup (25%)	$18.27	
Sub-total:	$91.36	
Contingency (15%)	$13.70	
Total:	$105.07	Use $105.00

14-inch force main sewer

14" DIP force main	$54.60	
Clearing and Grubbing 6.88 X 10^{-4} ac/ft	$1.66	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$3.45	
Sub-total:	$67.19	
Project Markup (25%)	$16.80	
Sub-total:	$83.99	
Contingency (15%)	$12.60	
Total:	$96.59	Use $97.00

12-inch force main sewer

12" DIP force main	$47.30	
Clearing and Grubbing 6.88 X 10^{-4} ac/ft	$1.66	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$3.45	
Sub-total:	$59.89	
Project Markup (25%)	$14.97	
Sub-total:	$74.86	
Contingency (15%)	$11.23	
Total:	$86.09	Use $86.00

10-inch force main sewer

10" DIP force main	$39.90	
Clearing and Grubbing 6.88 X 10^{-4} ac/ft	$1.66	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$3.45	
Sub-total:	$52.49	
Project Markup (25%)	$13.12	
Sub-total:	$65.61	
Contingency (15%)	$9.84	
Total:	$75.45	Use $76.00

Wiley & Wilson
Employee-Owned

DESIGN CALCULATIONS

8-inch force main sewer

8" DIP force main	$31.50	
Clearing and Grubbing 6.88 X 10^{-4} ac/ft	$1.66	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$3.45	
Sub-total:	$44.09	
Project Markup (25%)	$11.02	
Sub-total:	$55.11	
Contingency (15%)	$8.27	
Total:	$63.38	Use $63.00

6-inch force main sewer

6" DIP force main	$28.40	
Clearing and Grubbing 6.88 X 10^{-4} ac/ft	$1.66	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$3.45	
Sub-total:	$40.99	
Project Markup (25%)	$10.25	
Sub-total:	$51.24	
Contingency (15%)	$7.69	
Total:	$58.92	Use $59.00

4-inch force main sewer

4" DIP force main	$25.20	
Clearing and Grubbing 6.88 X 10^{-4} ac/ft	$1.66	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$3.45	
Sub-total:	$37.79	
Project Markup (25%)	$9.45	
Sub-total:	$47.24	
Contingency (15%)	$7.09	
Total:	$54.32	Use $54.00

Project Markup (25%):

1. Survey
2. Design
3. Easement procurement (assume 30-foot width)
4. Construction administration
5. Shopdrawing review
6. Authority inspection
7. As-built drawing preparation

Contingency (15%):

1. Design contingency
2. Construction contingency

Wiley & Wilson
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DESIGN CALCULATIONS

3. Water Main Unit Costs

12-inch water line

12" DIP water main	$47.30	
Clearing and Grubbing 6.88 X 10^{-4} ac/ft	$1.66	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$3.45	
Sub-total:	$59.89	
Project Markup (25%)	$14.97	
Sub-total:	$74.86	
Contingency (15%)	$11.23	
Total:	$86.09	Use $86.00

10-inch water line

10" DIP force main	$39.90	
Clearing and Grubbing 6.88 X 10^{-4} ac/ft	$1.66	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$3.45	
Sub-total:	$52.49	
Project Markup (25%)	$13.12	
Sub-total:	$65.61	
Contingency (15%)	$9.84	
Total:	$75.45	Use $76.00

8-inch water line

8" DIP force main	$31.50	
Clearing and Grubbing 6.88 X 10^{-4} ac/ft	$1.66	
Coarse Granular Fill and Coarse Aggregate, 0.19 tons/lf	$4.75	
Silt Fence	$2.73	
Seeding and Fine Grading 3.33 sy/ft	$3.45	
Sub-total:	$44.09	
Project Markup (25%)	$11.02	
Sub-total:	$55.11	
Contingency (15%)	$8.27	
Total:	$63.38	Use $63.00

Project Markup (25%):

1. Survey
2. Design
3. Easement procurement (assume 30-foot width)
4. Construction administration
5. Shopdrawing review
6. Authority inspection
7. As-built drawing preparation

Contingency (15%):

1. Design contingency
2. Construction contingency

4. Tank Unit Costs

Tank Size	Unit Cost
0.35 MG	$650,000
0.5 MG	$850,000
0.75 MG	$1,300,000
1.0 MG	$1,750,000
1.5 MG	$2,400,000

COST ESTIMATE

Wiley & Wilson
Employee-Owned

DESIGN CALCULATIONS

Opinion of probable cost (2006 dollars)

