AGENDA
POWHATAN COUNTY BOARD OF SUPERVISORS
WORKSHOP
MAY 8, 2025
3:00 PM CALL TO ORDER

This meeting is being held in the Village Building and is open to the public to attend in person.

If you would like to watch in real-time, use this link: http://powhatanva.gov/432/Live-Stream-of-Powhatan-County-Meetings

If you would like to watch the meeting later, at your convenience, use this link: http://powhatanva.gov/433/County-Meetings-and-Workshop-Videos-On-D

Public comments may be made in person during the appropriate comment period or submitted to administration@powhatanva.gov or by leaving a voicemail at (804) 598-5612 prior to the meeting. Any comments received up until 12:00 PM of the day of the meeting shall be entered into the meeting minutes.

1. **Call to Order**

2. **Pledge of Allegiance**

3. **Invocation**

4. **Requests to Postpone Agenda Items and Additions, Deletions or Changes in the Order of Presentation**

5. **Formal Approval of Agenda**

6. **County Administrator Updates**

7. **Public Comment** (time limit 3 minutes per individual/5 minutes per group, 30 minutes total time limit that can be extended by the Board)

8. **Presentation –** Dewberry and Associates Water and Waste Water Master Plan

9. **County Attorney Comments**

15. **County Administrator Comments**

16. **Board Comments**

17. **Adjournment**

REFERENCE NO. 50180282

WATER AND WASTEWATER MASTER PLAN UPDATE

Powhatan County, VA

MAY 2025

Dewberry

FINAL

SUBMITTED BY
Dewberry Engineers Inc.
4805 Lake Brook Dr.
Glen Allen, Virginia 23060
804.290.7957

SUBMITTED TO
Powhatan County
3834 Old Buckingham Rd.
Powhatan, Virginia 23139

Water and Wastewater Master Plan Update

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1. Executive Summary

1.1 Purpose and Scope

The purpose of this Water and Wastewater Master Plan Update is to provide the Powhatan County (County) Utilities Department with a road map for planning improvements and upgrades to meet future needs in maintaining cost-effective water and wastewater service to a growing number of County customers.

This Plan Update provides a comprehensive evaluation of the County's water and wastewater system within the Water and Sewer Service Area (WSSA) and identifies recommended improvements projected to be required through the Year 2045.

The general approach for development of this Plan Update incorporated the following steps:

1. Collect and review available information on the County's existing water and wastewater systems.
2. Conduct workshops with representatives from Utilities, Administration, and Planning Departments to gather information and develop concurrence regarding the methodologies used to develop the Plan Update.
3. Obtain information from the County on proposed land use, targeted growth areas, and population projections.
4. Develop demand projections through 2045 and distribute the demand projections throughout the WSSA in areas projected to be developed during several future time steps. Note that bi-monthly billing data from November 2021 to March 2024 was used as the baseline for demand projections.
5. Update models of the water and wastewater systems to identify existing system deficiencies and model the water and wastewater systems to identify Master Plan Capital Improvement Projects (CIPs) based on demand projections that will address growth within the County based on these projections.
6. Develop the Water and Wastewater Master Plan Update to summarize project activities and provide costs and recommendations for CIPs throughout the planning period.

1.2 Water and Sewer Service Area

As part of the Master Plan Update, the County identified parcels that will likely be developed within the planning period of this report. Specific parcels and their proposed land use were identified. Land use types included residential, mixed use, commercial, industrial, and data center.

The WSSA is divided into three (3) targeted growth areas:

- Route 711 Service Area (currently served by the Founders Bridge Utility Company (FBUC))
- Courthouse Service Area (currently served by Aqua Virginia (Aqua) and the County's Fighting Creek WWTP)
- Flat Rock Service Area (currently served by the County's water system and the County's Dutoy WWTP)

Future water and sewer demands, recommended improvements, and CIP projects have been organized based on these targeted growth areas. **Figure 2-1** illustrates the WSSA targeted growth areas.

1.3 Existing Water System

The Flat Rock Water System (PWSID VA4145190) is the existing County-owned public water system in the County that is located along Route 60 in the eastern portion of the County. The water system is a consecutive water system that receives its supply from an interconnection with the Chesterfield County (Chesterfield) water system. Aqua currently owns the system that provides water to the Courthouse Service Area and FBUC currently owns the system that provides water to the Route 711 Service Area.

The agreement with Chesterfield provides the County with a maximum day capacity of 572,000 gallons per day (GPD) within the Flat Rock Water System. The water distribution system consists of approximately 26 miles of waterlines, ranging from in diameter from 3 to 12 inches, and is generally located along Route 60 from Rocky Oak Road to County Line Road.

The Flat Rock Water System has two pressure zones, with the higher elevation pressure zone being supplied with water by a water booster station (WBS). The WBS, located near the intersection of South Creek One and Carter Gallier Blvd, pumps water from the lower pressure zone, which is fed by the Chesterfield connection, into a 0.5 million gallon (MG) elevated storage tank (EST) located in the high elevation pressure zone. This tank, along with the connection from Chesterfield, provides water to meet maximum daily demands and supply water to meet fire flow protection requirements.

In 2023, the County provided water service to 111 residential and commercial customers as follows:

- Residential customers: 7
- Commercial customers: 104
- Total customers: 111

In 2023, based on billing records, the average day demand for the Flat Rock Water System was approximately 46,000 GPD. During this same period, the average day water supplied from the Chesterfield Connection was approximately 152,000 GPD. After including the estimated average daily water flushing volume, 85,000 GPD of flushing, approximately 21,000 GPD (14%) of water that is leaving the system is unaccounted for. Refer to **Table 3-2** for additional information.

County staff has been active in working to identify the sources of unaccounted for water. These activities have included inspecting the water system to look for evidence of leaks, requesting overnight meter readings from Chesterfield during times of low water use to verify meter accuracy during low flows, and the installation of a meter on the tank drain line to verify the actual volume of flushing from the tank. To date, these activities have not found a significant source of unaccounted for water. This information, along with currently available information, will be used to develop a water balance throughout the system to try to account for all water usage.

Based on County Line Monthly Operating Report (MOR), the maximum day demand in the system was 839,000 GPD. The 98th Percentile Flow at the County Line was 281,200 GPD. The peak flow of 839,000 GPD occurred on April 7, 2022 due to a water main break in the 1300 block of Anderson Highway. The existing maximum day capacity of 572,000 GPD is sufficient for the current demand.

1.4 Existing Wastewater System

The County's public wastewater system in the WSSA provides wastewater service with two wastewater treatment facilities: the 0.25 million gallon per day (MGD) Dutoy Creek Wastewater Treatment Plant (WWTP) and the 0.1 MGD Fighting Creek WWTP.

Wastewater flows within the WSSA are collected in two service areas: the Flat Rock Service Area and the Courthouse Service Area. The Dutoy Creek WWTP provides treatment for wastewater flows in the Flat Rock Service Area and the Fighting Creek WWTP provides treatment for wastewater flows in the Courthouse Service Area.

The Flat Rock wastewater system consists of approximately 6 miles of gravity sanitary sewer, ranging in diameter from 8 to 16 inches, 6 miles of force main, ranging in diameter from 6 to 12 inches, and two wastewater pump stations. The collection system conveys wastewater flows to the Dutoy Creek WWTP for treatment.

The Courthouse system consists of approximately 8 miles of gravity sanitary sewer, ranging in diameter from 8 to 15 inches, 2 miles of force main, ranging in diameter from 6 to 8 inches, and two wastewater pump stations. The collection system conveys wastewater flows to the Fighting Creek WWTP for treatment.

From January 1, 2021 to March 12, 2024, the Fighting Creek WWTP and Dutoy Creek WWTP had an average daily flow of 39,000 GPD and 52,000 GPD, respectively.

In 2023, the County provided wastewater service to 281 residential and commercial customers as follows:

- Residential customers: 164
- Commercial customers: 117
- Total customers 281

1.5 Future Demand Projections

Future conditions in the County were evaluated to identify water and wastewater system improvements required to meet future needs. Recommended improvements within the planning period (2030-2045) were identified based on projected land use within the WSSA. These projections were developed utilizing methodologies consistent with the provisions of the County's 2021 Comprehensive Plan and input from the County's Utilities and Planning Departments.

1.6 System Modeling

Water and wastewater system computer models were developed in order to evaluate system conditions throughout the planning period and to identify improvements required to meet future needs. Bentley WaterGEMs and SewerGEMs were utilized to model the water system and wastewater system, respectively.

The models were calibrated to reflect actual conditions, and average, maximum day, and peak hour scenarios were run for each of the time increments within the planning period to evaluate the scope and timing of system improvement requirements. This modeling analysis led to development of the water and wastewater system improvement programs through 2045.

1.7 Water System Improvements

Water system improvements that are proposed to provide water service within the WSSA through the Year 2045 are identified on the Proposed Water Improvement Map in **Appendix A**. Improvements shown on the Proposed Water Improvement Map are color coded by the year that the improvement is needed and corresponds to the water system cost estimate (**Table 9-5**).

The County generally constructs projects required to provide an adequate water supply to an area, and the private sector constructs projects required to provide water service to a specific area or development. Both the Virginia Department of Health (VDH) and County requirements were considered when developing this plan.

In general, the water system improvements program involves improvements to water supply, water storage, and water distribution to ensure adequate supply and pressures throughout the planning period. A brief overview of improvements is provided in the following sections.

1.7.1 Water Supply

Throughout the planning period from 2030-2045, the County could continue to purchase water from Chesterfield at the existing Route 60 Connection Point. The current demands are sufficiently met through the purchasing of water from Chesterfield at the Route 60 connection point. However, as population grows within the WSSA, it is anticipated that the 0.572 MGD maximum day supply from Chesterfield will not be sufficient to meet peak system demands between 2030 and 2035. If the County is not able to acquire additional supply from Chesterfield, a new water supply will be required to support continued growth and development in the County.

If a new water supply is required, potential options include a new intake and water treatment plant (WTP) owned and operated by the County or new water supply connection from a regional partner, such as Henrico County.

Construction of a new intake and WTP would require extensive permitting, design, construction and operational costs. This would likely not be completed between the year 2030 and 2035 when the demand projections show a need for additional water supply.

A new water supply connection with a regional partner, such as Henrico County, offers more flexibility to serve all three service areas. A new water supply connection could be located at the far northeast corner of the County and would require a WBS, EST, and finished water transmission main along the east side of the County to Route 60 to transfer water to the service areas.

The Courthouse Service Area is privately owned by Aqua and currently has a permitted maximum day capacity of 176,000 gallons per day (GPD). It is anticipated that the service area will exceed the existing permitted maximum day capacity by the year 2030. It is assumed that Aqua will be able to increase their permitted maximum day capacity to serve this additional demand.

1.7.2 Water Storage

Equalization storage is needed to meet daily peak demands and at a minimum is equal to 20 percent of the maximum day demand. System storage required for fire flow is equal to 240,000 gallons, which is the volume of water needed to fight the County's design standard 2,000 GPM, 2-hour duration fire event in a non-residential area.

To address the County's needs for water storage during the planning period, the following improvements are recommended:

- 0.5 MG elevated storage tank between the Route 711 and Flat Rock Service Areas

1.7.3 Water Distribution

Master Plan Capital Improvement Projects (CIPs) associated with the water distribution system are generally required to address one or more of the following issues:

- Improvements to meet growing system demands in areas already served.
- Improvements desired to improve system reliability and/or service.
- Improvements needed to provide service to new areas within the Water Service Area(s)

A majority of the CIPs associated with the water distribution system are required for distribution of the water supply from the regional partner interconnection to the existing service areas. Additional CIP projects will be required if the County acquires the Courthouse water system to supply the required fire flow.

1.8 Wastewater System Improvements

Wastewater system improvements that are proposed to provide wastewater service within the County's WSSA through the Year 2045 are identified on the Proposed Sewer Improvements Map in **Appendix B**. Improvements shown on the Proposed Sewer Improvements Map are color coded by the year that the improvement is needed and corresponds to the wastewater system cost estimate (Error! Reference source not found.).

In general, the wastewater improvement programs involve treatment plant improvements, pump stations and force mains, and gravity sewer pipes.

1.8.1 Wastewater Treatment

For the Courhouse Service Area, the Fighting Creek WWTP is recommended to be taken offline and a pump station and force main be constructed to pump the wastewater flows from the Courthouse Service Area to the Flat Rock Service Area for treatment by the Dutoy Creek WWTP.

For the Route 711 Service Area, the construction of an additional WWTP was not recommended.it is recommended that a pump station and force main be constructed to pump the wastewater flows from the Route 711 Service Area to the Flat Rock Service Area for treatment by the Dutoy Creek WWTP.

The Flat Rock Service Area is currently served by the Dutoy Creek WWTP. With the addition of flows from the Courthouse and Route 711 Service Areas and anticipated development, the Dutoy Creek WWTP will need to be expanded. Based on the projected demand, Dutoy Creek WWTP will need to be upgraded to 0.5 MGD in 2030, 0.75 MGD in 2035, and 1.0 MGD in 2040.

VDEQ has noted that due to the low flow in the receiving stream, the Dutoy Creek WWTP is likely out of compliance. One solution is relocating the Dutoy Creek WWTP outfall to the James River. Relocation of the outfall would include construction of an effluent pump station at the Dutoy Creek WWTP and force main from Dutoy Creek WWTP to a new outfall on the James River. The undertaking of this project would come at significant cost to the County. Prior to starting this project, a stream study is recommended for the existing receiving stream to potentially revise the permitted effluent requirements and allow the County to continue discharging through the existing outfall. However, depending on the results of the study, the outfall may still need to be relocated.

1.8.2 Wastewater Collection and Conveyance

Master Plan Capital Improvement Projects (CIPs) associated with the wastewater collection system are generally required to address one or more of the following issues:

- Improvements needed to meet growing system demand in areas already served.
- Improvements desired to improve system reliability and/or service.
- Improvements needed to provide service to new areas within the Sewer Service Area.

The majority of the CIPs associated with the wastewater collection system are required for collecting and conveying proposed wastewater flows to Dutoy Creek WWTP.

To address the County's needs for wastewater collection and conveyance during the planning period, the following improvements are recommended:

- Fighting Creek Pump Station and Force Main: Convert Fighting Creek WWTP to pump station and send flow to Dutoy Creek WWTP for treatment.
- Route 711 Pump Station: Collect Route 711 wastewater and send flow to Dutoy Creek WWTP for treatment.
- Oakbridge Pump Station and Force Main: Convey wastewater flows from the Oakbridge Business Park, Parcel 42-79, Parcel 42-74, and surrounding areas to the existing force main along Route 60 to Dutoy Creek WWTP for treatment.
- Powhatan East Pump Station and Force Main: Developer pump station to convey wastewater flows from the proposed Route 711 pump station, Parcel 43-57, Parcel 43-62, and Parcel 43-61 to Dutoy Creek WWTP for treatment.
- Parcel 43-57 Pump Station: Developer pump station to serve Parcel 43-57.
- Parcel 54-15 Pump Station: Developer pump station to serve Parcel 54-15.

1.9 Implementation

Table 1-1 and **Table 1-2** outline the implementation plan for the water and wastewater system improvement program recommended in this Master Plan Update by providing a summary of the proposed projects by service area and construction cost, distributed by the year by which the project is proposed to be completed. Cost includes 15% contractor overhead and profit, 25% construction contingency, and 15% engineering fees. Planning, permitting, engineering, and construction must be started at least 3 to 5 years ahead of the time of completion (actual timeframe dependent on project complexity).

The Courthouse Service Area is currently served by Aqua and has a maximum day capacity of 176,000gpd. It is anticipated that the service area will exceed Aqua's current permitted maximum day capacity by the year 2030 and their permitted capacity will need to be increased.

Table 1-1. Water Improvement Estimated Cost by Fiscal Year

	Fiscal Year			
Water Improvements	**2030**	**2035**	**2040**	**2045**
Flat Rock Service Area				
Connection with Regional Partner				
Extend Waterline to Powhatan including James River Crossing		$25,000,000		
20-inch Transmission Main from Connection to Route 60		$31,530,000		
Water Booster Station with Chloramine Booster		$11,700,000		
0.5 MG Elevated Storage Tank		$4,930,000		
Loop at Old Church Road and Judes Ferry Road	$1,090,000			
*Water line to Parcel 43-61 (F14)**	*$1,150,000*			
*Water line to Parcel 41-19B (F2)**	*$400,000*			
*Water line to Parcel 43-57 (F12)**		*$1,210,000*		
*Water line to Parcel 54-15 (F18)**			*$2,410,000*	
*Water line to Parcel 41-17 (F1)**			*$570,000*	
*Water line to Parcel 41-5(F4)**				*$2,410,000*
Route 711 Service Area				
*Water line to Parcel 32-37 (R3)**				*$780,000*
Developer Total	$1,550,000	$1,210,000	$2,980,000	$3,190,000
COUNTY TOTAL	**$1,090,000**	**$73,160,000**	**-**	**-**

**Anticipated to be paid for by developers*

Table1-2. Wastewater Improvement Estimated Cost by Fiscal Year

	Fiscal Year			
Wastewater Improvements	**2030**	**2035**	**2040**	**2045**
Courthouse Service Area				
Take Fighting Creek WWTP Offline, Divert Flow to Dutoy Creek WWTP, PS, Force Main	$13,520,000			
Flat Rock Service Area				
Dutoy Effluent WWTP Effluent PS, Force Main and Outfall Relocation		$40,320,000		
Dutoy Creek WWTP 0.50 MGD Expansion	$12,000,000			
Dutoy Creek WWTP 0.75 MGD Expansion		$10,000,000		
Dutoy Creek WWTP 1.0 MGD Expansion			$8,000,000	
Oakbridge PS and Force Main	$6,737,000			
*Powhatan East PS and Force Main**		*$15,870,000*		
Parcel 43-57 (F12) PS and Force Main - Contingent on construction of the Powhatan East PS and Force Main*		*$3,280,000*		
*Parcel 54-15 (F18) PS and Force Main**			*$3,100,000*	
Gravity Sewer from Parcel 41-5				*$1,550,000*
Route 711 Service Area				
Route 711 PS and Force Main – Contingent on construction of the Powhatan East PS and Force Main			$8,970,000	
Developer Total	-	$19,150,000	$3,100,000	$1,550,000
COUNTY TOTAL	**$32,257,000**	**$50,320,000**	**$16,970,000**	**-**

**Anticipated to be paid for by developers*

2. Introduction

2.1 Purpose

The County provides water and wastewater service to a growing number of County customers. Cost efficient, environmentally sound water and wastewater service is a major contributor to the County's growth and quality of life. To ensure continued high quality service, while keeping pace with the challenges of a growing community, the County has developed this Water and Wastewater Master Plan Update. The purpose of the Plan Update is to assist the County with its planning for improvements, upgrades, extensions, and expansions that are required to meet future needs. The Plan Update addresses improvements and upgrades projected to be needed through the Year 2045.

This Water and Wastewater Master Plan Update is based on the best information available at this time. The plan serves as a road map for the County's Department of Utilities. It will need to be modified and refined based on actual development in the County and in response to changes that the County makes to its Comprehensive Plan in the future.

2.2 Scope

Preparation of the Water and Wastewater Master Plan Update involved extensive coordination with the County to incorporate available information into the plan, including existing water and wastewater system records, design information for planned projects, and methodologies for demand projections and system modeling.

The general approach for development of the Water and Wastewater Master Plan Update incorporated the following steps:

1. Collect and review available information on the County's existing water and wastewater systems.
2. Conduct workshops with representatives from Utilities, Administration, and Planning Departments to gather information and develop concurrence regarding the methodologies used to develop the Plan Update.
3. Obtain information from the County on proposed land use, targeted growth areas, and population projections.
4. Develop demand projections through 2045 and distribute the demand projections throughout the WSSA in areas projected to be developed during several future time steps. Note that bi-monthly billing data from November 2021 to March 2024 was used as the baseline for demand projections.
5. Update models of the water and wastewater systems to identify existing system deficiencies and model the water and wastewater systems to identify Master Plan CIPs based on demand projections that will address growth within the County based on these projections.
6. Develop the Water and Wastewater Master Plan Update to summarize project activities and provide costs and recommendations for CIPs throughout the planning period.

Projects that were identified as improvements and upgrades to the County's existing water and wastewater systems are summarized in **Sections 7** and **8**. The implementation plan for these improvements, outlining cost estimates and implementation schedules for each individual project, is included in **Section 9**.

2.3 Water and Sewer Service Area

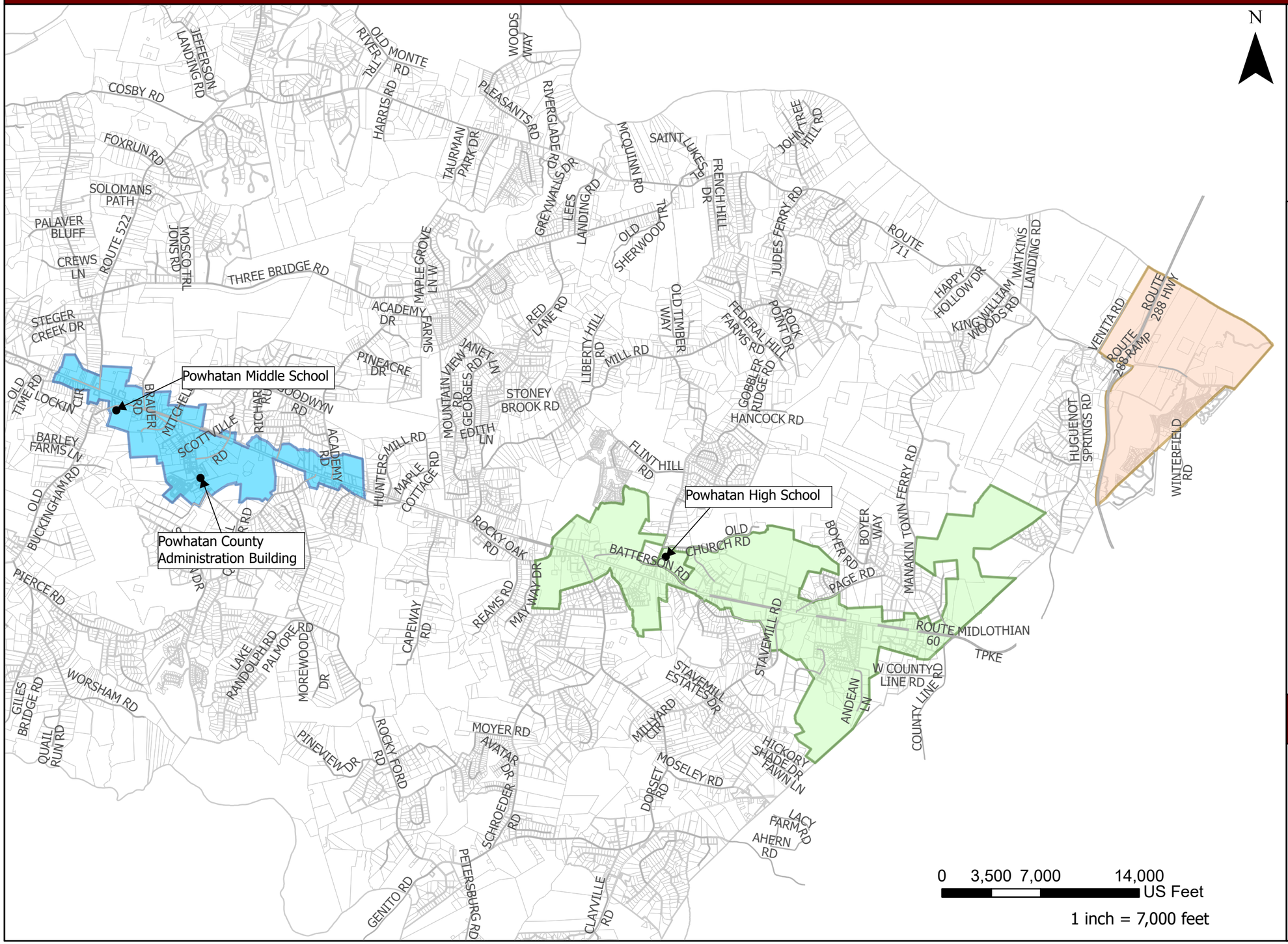
As part of the Master Plan Update, the County identified parcels that will likely be developed within the planning period of this report. Specific parcels and their proposed land use were identified. Land use types included residential, mixed use, commercial, industrial, and data center.

The WSSA is divided into the following targeted growth areas:

- Route 711 Service Area (currently served by the FBUC)
- Courthouse Service Area (currently served by Aqua and the County's Fighting Creek WWTP)
- Flat Rock Service Area (currently served by the County's water system and the County's Dutoy WWTP)

Future water and sewer demands, recommended improvements, and CIP projects have been organized based on these targeted growth areas. **Figure 2-1** illustrates the WSSA targeted growth areas.

FIGURE 2-1. Water and Sewer Service Areas



Legend

Service Areas

- Courthouse
- Flat Rock
- Route 711

MASTER PLAN UPDATE

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3. Existing Water System

This section of the Master Plan Update provides an overview of the County's existing water systems.

3.1 Water System Overview

The Flat Rock Water System (PWSID VA4145190) is the existing County-owned public water system in the County that is located along Route 60 in the eastern portion of the County. The water system is a consecutive water system that receives its supply from an interconnection with the Chesterfield water system. Aqua currently owns the system that provides water to the Courthouse Service Area and the FBUC currently owns the system that provides water to the Route 711 Service Area. More detailed information on the County's water supply facilities, storage facilities, and pumping facilities is provided in the following sections.

3.2 Flat Rock Water System

The Flat Rock Water System is owned and operated by the County and is currently supplied by a single connection point at Route 60, through a water supply agreement with Chesterfield. The agreement with Chesterfield allows for a maximum day water supply allocation of 0.572 MGD.

This system consists of approximately 26 miles of waterlines, ranging in diameter from 3 to 12 inches, and is generally located along Route 60 from Rocky Oak Road to County Line Road.

The water system has two pressure zones, with the higher elevation pressure zone being supplied with water by a WBS.