1. Sanitary sewer facilities

Item Description	Quantity	Units	Unit Price	Total
Southwest Area				
T6 (16-inch Force Main)	7,320	LF	105.00	$768,600.00
(Pump Station)	1	LS	500,000.00	$500,000.00
T6A (8-inch Gravity Sewer)	4,250	LF	95.00	$391,000.00
H1 (24-inch Gravity Sewer)	1,570	LF	169.00	$215,090.00
H1A (8-inch Gravity Sewer)	1,600	LF	95.00	$147,200.00
H2 (18-inch Gravity Sewer)	2,130	LF	142.00	$291,810.00
H2A (8-inch Gravity Sewer)	3,480	LF	95.00	$320,160.00
H3 (12-inch Gravity Sewer)	2,850	LF	115.00	$319,200.00
G1 (12-inch Gravity Sewer)	2,380	LF	95.00	$218,960.00
G1A (8-inch Gravity Sewer)	4,750	LF	95.00	$503,500.00
G2 (8-inch Gravity Sewer)	2,270	LF	95.00	$208,840.00
Southwest Total:				**$3,884,360.00**
Lovers Lane Area w/Baptist				
T3 (18-inch Force Main)	5,840	LF	114.00	$665,760.00
(Pump Station)	1	LS	550,000.00	$550,000.00
T3A (8-inch Gravity Sewer)	5,040	LF	95.00	$478,800.00
T4 (18-inch Gravity Sewer)	4,930	LF	142.00	$700,060.00
T4A (8-inch Gravity Sewer)	1,630	LF	95.00	$154,850.00
T5 (18-inch Gravity Sewer)	3,260	LF	142.00	$462,920.00
T5A (8-inch Gravity Sewer)	2,500	LF	95.00	$237,500.00
Lovers Lane Total:				**$3,249,890.00**
McDevit south & interceptor				
T1 (24-inch Gravity Sewer)	2,880	LF	169.00	$486,720.00
T1A (8-inch Gravity Sewer)	3,230	LF	95.00	$306,850.00
T2 (24-inch Gravity Sewer)	4,460	LF	169.00	$753,740.00
T2A (8-inch Gravity Sewer)	1,990	LF	95.00	$189,050.00
McDevit Total:				**$1,736,360.00**
Inlet west & McDevit north				
M6 (15-inch Gravity Sewer)	2,580	LF	123.00	$317,340.00
M6A (8-inch Gravity Sewer)	4,010	LF	63.00	$252,630.00
M7 (12-inch Gravity Sewer)	3,130	LF	123.00	$384,990.00
M7A (8-inch Gravity Sewer)	2,640	LF	95.00	$250,800.00
M7A1 (8-inch Gravity Sewer)	3,970	LF	95.00	$377,150.00
M7B (8-inch Gravity Sewer)	3,100	LF	95.00	$294,500.00
M8 (8-inch Gravity Sewer)	4,090	LF	95.00	$388,550.00
M8A (8-inch Gravity Sewer)	1,370	LF	95.00	$130,150.00
Total:				**$2,396,110.00**

Wiley & Wilson
Employee-Owned

DESIGN CALCULATIONS

Item Description	Quantity	Units	Unit Price	Total
Culpeper North				
N1 (8-inch Force Main)	7,120	LF	63.00	$448,560.00
(Pump Station)	1	LS	500,000.00	$500,000.00
N2 (8-inch Force Main)	10,120	LF	63.00	$637,560.00
(Pump Station)	1	LS	500,000.00	$500,000.00
N3 (4-inch Force Main)	1,590	LF	54.00	$85,860.00
(Pump Station)	1	LS	200,000.00	$200,000.00
Culpeper North Total:				**$2,371,980.00**
Jonus Run - Tributary 3				
J2C1 (8-inch Force Main)	3,810	LF	63.00	$240,030.00
(Pump Station)	1	LS	250,000.00	$250,000.00
J7 (8-inch Gravity Sewer)	3,220	LF	95.00	$305,900.00
J7A (8-inch Gravity Sewer)	2,680	LF	95.00	$254,600.00
Total:				**$1,050,530.00**
Jonus Run - Tributary 2				
J1D1 (10-inch Force Main)	4,190	LF	76.00	$318,440.00
(Pump Station)	1	LS	400,000.00	$400,000.00
J2D (15-inch Gravity Sewer)	2,630	LF	123.00	$323,490.00
J2D1 (8-inch Gravity Sewer)	3,160	LF	95.00	$300,200.00
J2D2 (8-inch Gravity Sewer)	920	LF	95.00	$87,400.00
J2E (12-inch Gravity Sewer)	1,910	LF	115.00	$219,650.00
J2E1 (8-inch Gravity Sewer)	1,070	LF	95.00	$101,650.00
J2F (12-inch Gravity Sewer)	2,790	LF	115.00	$320,850.00
J2F1 (8-inch Gravity Sewer)	500	LF	95.00	$47,500.00
Total:				**$2,119,180.00**
Jonus Run - Tributary 1				
M4A (12-inch Force Main)	5,580	LF	86.00	$479,880.00
(Pump Station)	1	LS	450,000.00	$450,000.00
J1D (15-inch Gravity Sewer)	2,600	LF	123.00	$319,800.00
Total:				**$1,249,680.00**
Inlet - Total:				**$6,815,500.00**
Mountain Run Interceptor				
M1 (24-inch Force Main)	2,000	LF	158.00	$316,000.00
(Pump Station - Influent)	1	LS	2,800,000	$2,800,000.00
M2 (36-inch Gravity Sewer)	3,260	LF	223.00	$726,980.00
M3 (36-inch Gravity Sewer)	9,410	LF	223.00	$2,098,430.00
M4 (30-inch Gravity Sewer)	15,210	LF	193.00	$2,935,530.00
M5 (30-inch Gravity Sewer)	6,380	LF	193.00	$1,231,340.00
Mt. Run Int. Total:				**$10,108,280.00**