Table 3-1. Water Booster Station Summary

No. of Pumps	Design Flow per Pump (GPM)	Design TDH (FT)	Firm Capacity (GPM)
2	500	92.4	500

1. Pump station has room to add a third pump to increase firm capacity to 1000 GPM

The WBS pumps water from the lower pressure zone, which is fed by the Chesterfield Connection, into a 0.5 MG EST with an overflow elevation of 571 feet, located in the higher elevation pressure zone. This tank, along with the connection from Chesterfield, provides water to meet maximum day water demands and supply water to meet fire flow demands of the system.

In 2023, the County provided water service to 111 residential and commercial customers as follows:

- Residential customers: 7
- Commercial customers: 104
- Total customers: 111

In 2023, based on billing records, the average day demand for the Flat Rock Water System was approximately 46,000 GPD. During this same period, the average day water supplied from the Chesterfield Connection was approximately 152,000 GPD. After including the estimated average daily water flushing volume, 85,000 GPD of flushing, approximately 21,000 GPD (14%) of water that is entering the system is unaccounted for. Both the flushing and unaccounted for water are considered non-revenue water. Refer to **Table 3-2** for additional information. American Water Works Association (AWWA) *Manual of Water Supply Practice M36 Water Audits and Loss Control Programs* suggests that non-revenue water over 20% is considered excessive. Many of the municipalities that participated in the development of AWWA M36 have established goals of 15% or less for non-revenue water. The County is unique in that it is a very linear system that requires significant flushing to maintain residual disinfectant in the system. System improvements including looping waterlines and the addition of a chloramine booster station at the any water supply interconnections would help to decrease the required flushing volume as discussed in subsequent sections.

Table 3-2. Average Day Demand Summary[1]

Water Supply[2] (GPD)	Powhatan Billing Data (GPD)	Estimated Flushing[3] (GPD)	Estimated Unaccounted for Water (GPD)
152,000	46,000	85,000	21,000

1. Based on 2023 data.
2. Based on County Line MOR Data (2021-2024).
3. Estimated daily flushing provided by the County.

County staff has been active in working to identify the sources of unaccounted for water. These activities have included inspecting the water system to look for evidence of leaks, requesting overnight meter readings from Chesterfield during times of low water use to verify meter accuracy during low flows, and the installation of a meter on the tank drain line to verify the actual volume of flushing from the tank. To date, these activities have not found a significant source of unaccounted for water. This information, along with currently available information, will be used to develop a water balance throughout the system to try to account for all water usage.

Based on County Line MOR, the maximum day demand in the system was 839,000 GPD. The 98th Percentile Flow at the County Line was 281,200 GPD. The peak flow of 839,000 GPD occurred on April 7, 2022 due to a water main break in the 1300 block of Anderson Highway. The existing maximum day capacity of 572,000 GPD is sufficient for the current demand.

A plan schematic of the Flat Rock Water System is shown in **Figure 3-1** and **Figure 3-2.**

3.3 Courthouse Water System

The Courthouse Water System is a privately owned system by Aqua. This system currently has a permitted maximum capacity of 176,000 GPD through the Virginia Department of Health and obtains its water supply through several wells connected to the system. The existing system currently supplies an estimated average daily demand of approximately 60,000 GPD and a maximum day demand of 120,000 GPD. The Courthouse Water System has 272 service connections and serves a population of 2,605.

The Courthouse water system is comprised of three wells, two ground storage tanks (GST) (0.01 MG and 0.04 MG), two hydropneumatic tanks, booster pumps, and iron and manganese treatment facility. The distribution system consists of approximately 9 miles of waterlines, ranging in diameter from 2 to 10 inches and is generally located along Route 60 from Route 522 east to Academy Road including the Courthouse Historic District. The County owns a 0.5 MG non-potable EST that is used for fire protection for the County's elementary and middle school.

A plan schematic of the existing Courthouse Water System is shown in **Figure 3-3.**

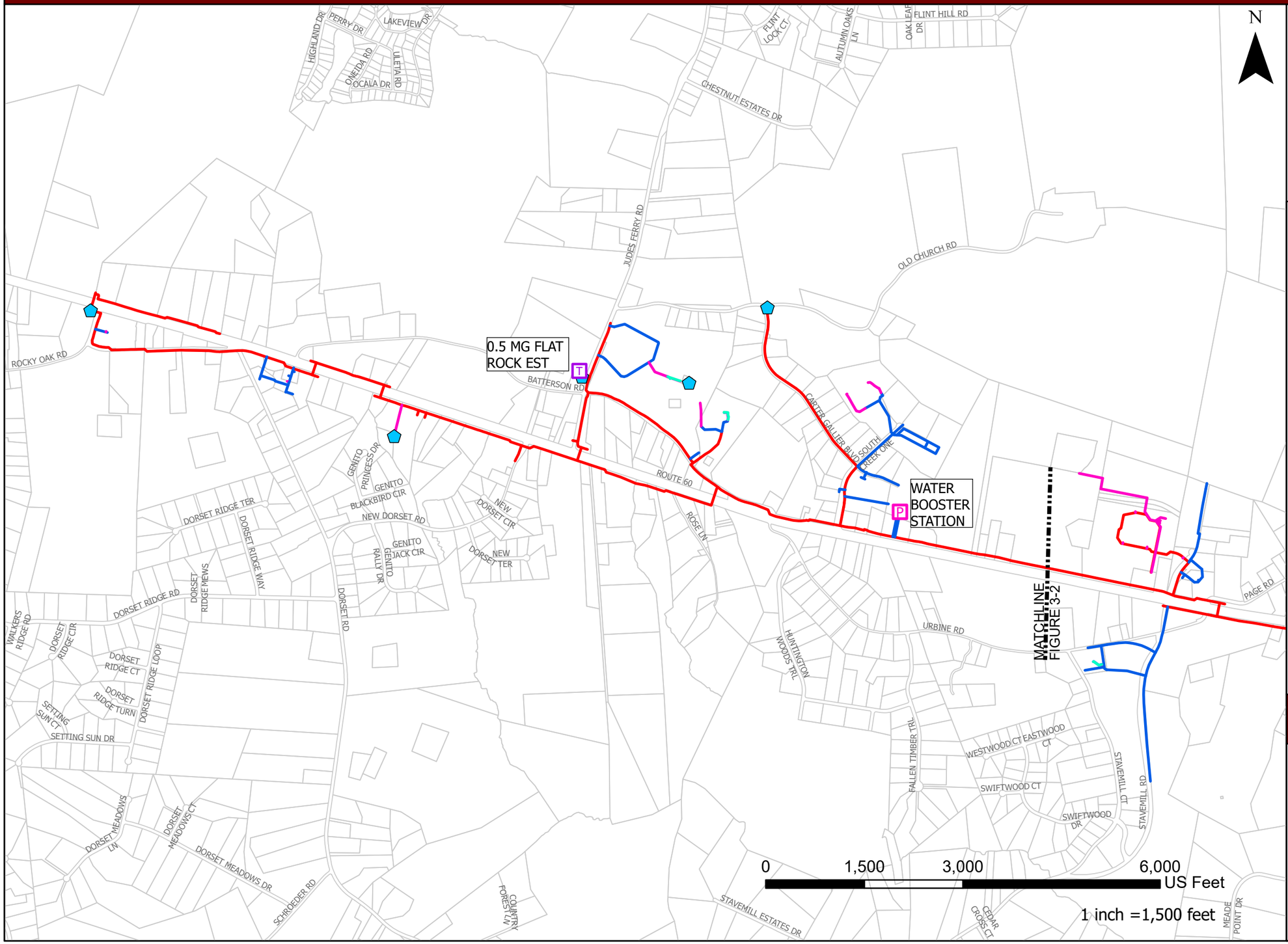
3.4 Route 711 Water System

The Route 711 area is served by the privately owned FBUC. FBUC has an agreement with Chesterfield County to provide 180,000 GPD (maximum day) of water. The FBUC currently serves 344 commercial and residential connections. There are an additional 78 irrigation connections, mainly used for residential irrigation.

3.5 Private Permitted Water Systems

There are many private permitted water systems throughout the County. A map of these systems is included in **Appendix F**. There are no changes anticipated with these systems, and they are included in this plan for reference only.

FIGURE 3-1. Existing Water Western Flat Rock Service Area



Legend

- Existing Autoflusher
- Water Booster Station
- Chesterfield Connection Point
- Tanks

Waterline

- 3" Waterline
- 4" Waterline
- 6" Waterline
- 8" Waterline
- 12" Waterline

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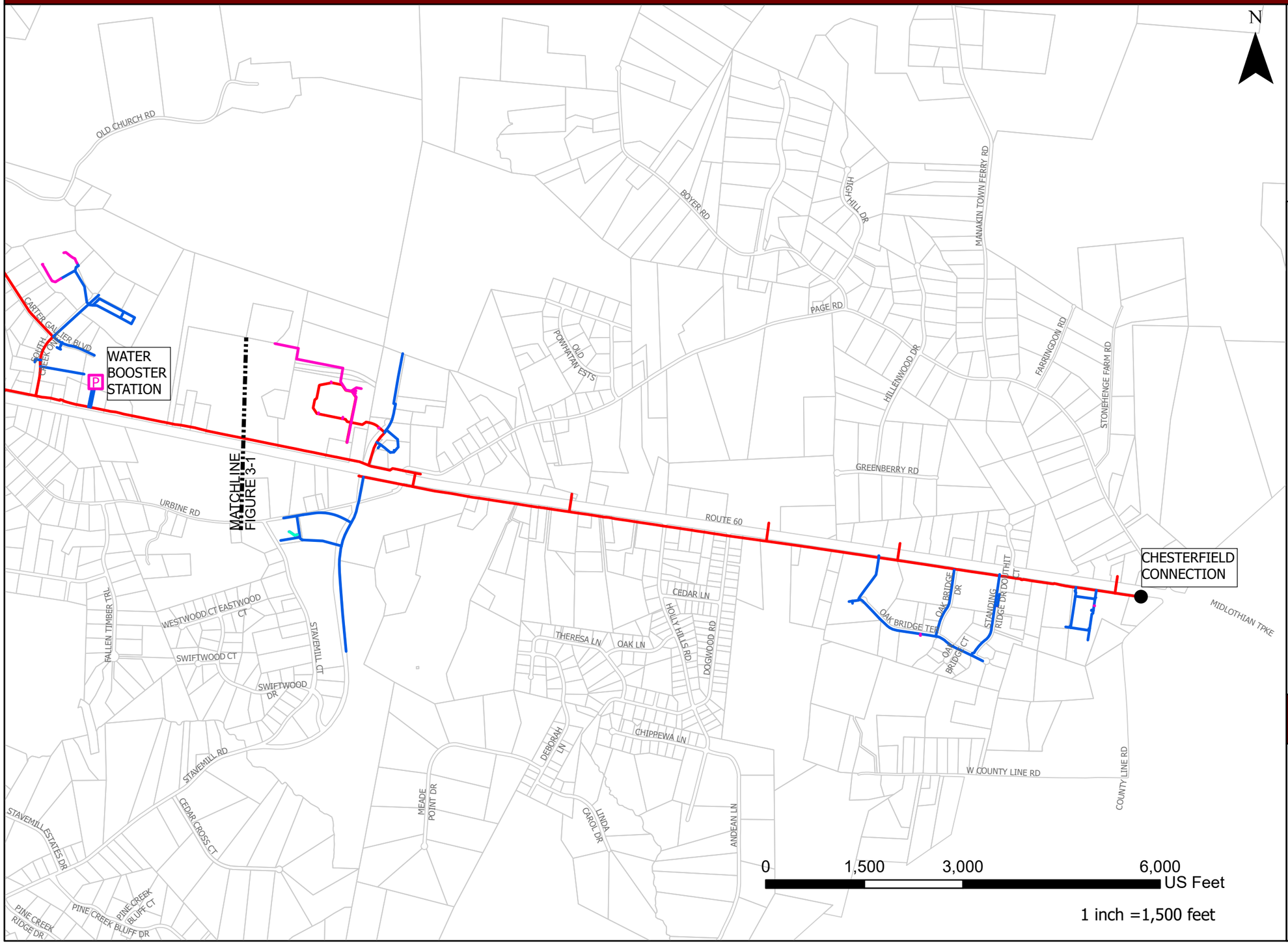
FIGURE 3-2. Existing Water Eastern Flat Rock Service Area



Legend

- Existing Autoflusher
- Water Booster Station
- Chesterfield Connection Point
- Tanks

Waterline

- 3" Waterline
- 4" Waterline
- 6" Waterline
- 8" Waterline
- 12" Waterline

MASTER PLAN UPDATE

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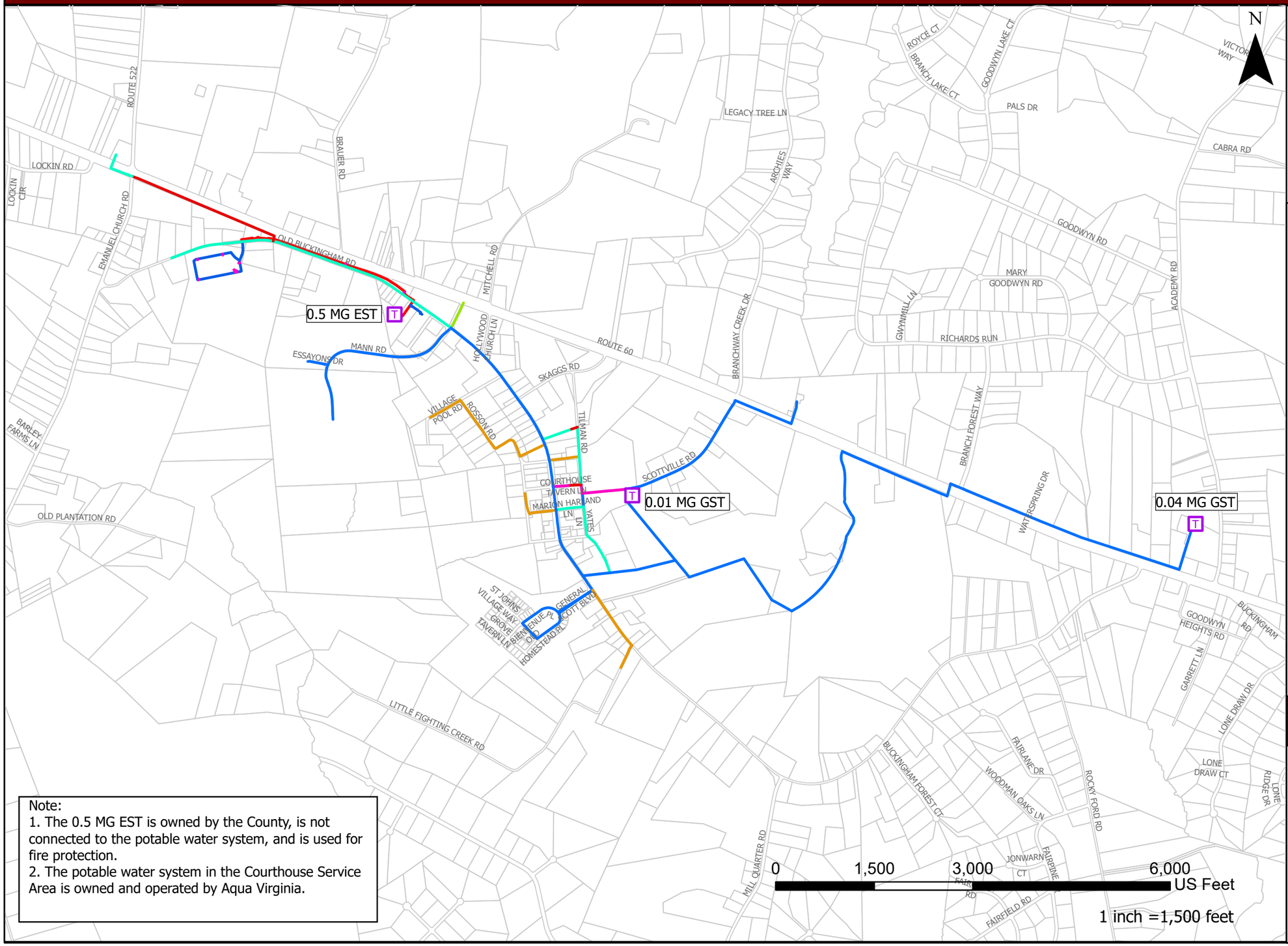
FIGURE 3-3. Existing Water Courthouse Service Area



Legend

- Tanks

Waterline

- 2" Waterline
- 3" Waterline
- 4" Waterline
- 6" Waterline
- 8" Waterline
- 10" Waterline

Note:
1. The 0.5 MG EST is owned by the County, is not connected to the potable water system, and is used for fire protection.
2. The potable water system in the Courthouse Service Area is owned and operated by Aqua Virginia.

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4. Existing Wastewater System

This section of the Master Plan Update provides an overview of Powhatan County's existing wastewater system.

4.1 Wastewater System Overview

The County owns two WWTPs in the WSSA: Dutoy Creek WWTP and Fighting Creek WWTP which are rated for 0.25 MGD and 0.1 MGD, respectively. Wastewater flows within the WSSA are collected in two service areas: Flat Rock Service Area and Courthouse Service Area. The Dutoy Creek WWTP provides treatment of wastewater flows in the Flat Rock Service Area and the Fighting Creek WWTP provides treatment of wastewater flows in the Courthouse Service Area.

In 2023, the County provided wastewater service to 281 residential and commercial customers as follows:

- Residential customers: 164
- Commercial customers: 117
- Total customers 281

From January 1, 2021 to March 12, 2024, the Fighting Creek WWTP and Dutoy Creek WWTP had an average daily flow of 39,000 GPD and 52,000 GPD, respectively.

4.2 Flat Rock Wastewater System

The Flat Rock Wastewater System consists of approximately 6 miles of gravity sewer, ranging in diameter from 8 to 16 inches, 6 miles of force main, ranging in diameter from 6 to 12 inches, and two wastewater pump stations. The collection system conveys wastewater flows to the Dutoy Creek WWTP for treatment.

A plan schematic of the existing Flat Rock Wastewater System is shown in **Figure 4-1** and **Figure 4-2.**

4.2.1 Dutoy Creek Wastewater Treatment Plant

The Dutoy Creek WWTP has a permitted capacity of up to 250,000 GPD through the Virginia Pollutant Discharge Elimination System (VPDES) Permit No. VA0090727 and includes 50,000 GPD, 125,000 GPD, and 250,000 GPD flow tiers. Currently, the plant is operating at the 125,000 GPD tier.

The treatment process consists of an influent pump station, screening, pre-equalization basin, sequencing batch reactor (SBR), post equalization/re-aeration basin, cloth media disk filters, and ultraviolet disinfection. A gravity outfall conveys the effluent to a tributary of Dutoy Creek which combines with Norwood Creek and discharges to the James River.

The solids handling process consist of two aerobic digester basins with liquid sludge being hauled periodically by a contractor to be disposed of at a landfill or land applied.

4.2.2 Flat Rock Wastewater Pump Stations

The Flat Rock wastewater system mostly consists of gravity sewer but also includes two (2) county owned pump stations (PS).

Flat Rock Pump Station is located near the western end of the Flat Rock service area and serves the surrounding area. This pump station consists of two suction lift pumps designed to pump 600 GPM at 100 feet of TDH. The pumps convey wastewater out of a 10-foot diameter wet well and discharge through approximately 7,900 feet of 10-inch and 12-inch force main to gravity sewer located near the intersection of South Creek One and Route 60.

Frisby's Pump Station is located near the intersection of Batterson Road and Route 60 and serves the Powhatan High School and Flat Rock Elementary School area. This pump station consists of two suction lift pumps designed to pump 700 gallons per minute at 55 feet of head. The pumps lift wastewater out of an 8-foot diameter wet well and discharge through approximately 165 feet of 12-inch force main and share a common force main along Route 60 with the Flat Rock Wastewater Pump Station.

4.3 Courthouse Wastewater System

The Courthouse Wastewater System is owned and operated by the County. This system consists of approximately 8 miles of gravity sanitary sewer, ranging in diameter from 8 to 15 inches, 2 miles of force main, ranging in diameter from 6 to 8 inches, and two wastewater pump stations. The collection system conveys wastewater flows to the Fighting Creek WWTP for treatment.

A plan schematic of the existing Courthouse Wastewater System is shown in **Figure 4-3.**

4.3.1 Fighting Creek Wastewater Treatment Plant

The Fighting Creek WWTP has up to a permitted capacity of 100,000 GPD through the Virginia Pollutant Discharge Elimination System (VPDES) Permit No. VA0089206.

The treatment process consists of an influent grinder, pump station, pre-equalization basin, sequencing batch reactor (SBR), post equalization/re-aeration basin, and ultraviolet disinfection. A gravity outfall conveys the effluent to an unnamed tributary of Fighting Creek which combines with Rocky Ford Creek and flows to the Appomattox River.

The solids handling process consist of two aerobic digester basins with liquid sludge being hauled periodically by a contractor to be disposed of at a landfill or land applied.

4.3.2 Courthouse Wastewater Pump Stations

The Pocahontas Pump Station is located at the western end of the Courthouse service area and serves the Pocahontas Elementary School and the Pocahontas Middle School. This pump station consists of two suction lift pumps designed to pump 200 gallons per minute at 70 feet of head. The pumps lift wastewater out of a 6-foot diameter wet well and discharge through approximately 6,000 feet of 6-inch force main to gravity sewer located behind the Powhatan Middle School.

Academy Road Pump Station is located near the intersection of Branchway Creek Drive and Route 60 and serves the eastern end of the Courthouse service area. This pump station consists of two suction lift pumps designed to pump 350 gallons per minute at 95 feet of head. The pumps lift wastewater out of an 8-foot diameter wet well and discharges through approximately 5,000 feet of 8-inch force main to gravity sewer located along Route 60.

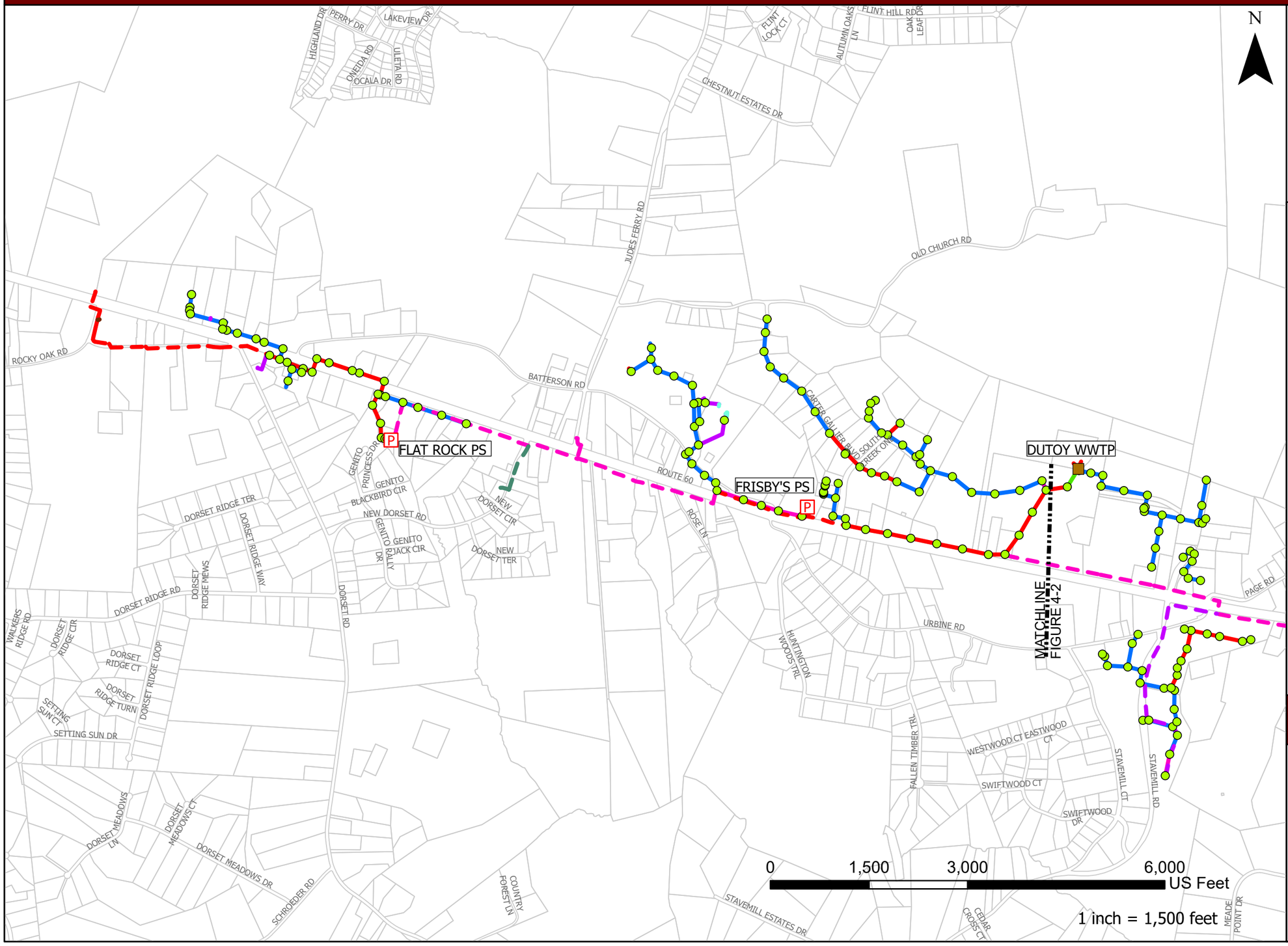
4.4 Route 711 Wastewater System

The Route 711 area is served by privately owned FBUC. FBUC has an agreement with Chesterfield County to provide sewer service up to 135,000 GPD.

4.5 Private Permitted Wastewater Systems

There are three private permitted wastewater systems throughout the County. A map of these systems is included in **Appendix F**. There are no changes anticipated with these systems, and they are included in this plan for reference only.