Item Description	Quantity	Units	Unit Price	Total
Hubbard Run				
F3 (16-inch Force Main)	3,880	LF	105.00	$407,400.00
(Pump Station - Airpark)	1	LS	250,000.00	$250,000.00
F4 (16-inch Force Main)	6,950	LF	105.00	$729,750.00
(Pump Station - Elkwood)	1	LS	500,000.00	$500,000.00
F4A (8-inch Gravity Sewer)	5,060	LF	95.00	$480,700.00
E1 (24-inch Gravity Sewer)	4,380	LF	169.00	$740,220.00
E1A (15-inch Gravity Sewer)	820	LF	123.00	$100,860.00
E1B (8-inch Gravity Sewer)	5,080	LF	95.00	$482,600.00
E2 (8-inch Gravity Sewer)	2,750	LF	95.00	$261,250.00
E2A (8-inch Gravity Sewer)	2,590	LF	95.00	$246,050.00
E3 (8-inch Gravity Sewer)	1,770	LF	95.00	$168,150.00
Total:				**$4,366,980.00**
Flat Run				
F (24-inch Gravity Sewer)	2,510	LF	169.00	$424,190.00
F1 (20-inch Force Main)	13,550	LF	129.00	$1,747,950.00
(Pump Station - Flat Run)	1	LS	600,000.00	$600,000.00
F1A (12-inch Gravity Sewer)	6,370	LF	115.00	$732,550.00
F1A1 (8-inch Gravity Sewer)	2,330	LF	95.00	$221,350.00
F1B (8-inch Gravity Sewer)	4,540	LF	95.00	$431,300.00
F1B1 (8-inch Gravity Sewer)	1,300	LF	95.00	$123,500.00
F1C (8-inch Gravity Sewer)	2,330	LF	95.00	$221,350.00
F2 (24-inch Gravity Sewer)	7,390	LF	169.00	$1,248,910.00
Total:				**$5,751,100.00**
Jonas Run				
F1D (8-inch Force Main)	4,060	LF	63.00	$255,780.00
(Pump Station - Jonas Run)	1	LS	350,000.00	$350,000.00
J3A (8-inch Gravity Sewer)	1,210	LF	95.00	$114,950.00
J4 (12-inch Gravity Sewer)	1,800	LF	115.00	$207,000.00
J4A (8-inch Gravity Sewer)	1,570	LF	95.00	$149,150.00
J4A1 (8-inch Gravity Sewer)	2,340	LF	95.00	$222,300.00
J4B (8-inch Gravity Sewer)	1,960	LF	95.00	$186,200.00
Total:				**$1,485,380.00**
Brandy Station/Elkwood Total:				**$11,603,460.00**
Total: All Areas				**$39,769,830.00**