FIGURE 4-1. Existing Sewer Western Flat Rock Area



Legend

- Pump Station
- Wastewater Treatment Plant
- Manhole

Forcemain

- 1.5" Forcemain
- 2" Forcemain
- 3" Forcemain
- 4" Forcemain
- 6" Forcemain
- 8" Forcemain
- 10" Forcemain
- 12" Forcemain

Gravity Main

- 4" Gravity Line
- 6" Gravity Line
- 8" Gravity Line
- 10" Gravity Line
- 12" Gravity Line
- 15" Gravity Line
- 16" Gravity Line

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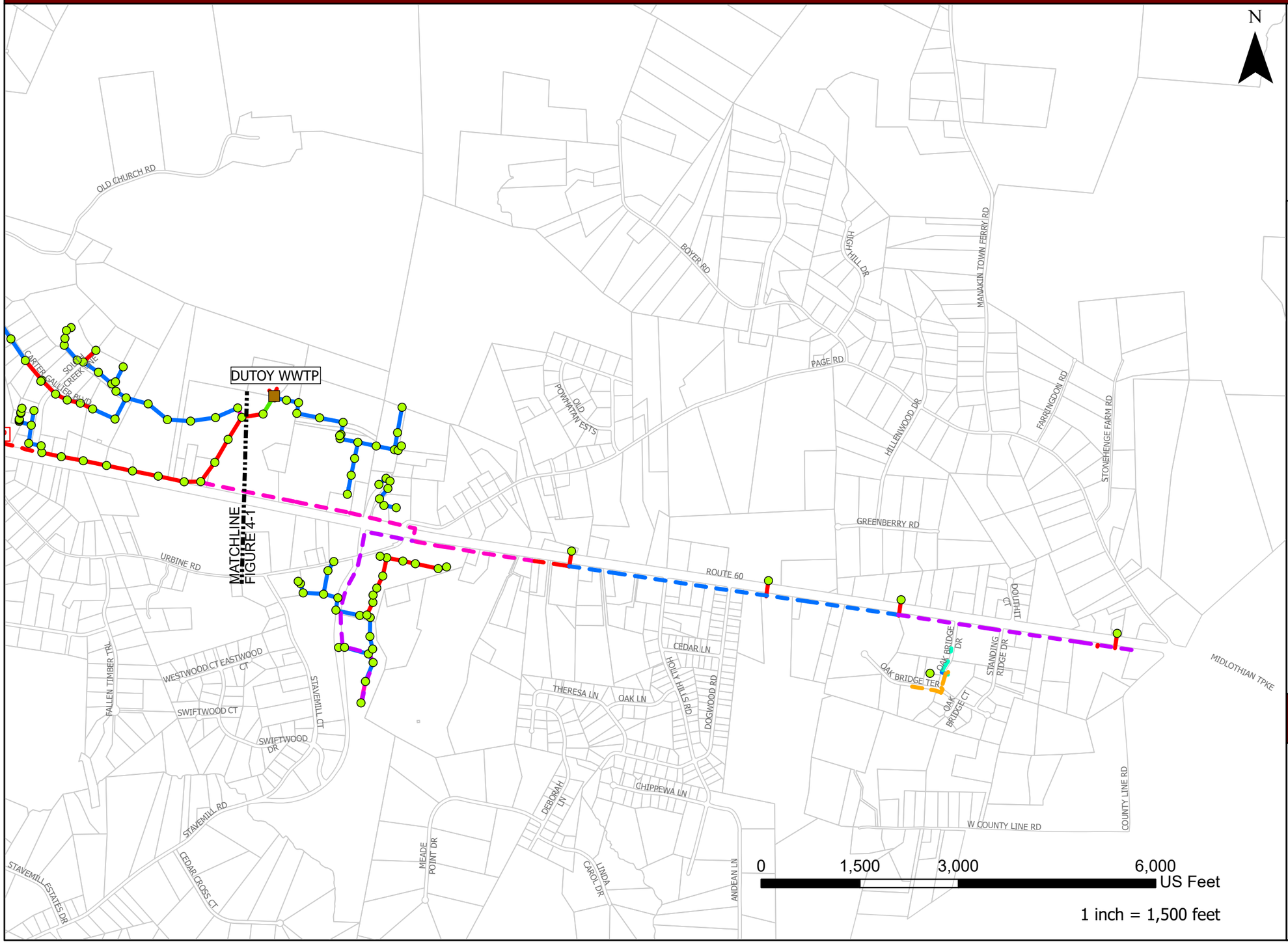
FIGURE 4-2. Existing Sewer Eastern Flat Rock Area



Legend

- Pump Station
- Wastewater Treatment Plant
- Manhole

Forcemain

- 1.5" Forcemain
- 2" Forcemain
- 3" Forcemain
- 4" Forcemain
- 6" Forcemain
- 8" Forcemain
- 10" Forcemain
- 12" Forcemain

Gravity Main

- 4" Gravity Line
- 6" Gravity Line
- 8" Gravity Line
- 10" Gravity Line
- 12" Gravity Line
- 15" Gravity Line
- 16" Gravity Line

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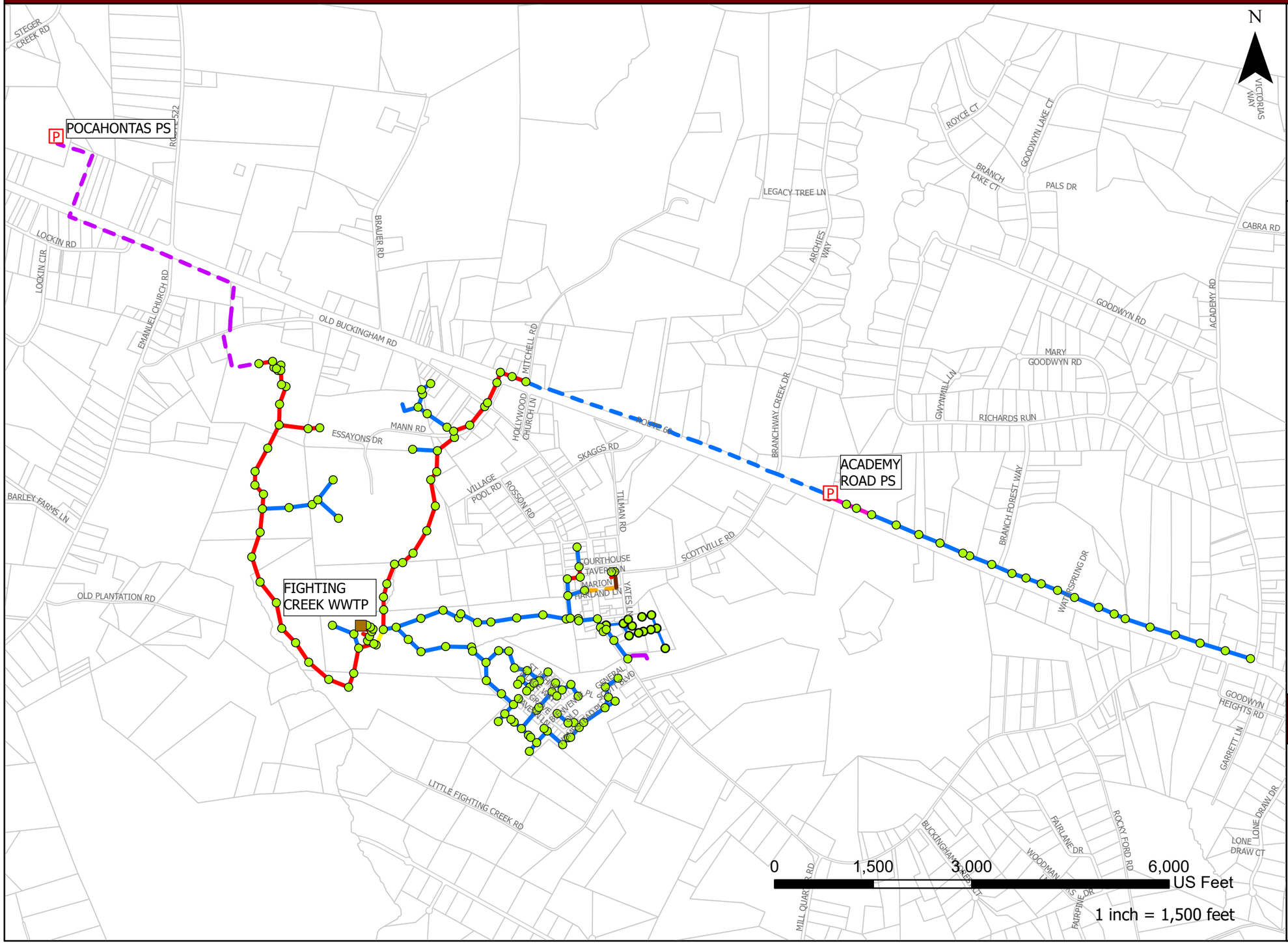
FIGURE 4-3. Existing Sewer Courthouse Area



Legend

- Pump Station
- Wastewater Treatment Plant
- Manhole

Forcemain

- 1.5" Forcemain
- 2" Forcemain
- 3" Forcemain
- 4" Forcemain
- 6" Forcemain
- 8" Forcemain
- 10" Forcemain
- 12" Forcemain

Gravity Main

- 4" Gravity Line
- 6" Gravity Line
- 8" Gravity Line
- 10" Gravity Line
- 12" Gravity Line
- 15" Gravity Line
- 16" Gravity Line

MASTER PLAN UPDATE

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5. Future Demand Projections

5.1 General

Future conditions in the County were evaluated to identify water and wastewater system improvements required to meet future needs associated with the projected growth of population within the WSSA.

This Master Plan Update addresses future conditions and identifies required water and wastewater system improvements based on development projections provided by the County throughout the WSSA for the planning period, which is defined as the years 2030 through 2045.

Proposed projects are based on projections and will need to be adjusted based on actual growth patterns within the WSSA. This is particularly true of any project more than 3 years in the future.

5.2 Existing Demands

In order to develop future demand projections, it is important to research existing water demands, which is typically done by investigating several sources of water use. Baseline demands are estimated based on water meter data from the existing water customers including residential, commercial, and industrial. Another source of water demand includes auto flushers, which according to County staff are utilized daily, to improve water quality in the system.

The estimated usage from metered connections and flushing is compared with water production and supply meter data to determine the amount of unaccounted for water. Typical sources of unaccounted for water include unrecorded flushing activities, water leakage in the line that results from aging pipes and loose connections, faulty meters, and unmetered connections.

Water meter data was provided by the County for all of the water customers served by the County water system (Flat Rock Service Area). The average daily water use at each meter was totaled and equaled approximately 45,700 GPD. The County stated that flushing accounts for approximately 85,000 GPD.

These demands were compared with daily meter data at the connection with Chesterfield. During this same time period, the daily water meter data indicated an average water usage by the County of approximately 151,700 GPD, which indicates approximately 21,000 GPD (14%) of the water entering the Flat Rock water system is unaccounted for. It is recommended that the County conduct a study to determine the sources of unaccounted for water.

The Courthouse Water System is currently owned and operated by Aqua, a private company. This system currently has a permitted capacity of 176,000 GPD through the Virginia Department of Health and obtains its supply through several wells connected to the system. The existing system currently supplies an estimated average demand of approximately 60,000 GPD and a maximum day demand of approximately 120,000 GPD.

The Route 711 Water System is currently owned and operated by the FBUC, a private company. This system currently has a permitted capacity of 180,000 GPD through the Virginia Department of Health and obtains its supply from Chesterfield. The existing system currently supplies an estimated average demand of approximately 90,000 GPD and a maximum day demand of approximately 180,000 GPD.

5.3 Future Population

Powhatan County provided county-wide population projections per year through the end of the planning period (2045). The population is estimated to increase by approximately one percent per year. The current population and projected population provided by the county for each of the master planning periods in included in **Table 5-1**.

Table 5-1. County-Wide Population

Year	County-wide Population
2024	31,942
2025	32,327
2030	34,249
2035	36,170
2040	38,092
2045	40,014

The population increase for each time step is included in the table below.

Table 5-2. Population Increase per Planning Period

Time Step	Years	County-Wide Population Increase
1 to 5 years	2025-2030	1,922
6 to 10 years	2030-2035	1,921
11 to 15 years	2035-2040	1,922
16 to 20 years	2040-2045	1,922

5.4 Development of Future Water and Sewer Demands

Workshops were held with County staff to develop the future development projections on May 7, 2024 and August 16, 2024. During these workshops, areas of anticipated future growth were identified, such as residential neighborhoods, industrial parks, commercial developments, mixed-use developments, and data centers and timeframes as to when those areas would need water and sewer service.

5.4.1 Developable Area

The developable area of each parcel within the Courthouse and Flat Rock Service Areas was reduced by 40% to account for roads, green space, water bodies, and other undevelopable features in the area. Therefore, 60% of the parcel area was included in the demand calculations. Drawings of existing developments were reviewed to estimate a typical developable area.

The Route 711 service area is in close proximately to the James River. This area is assumed to have a larger undevelopable area, of 60%, due to RPAs, wetlands and other environmental considerations. 40% of the parcel area was included in the demand projections for this area.

5.4.2 Residential Demands

The 2020 Census Data for Powhatan County states the County had a total population of 30,333 and total number of households of 11,077. Using the Census data resulted in a capita rate of 2.74 people per household. Using 2023 billing data, the total average residential water usage per day was 16,400 GPD with 166 residential connections. Using the capita rate of 2.74 people per unit results in a total of 455 people. This came out to a usage of 36 GPD per person or 100 GPD (rounded) per household. This value, 100 GPD, was used for water demand per household including irrigation. The AWWA Design and Construction of Small Systems has a usage of 31.25 GPD per person, average day. Using the per capita rate and 31.25 GPD per person results in 85 GPD per household. This number, 85 GPD, was used for sewer demand and does not include irrigation usage. **Table 5-3** below summarizes the calculation.

Table 5-3. Residential Water Demands

Parameter	Value
Average Daily Residential Water Usage (2023)	16,400 GPD
Number of Residential Connections	166
Number of People Using 2.74 people per household	455
Average Usage per Person	36 GPD
Average Usage per Household (w/ irrigation)	100 GPD (rounded)
Average Usage per Household (w/o irrigation)	85 GPD*

* Use 31.25 GPD (from AWWA Small Systems) x 2.74

Four (4) dwellings per acre was used for residential water demands based on the County's Comprehensive Plan and County feedback. Future demands were calculated for each parcel identified to be developed as residential in the next 20 years.

Table 5-4 includes an example calculation for proposed residential demand on a 10-acre parcel located in the Flat Rock Service Area.

Table 5-4. Example Residential Demand Calculation

Parameter	Value	Note
Parcel Area (acres)	10	Total Parcel Area
Developable Area (acres)	6	60% of Parcel Area
Number of Households	24	4 Dwelling per Developable Acre
Water Demand (GPD)	2,400	100 GPD per Household
Sewer Demand (GPD)	2,040	85 GPD per Household

5.4.3 Commercial/Industrial Demands

Commercial and industrial demands were calculated the same way. According to the Chesterfield County Water and Sewer Specifications and Procedures, the retail equivalent persons per acre is 20 which was used for commercial properties. The light industrial equivalent persons per acre is also 20 which was used for industrial properties. The AWWA Design and Construction of Small System Manual stated that for a factory, account for a peak demand of 15 gallons per person per shift. Since this is peak demand, an average demand of 7.5 gallons per person per shift was used. Using 7.5 gallons per person and 20 persons per acre, the demand was calculated to be 150 gallons per acre. This was assumed to not include irrigation; therefore, this value was used to calculate sewer demand. For water demand including irrigation, a value of 175 gallons per acre was used.

Table 5-5 includes an example calculation for proposed commercial or industrial demand on a 10-acre parcel located in the Flat Rock Service Area.

Table 5-5. Example Commercial or Industrial Demand Calculation

Parameter	Value	Note
Parcel Area (acres)	10	Total Parcel Area
Developable Area (acres)	6	60% of Parcel Area
Water Demand (GPD)	1,050	175 GPD per Developable Acre
Sewer Demand (GPD)	900	150 GPD per Developable Acre

5.4.4 Mixed Use Water Demands

For areas identified as future mixed-use development, the County provided the following breakdown of residential and commercial for each service area. The demands were calculated as described above for residential and commercial uses. The total developable area of each parcel was divided into residential and commercial areas using the breakdowns in **Table 5-6**.

Table 5-6. Percentage of Commercial and Residential in Mixed Use Development

Service Area	Residential	Commercial
Route 711	50%	50%
Courthouse	60%	40%
Flat Rock	10%	90%

5.5 Water Demand Factors

Maximum day demand (MDD) projections were estimated based on reviewing daily water production and supply data for the Flat Rock Water System. The maximum days reported were unusually high potentially due to a water main break or fire flow event; therefore, the 98th percentile was used to calculate the peaking factor. **Table 5-7** includes the average day, and max day for the County Line and Booster Station. The peaking factor was calculated by dividing the 98th percentile by the average day. For the purposes of this Master Plan the peak day factor was conservatively rounded to 2.0. It is assumed that the Route 711 and Courthouse service areas would experience a similar peaking factor; therefore, 2.0 was also used for the peak day factor in those areas. The MDD is calculated by multiplying the average day by 2.0. The peak hour demand (PHD) is calculated by multiplying the average day demand (ADD) by 4.0 or the MDD by 2.0.

Table 5-7. Water System MORs (2021 – 2024)

	Avg Day (GPD)	Max Day (GPD)	Max Day 98th Percentile (GPD)	Peak Factor using 98th Percentile
County Line	151,700	839,000	281,200	1.85
Booster Station	120,000	501,000	231,500	1.93

5.6 Water Demand Projections

Table 5-10 summarizes average water demand distributions for each five-year time increment throughout the planning period (existing, 2030, 2035, 2040, and 2045) by service area (Courthouse, Flat Rock, and Rt 711) and proposed development parcel. **Figure 5-1** through **Figure 5-3** show the proposed development for each growth area and time increment.

5.7 Water Demand Summary

A summary of average water system demand by service area and year is provided in **Table 5-8.**

Table 5-8. Average Water Demand

	Average Water Demand (GPD)				
	Existing	**2030**	**2035**	**2040**	**2045**
Courthouse	60,000[1]	78,600	82,500	139,300	139,300
Flat Rock	151,700[2]	233,200	603,600	664,800	715,200
Rt 711	90,000[3]	90,000	112,800	259,400	287,900
TOTAL	**301,700**	**401,800**	**798,900**	**1,063,500**	**1,142,400**

1. Courthouse Water System is served by privately owned Aqua Virginia.
2. Flat Rock is served by the County. The existing demand is based on the average demand from 2021 – 2024 at the County Line. This demand includes a current flushing of approximately 85,000 GPD.
3. Route 711 System is served by privately owned Founders Bridge Utility Company.

5.8 Wastewater Demand Projections

Table 5-11 summarizes average sewer demands for each five-year time increment throughout the planning period (existing, 2030, 2035, 2040, and 2045) by service area (Courthouse, Flat Rock, and Rt 711) and proposed development parcel. **Figure 5-1** through **Figure 5-3** show the proposed development for each service area and time increment.

5.8.1 Wastewater Demand Summary

A summary of average wastewater system demand by service area and year is provided in **Table 5-9.**

Table 5-9. Average Wastewater Demand

	Average Wastewater Demand (GPD)				
	Existing	**2030**	**2035**	**2040**	**2045**
Courthouse	38,600[1]	54,400	57,700	106,100	106,100
Flat Rock	52,200[2]	136,300	415,500	510,100	553,300
Rt 711	33,750[3]	33,750	53,350	178,250	202,450
TOTAL	**124,550**	**224,450**	**526,550**	**794,450**	**861,850**

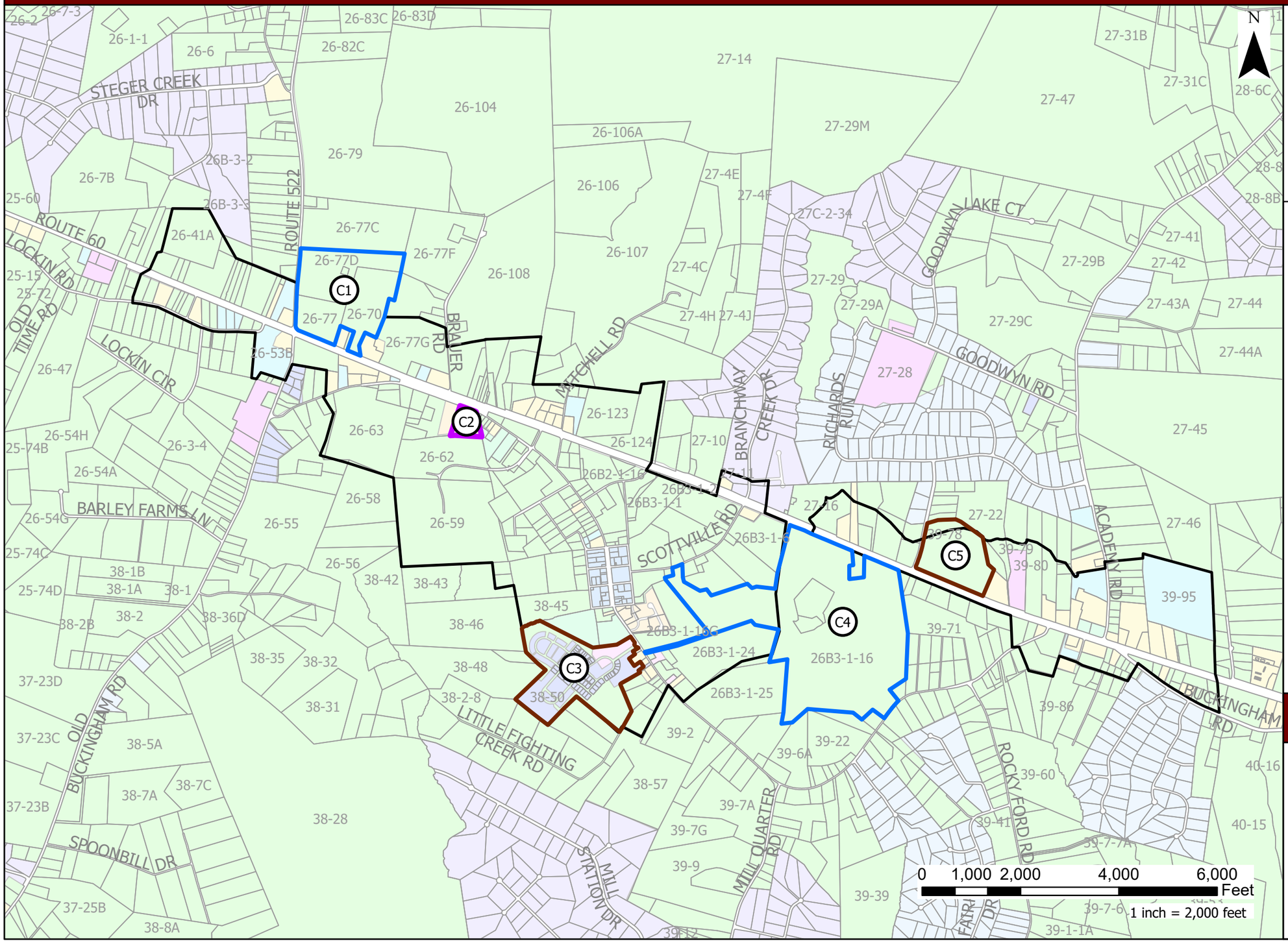
1. Courthouse is served by the County's Fighting Creek WWTP which has an average flow of 38,600 GPD based on data provided from 2021-2024.
2. Flat Rock is served by the County's Dutoy WWTP which has an average flow of 52,500 GPD based on data provided from 2021-2024.
3. Route 711 System is served by privately owned Founders Bridge Utility Company.

Table 5-10. Average Day Water Demand Projections										
Map ID			Future Residential Demand (gpd)	Future Commercial Demand (gpd)	Future Industrial Demand (gpd)	Existing	2030	2035	2040	2045
						Water Usage (gpd)				
Courthouse										
	Existing Demand					60,000				
C1	Mixed Use	Mixed	11,300	3,300	-				14,600	
C2	Depot	Mixed	3,600	300	-			3,900		
C3	Scottsville Buildout	Residential	1,200	-	-		1,200			
C4	Lewis Property	Mixed	32,700	9,500	-				42,200	
C5	Spring Branch	Mixed	15,900	1,500	-		17,400			
		Total Demand	**64,700**	**14,600**	**-**	**60,000**	**78,600**	**82,500**	**139,300**	**139,300**
Flat Rock										
	Existing Demand					66,700				
F1	Mixed Use	Mixed	3,200	12,800	-				16,000	
F2	Mixed Use	Mixed	1,800	7,000	-		8,800			
F3	Residential	Residential	26,100	-	-			26,100		
F4	West of Judges Ferry Rd	Mixed/Industrial/Data	-	-	33,600					33,600
F5	Commercial/Industrial	Commercial/Industrial	-	-	2,000			2,000		
F6	Commercial/Industrial	Commercial/Industrial	-	-	5,600				5,600	
F7	Light Industrial	Light Industrial	-	-	5,300			5,300		
F8	Residential	Residential	16,900	-	-				16,900	
F9	Parcel 42-79	Mixed	1,900	7,400	-			9,300		
F10	Light Industrial	Light Industrial	-	-	4,400		4,400			
F11	Industrial	Industrial	-	-	16,800					16,800
F12	Mixed Use	Mixed	15,000	59,100	-			74,100		
F13	Data Center (future)	Data	-	240,000	-			240,000		
F14	Data Center	Data	-	100,000	-		100,000			
F15	Oakbridge Area	Mixed	8,000	3,100	-			11,100		
F16	Oakbridge Area	Mixed	1,000	400	-			1,400		
F17	Oakbridge Area	Mixed	800	300	-			1,100		
F18	Residential	Residential	72,700	-	-				72,700	
F19	Mixed Use	Mixed	700	2,600	-		3,300			
	Flushing Demand		-	-	-	85,000	50,000	50,000		
		Total Demand	**148,100**	**432,700**	**67,700**	**151,700**	**233,200**	**603,600**	**664,800**	**715,200**
Route 711										
	Existing Demand					90,000				
R1	Mixed Use	Mixed	102,000	44,600	-				146,600	
R2	Commercial	Commercial	-	22,800	-			22,800		
R3	Mixed Use	Mixed	19,800	8,700	-					28,500
		Total Demand	**121,800**	**76,100**	**-**	**90,000**	**90,000**	**112,800**	**259,400**	**287,900**
					TOTAL AVERAGE DAY	**301,700**	**401,800**	**798,900**	**1,063,500**	**1,142,400**

1. The Courthouse Service area is currently served by privately owned Aqua Virginia. The permitted capacity is 176,000 gpd. The maximum day demand is 120,000 gpd. A peaking factor of 2 was assumed for an average day demand of 60,000 gpd.