Wiley & Wilson
Employee-Owned

DESIGN CALCULATIONS

Item Description	Quantity	Units	Unit Price	Total
Jonas Run Tributaries - gravity sewers (optional)				
J1 (24-inch Gravity Sewer)	4,670	LF	169.00	$789,230.00
J1A (15-inch Gravity Sewer)	5,530	LF	123.00	$680,190.00
J1B (15-inch Gravity Sewer)	2,720	LF	123.00	$334,560.00
J1C (15-inch Gravity Sewer)	4,850	LF	123.00	$596,550.00
J2 (18-inch Gravity Sewer)	5,330	LF	142.00	$756,860.00
J2A (12-inch Gravity Sewer)	4,190	LF	115.00	$481,850.00
J2B (12-inch Gravity Sewer)	4,150	LF	115.00	$477,250.00
J2C (12-inch Gravity Sewer)	4,410	LF	115.00	$507,150.00
J3 (12-inch Gravity Sewer)	2,010	LF	115.00	$225,120.00
J5 (10-inch Gravity Sewer)	5,850	LF	109.00	$620,100.00
J6 (8-inch Gravity Sewer)	5,610	LF	95.00	$516,120.00
Total:				**$5,984,980.00**
Stevensburg				
S1 (8-inch Gravity Sewer)	7,770	LF	95.00	$738,150.00
S1A (8-inch Gravity Sewer)	4,950	LF	95.00	$470,250.00
S1A1 (8-inch Gravity Sewer)	3,900	LF	95.00	$370,500.00
S1B (8-inch Gravity Sewer)	1,250	LF	95.00	$118,750.00
S1C (8-inch Gravity Sewer)	1,800	LF	95.00	$171,000.00
S1D (4-inch Force Main)	1,740	LF	54.00	$93,960.00
(Pump Station)	1	LS	200,000.00	$200,000.00
Total:				**$2,162,610.00**

Wiley & Wilson
Employee-Owned

DESIGN CALCULATIONS

2. Water Facilities

Item Description	Quantity	Units	Unit Price	Total
1 (12-inch Water Line)	6,640	LF	86.00	$571,040.00
2 (12-inch Water Line)	11,830	LF	86.00	$1,017,380.00
3 (12-inch Water Line)	6,250	LF	86.00	$537,500.00
4 (16-inch Water Line)	6,100	LF	105.00	$640,500.00
5 (16-inch Water Line)	5,400	LF	105.00	$567,000.00
6 (16-inch Water Line)	6,140	LF	105.00	$644,700.00
7 (12-inch Water Line)	1,920	LF	86.00	$165,120.00
8 (12-inch Water Line)	5,250	LF	86.00	$451,500.00
9 (12-inch Water Line)	5,750	LF	86.00	$494,500.00
10 (16-inch Water Line)	5,940	LF	105.00	$623,700.00
11 (16-inch Water Line)	2,110	LF	105.00	$221,550.00
12 (16-inch Water Line)	5,130	LF	105.00	$538,650.00
13 (12-inch Water Line)	5,440	LF	86.00	$467,840.00
14 (12-inch Water Line)	5,060	LF	86.00	$435,160.00
15 (16-inch Water Line)	16,000	LF	105.00	$1,680,000.00
16 (12-inch Water Line to Mitchells)	37,100	LF	86.00	$3,190,600.00
17 (12-inch Water Line)	13,950	LF	86.00	$1,199,700.00
18 (12-inch Water Line)	7,540	LF	86.00	$648,440.00
19 (12-inch Water Line)	3,670	LF	86.00	$315,620.00
20 (12-inch Water Line)	6,930	LF	86.00	$595,980.00
21 (12-inch Water Line)	5,630	LF	86.00	$484,180.00
22 (12-inch Water Line)	16,150	LF	86.00	$1,388,900.00
23 (12-inch Water Line)	11,620	LF	86.00	$999,320.00
24 (12-inch Water Line)	5,590	LF	86.00	$480,740.00
25 (12-inch Water Line)	7,120	LF	86.00	$612,320.00
26 (8-inch Water Line)	3,430	LF	63.00	$216,090.00
27 (8-inch Water Line)	5,700	LF	63.00	$359,100.00
0.50 MG Water Storage Tank	1	LS	850,000.00	$850,000.00
0.75 MG Water Storage Tank	3	LS	#########	$3,900,000.00
1.0 MG Water Storage Tank	2	LS	#########	$3,500,000.00

Southwest Total: (Lines and Storage)	**$5,249,120.00**
Lovers Lane Total: (Lines and Storage)	**$3,913,760.00**
McDevitt Total: (Lines and Storage)	
Inlet Total: (Lines and Storage)	**$4,281,070.00**
Culpeper North Total: (Lines and Storage)	**$2,741,650.00**
Brandy Station/Elkwood Total: (Lines and Storage)	**$6,383,420.00**
Stevensburg Total: (Lines and Storage)	**$2,037,510.00**
Mitchells (line)	**$3,190,600.00**

Well development cost ($200,000 per well) not included.