2. The Route 711 Service area is currently served by privately owned Founders Bridge Utility Company. The peak water capacity is 180,000 gpd. A peaking factor of 2 was assumed for an average day demand of 90,000 gpd.

FIGURE 5-1. Courthouse Proposed Development



Legend

Area of Future Development
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- Growth Area
- (XX) Map ID

Zoning
- Agricultural-10
- Agricultural/Animal Confinement
- General Commercial
- Commerce Center
- Commerce Center Planned Development
- Courthouse Square Center
- Crossroads
- Light Industrial
- Heavy Industrial
- Mining and Mineral Extraction
- Office
- Single Family Residential
- Rural Residential
- Residential Utility
- Rural Residential 5
- Village Center
- Village Center Planned Development
- Village Residential Planned Development

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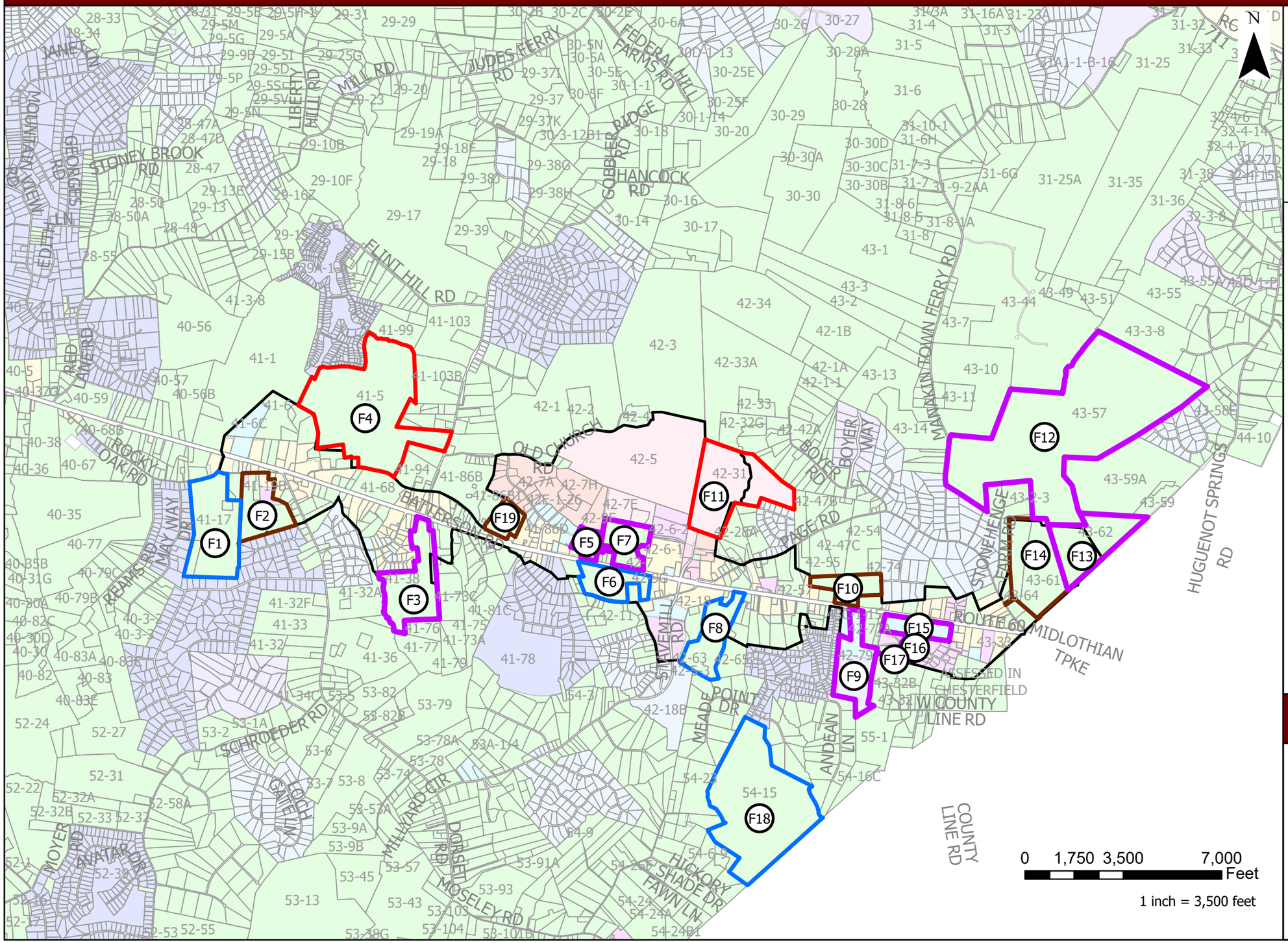
FIGURE 5-2. Flat Rock Proposed Development



N

Legend

Area of Future Development
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- Growth Area
- (XX) Map ID

Zoning
- Agricultural-10
- Agricultural/Animal Confinement
- General Commercial
- Commerce Center
- Commerce Center Planned Development
- Courthouse Square Center
- Crossroads
- Light Industrial
- Heavy Industrial
- Mining and Mineral Extraction
- Office
- Single Family Residential
- Rural Residential
- Residential Utility
- Rural Residential 5
- Village Center
- Village Center Planned Development
- Village Residential Planned Development

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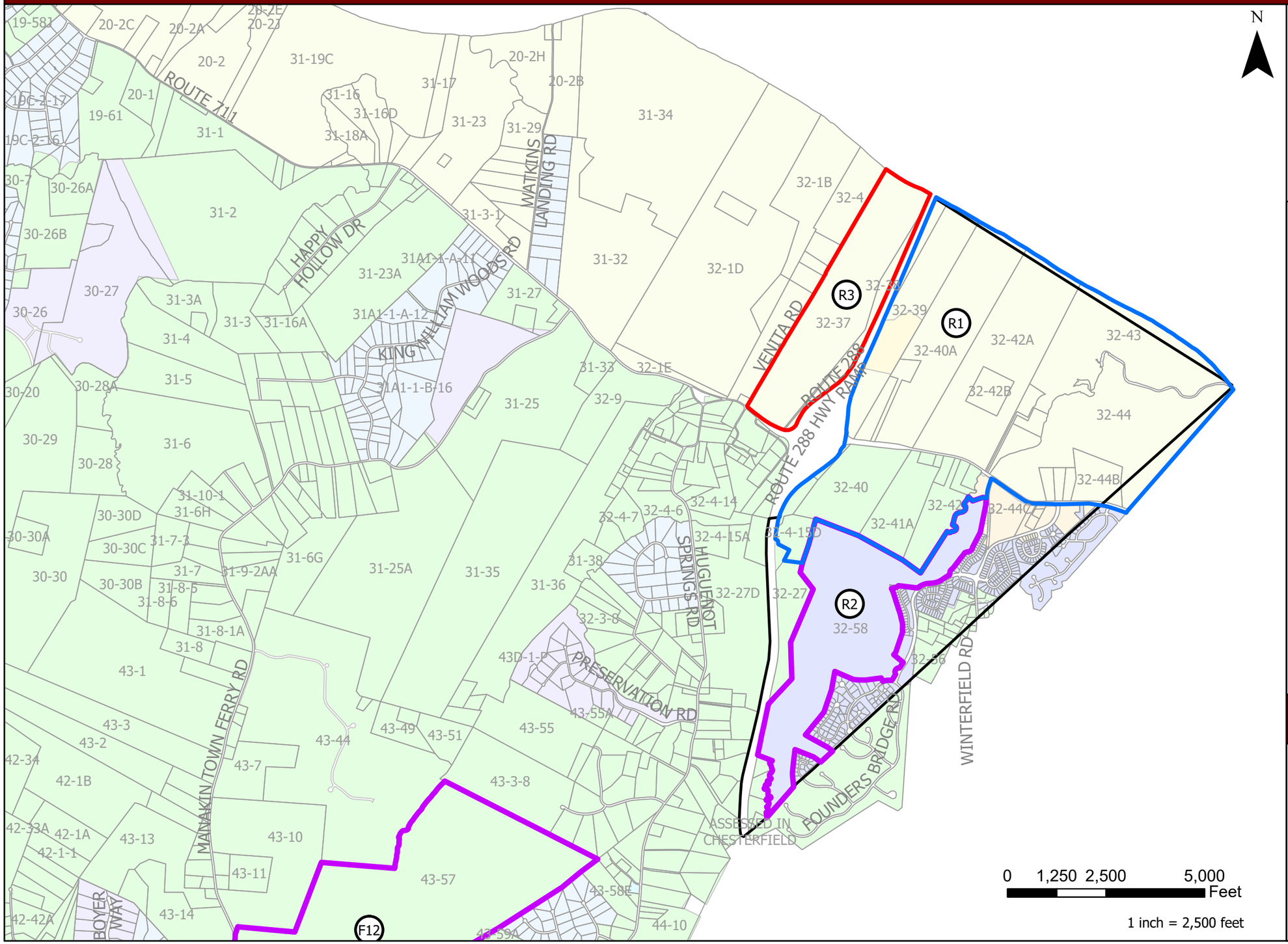
FIGURE 5-3. Route 711 Proposed Development



Legend

Area of Future Development
- 1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- Growth Area
- (XX) Map ID

Zoning
- Agricultural-10
- Agricultural/Animal Confinement
- General Commercial
- Commerce Center
- Commerce Center Planned Development
- Courthouse Square Center
- Crossroads
- Light Industrial
- Heavy Industrial
- Mining and Mineral Extraction
- Office
- Single Family Residential
- Rural Residential
- Residential Utility
- Rural Residential 5
- Village Center
- Village Center Planned Development
- Village Residential Planned Development

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Table 5-11. Average Day Sewer Demand Projection										
Map ID			Future Residential Demand (gpd)	Future Commercial Demand (gpd)	Future Industrial Demand (gpd)	Existing	2030	2035	2040	2045
						Sewer Demand (gpd)				
Courthouse										
	Existing Demand					38,600				
C1	Mixed Use	Mixed	9,600	2,800	-				12,400	
C2	Depot	Mixed	3,100	200	-			3,300		
C3	Scottsville Buildout	Residential	1,000	-	-		1,000			
C4	Lewis Property	Mixed	27,800	8,200	-				36,000	
C5	Spring Branch	Mixed	13,500	1,300	-		14,800			
		Total Demand	**45,400**	**9,700**	**-**	**38,600**	**54,400**	**57,700**	**106,100**	**106,100**
Flat Rock										
	Existing Demand					52,200				
F1	Mixed Use	Mixed	2,800	10,900	-				13,700	
F2	Mixed Use	Mixed	1,500	6,000	-		7,500			
F3	Residential	Residential	22,200	-	-			22,200		
F4	West of Judges Ferry Rd	Mixed/Industrial/Data	-	-	28,800					28,800
F5	Commercial/Industrial	Commercial/Industrial	-	-	1,700			1,700		
F6	Commercial/Industrial	Commercial/Industrial	-	-	4,800				4,800	
F7	Light Industrial	Light Industrial	-	-	4,500			4,500		
F8	Residential	Residential	14,300	-	-				14,300	
F9	Parcel 42-79	Mixed	1,600	6,300	-			7,900		
F10	Light Industrial	Light Industrial	-	-	3,800		3,800			
F11	Industrial	Industrial	-	-	14,400					14,400
F12	Mixed Use	Mixed	12,700	50,600	-			63,300		
F13	Data Center (future)	Data	-	168,000	-			168,000		
F14	Data Center	Data	-	70,000	-		70,000			
F15	Oakbridge Area	Mixed	6,800	2,700	-			9,500		
F16	Oakbridge Area	Mixed	800	300	-			1,100		
F17	Oakbridge Area	Mixed	700	300	-			1,000		
F18	Residential	Residential	61,800	-	-				61,800	
F19	Mixed Use	Mixed	600	2,200	-		2,800			
		Total Demand	**125,200**	**315,100**	**58,000**	**52,200**	**136,300**	**415,500**	**510,100**	**553,300**
Route 711										
	Existing Demand					33,750				
R1	Mixed Use	Mixed	86,700	38,200	-				124,900	
R2	Commercial	Commercial	-	19,600	-			19,600		
R3	Mixed Use	Mixed	16,800	7,400	-					24,200
		Total Demand	**86,700**	**57,800**	**-**	**33,750**	**33,750**	**53,350**	**178,250**	**202,450**
					TOTAL AVERAGE DAY	**124,550**	**224,450**	**526,550**	**794,450**	**861,850**

1. Courthouse Fighting Creek WWTP Average Day 38,628 gpd
2. Flat Rock Dutoy WWTP Average Day 52,532 gpd
3. The Route 711 Service area is currently served by privately owned Founders Bridge Utility Company. The peak wastewater capacity is 135,000 gpd. A peaking factor of 4 was assumed for an average day demand of 33,750 gpd.

6. System Modeling

6.1 General

The County's water and wastewater systems were modeled in order to evaluate system conditions throughout the planning period to identify improvements required to meet future needs. Computer modeling software was used to develop the system models, which were loaded with water and wastewater demand projections that were developed as described in **Section 5** and calibrated to reflect actual conditions within the County. The models were then used to evaluate cost-effective improvement scenarios required to support future development.

Brief summaries of the water and wastewater system modeling software packages, model development activities, system loading procedures, assumptions, calibration techniques, and modeling scenarios are provided in the following sections.

6.2 Water Model

Water system modeling activities were conducted utilizing the Bentley WaterGEMS Modeling Software.

6.2.1 Model Build

The water model was updated utilizing data from the County's GIS and supplemented by available record drawing information, field verification of above ground features and survey data. Elements that were included in the water system model consisted of the following:

- Water distribution lines (with pipe roughness coefficient ranging from 100 to 150) ranging in diameter from 1-inch to 12-inch
- Water storage tanks
- Water booster stations
- Other source water connections

Pipe modeling information was based on a GIS geodatabase provided by the Couty and updated by Dewberry. The GIS data was supplemented by record drawing information as needed to fill in data gaps.

Junctions in the model were created automatically by the WaterGEMS model at each change in pipe size, change in pipe direction, such as intersections, and any "break" in GIS pipes, such as valves. Each junction was assigned an elevation in the model based on GIS topography contours provided by the County. Waterlines were assumed be at a depth of 3.5 feet.

A schematic of existing water lines that were included in the model are shown in **Figure 3-1** and **Figure 3-2.** The Courthouse and Rt 711 service areas were not included in the water model since they are owned and operated by private utility companies.

6.2.2 Model Demand Allocation

Demands were allocated to the model in order to simulate system conditions under both average and maximum day demands. These demands were allocated in the model to the nearest node based on geo-coded service addresses for existing customers or assumed connection points for future development. A detailed summary of system demands is provided in **Sections 3** and **5**.

6.2.3 Model Calibration

Dewberry developed and assisted the County in performing hydrant flow tests in 11 different locations throughout the Flat Rock Service Area. Residual, static, pitot pressures and flows were recorded. The hydrant testing plan is included for reference as **Appendix E**.

The WaterGEMS software includes a calibrator feature that uses an algorithm to adjust pipe roughnesses based on information input from the hydrant testing, demand information, operational controls, and tank elevation. Pipes are separated into pipe roughness groups based on pipe size and geographic area. Each hydrant test's observed flow rate, residual and static pressure, and corresponding storage tank level (for hydrants downstream of the County's storage tank) were input into the calibrator. Based on the observed

flow rates and tank level, the calibrator modifies the pipe roughness coefficients of each roughness group. When the calibrator finishes, the solution's "fitness" can be graphically summarized by comparing the observed HGL and simulated HGL for each static and residual pressure reading taken during the hydrant testing. **Figure 6-1** displays the fitness of the calibration.

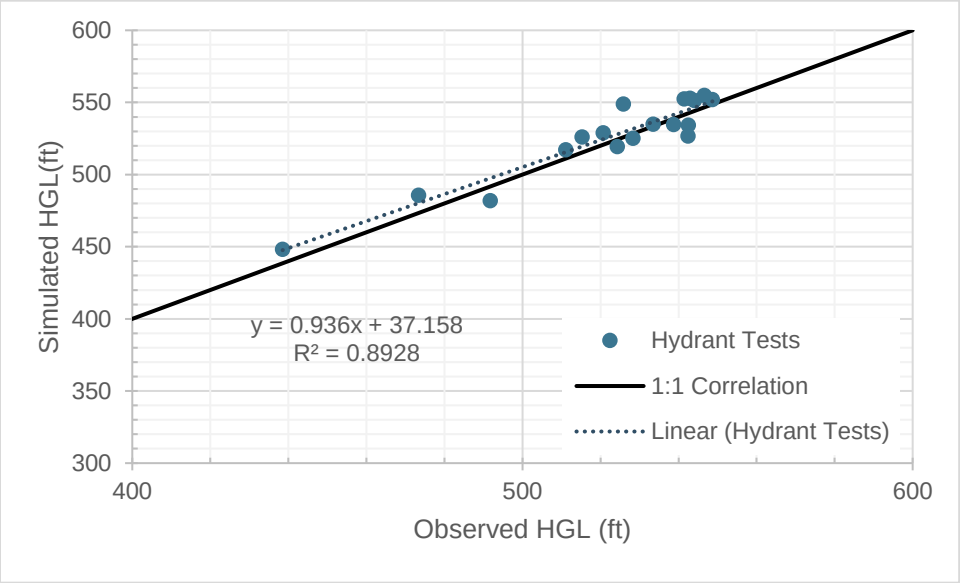


Figure 6-1. Calibration Fitness

As observed in **Figure 6-1**, the fitness of the data is fairly close to a 1:1 correlation. However, it is noted that there are hydrant tests that significantly underpredict and overpredict the simulated flows. These points can be seen further away from the 1:1 correlation line. While these points do affect the overall fitness of the calibration, they lie within the acceptable error for calibration. Hydrant Tests 7 and 12 were removed from the model calibration due to the difference in the observed and simulated HGL. The error seen could be the result of a valve being left partially closed after maintenance or incorrect pipe diameter information in the model compared to actual conditions. Additional investigation into each of these hydrant tests is recommended.

6.2.4 Model Scenarios

Once the model was calibrated, steady-state model runs were used for the ADD, MDD, and PHD for each of the time increments (2024, 2030, 2035, 2040, and 2045) within the planning period to verify the system pressures were above the minimum.

Available fire flow was determined by running a fire flow analysis using MDD with the WBS turned off. The County requires 2,000 GPM for a 2-hour period for commercial areas and 1,000 GPM for a 2-hour period for residential areas.

Following the steady state fire flow analysis, extended period simulations for 20-day periods using average day demands were run for each of the time increments to identify areas of high water age. Water age was determined with a starting point of 0 hours at the Chesterfield connection. Multiple areas reached a water age of greater than 14 days, indicating the need for looping of water lines and flushing.

Water model results are included in **Appendix C**.

By evaluating the adequacy of the system at each time increment through the planning period, the timing of individual CIP requirements was determined. The analysis led to the development of the water system improvement program that is described in detail in **Section 7**.

6.3 Wastewater Model

Sewer system modeling activities were conducted utilizing the Bentley SewerGEMS Modeling Software.

6.3.1 Model Build

The sewer model was updated utilizing data from the County's GIS and supplemented by available record drawing information, field verification of above ground features and survey data. Elements that were included in the sewer system model consisted of the following:

- Gravity sewer lines 6-inches in diameter or greater, as determined to be necessary for accurate modeling
- Wastewater pump stations
- Force main piping

A schematic of existing gravity sewer lines, wastewater pump stations, and force main piping that were included in the model are shown in **Figure 4-1**, **Figure 4-2**, and **Figure 4-3**.

Information from the GIS database was used, where possible, to provide information on pipe lengths, slopes, and ground and invert elevations and to establish continuity throughout the system. For portions of the system where available information was not available in GIS data, invert and ground elevations were taken from record drawings.

6.3.2 Model Loading Allocation

The wastewater system model was loaded through individual manholes within the distribution system. Existing residential, commercial and industrial demands were distributed to the nearest manhole in the system. A total of 101 manholes throughout the system were loaded with demands in the baseline year.

6.3.3 Model Calibration

The wastewater system model was calibrated for the baseline year of 2023 to reflect actual flows at the end points of each of the two sewer basins, the Dutoy Creek WWTP and the Fighting Creek WWTP.

Drawdown testing was performed at the Flat Rock PS, Frisby's PS, Pocahontas PS and Academy Road PS. Two draw down tests were completed for each pump for a total of four draw down tests per pump station. The fill rate was calculated by measuring the increase in wet well level over a time period (one minute for most). The total flow rate leaving the station was calculated by adding the fill rate to the calculated drawdown rate. The Hazen-Williams C value, which indicates the roughness of the pipe based on material and age, was adjusted in the modeled force mains with the results of the drawdown tests. The calculated average pumping rate for each pump station that was used in the calibration is included in **Table 6-1**.

Table 6-1. Sewer Pump Station Draw Down Test Results

Pump Station	Calculated Flow Rate (GPM)	Pump Design Point
Flat Rock	799	600 GPM @ 100 ft TDH
Frisby's	654	700 GPM @ 55 ft TDH
Pocahontas	213	200 GPM @ 70 ft TDH
Academy Road	160	350 GPM @ 95 ft TDH

6.3.4 Model Scenarios

Utilizing loading and model inputs from the calibrated model and **Table 5-11**, average and peak hourly flow analyses were run for each of the time increments (2024, 2030, 2035, 2040, and 2045) within the planning period to evaluate system improvement requirements and identify Master Plan Capital Improvement Projects (CIPs). By evaluating modeled system flows at each of the time increments, the timing of individual CIP requirements was determined. This analysis led to the development of the wastewater system improvement program that is described in detail in **Section 8.**

Wastewater model results are included in **Appendix D**.

7. Water System Improvements

7.1 General

This section of the Master Plan Update presents an overview of system improvements that are proposed to provide water service within the County's WSSA through the Year 2045. In general, the County constructs projects required to provide adequate water supply to an area, and the private sector constructs projects required to provide water service to a specific area. Both VDH and County requirements were considered when developing this plan.

The proposed water improvements map, included in **Appendix A** of this report, provides a graphical presentation of the recommended water system improvements. Improvements shown on this plate are color coded by the year that the improvement is needed and that corresponds to the water system cost estimates for cross-referencing.

In addition, there are some developer-driven improvements identified that are recommended to be constructed and paid for by private development. Other currently unidentified developer-driven improvements may be necessary as development occurs through the planning period.

In general, the water system improvements program involves improvements to water supply, water storage, and water distribution to ensure adequate supply and pressures throughout the planning period.

It should be noted that these improvements do not address operational or maintenance improvements, which are funded by user fees.

A brief overview of improvements is provided in the following sections and are shown in **Figure 7-1, Figure 7-2,** and **Figure 7-3.** More detailed descriptions of individual CIPs are provided at the end of this section. Improvements shown correspond to the water system cost estimates for cross-referencing.

7.2 Water Supply Capacity

An evaluation of the planning period from existing to 2045 indicates that with the anticipated development, the County's available water supply will not be sufficient to meet peak system demands between the year 2030 and 2035. **Table 7-1** provides a summary of the existing water supply sources for the County's water service areas and **Table 7-2** shows the projected maximum day water demands through the end of the planning period in 2045.

Table 7-1. Existing Water Supply Sources

Existing Supply Source	Service Area	Maximum Day Capacity (GPD)
Chesterfield County (Route 60)	Flat Rock	572,000
Aqua Virginia[1]	Courthouse	176,000
Founders Bridge Utility Company[1]	Route 711	180,000
Total		928,000

1. Privately owned water system

Table 7-2. Water Demand Projections (Maximum Day Demands)

Demand Projections (MGD)					
	Existing	2030	2035	2040	2045
Flat Rock Service Area	0.303	0.466	1.207	1.330	1.430
Courthouse Service Area	0.120	0.157	0.165	0.278	0.279
Route 711 Service Area	0.180	0.180	0.226	0.519	0.576
Total	**0.603**	**0.804**	**1.598**	**2.127**	**2.285**

Additional water supply will need to be provided to ensure reliable water service to County residents in order to meet projected maximum day and peak hour demands.

7.2.1 New Water Supply Alternatives

7.2.1.1 Additional Supply from Chesterfield County

The County is interested in increasing their water supply allocation with Chesterfield, which is currently a maximum day of 572,000 GPD. A second interconnection with Chesterfield can be added at Robious Road to serve the Route 711 Service Area and provide additional redundancy back to the Flat Rock System. This interconnection is not a prerequisite for receiving additional water from Chesterfield as the existing 12" waterline on Route 60 can support up 3.5 MGD of total flow. It is not known if system improvements would be required on the Chesterfield side of the interconnection to increase the water supply allocation to the County. If Chesterfield is unable to increase the water supply allocation to the County, a new water supply would be required.

7.2.1.2 New Intake and Water Treatment Plant Owned and Operated by the County

The County has considered building their own intake, either on the James River or Appomattox River, and water treatment plant. This alternative would require extensive permitting, design and construction cost. The County would also need additional staff, including licensed operators, to operate the new treatment plant and associated infrastructure. Between permitting and construction, this alternative would not likely be completed between the year 2030 and 2035 when the demand projections show a need for additional water supply. Due to the schedule and cost for this alternative, a new water treatment plant is not recommended at this time.

7.2.1.3 New Water Supply Connection with Regional Partner

A new water supply connection could be located at the far northeast corner of the County with a regional partner. Henrico has expressed interest in providing water to the County and has proposed an initial capacity of 2.5 MGD. An interconnection with Henrico would include the construction of a 20-inch transmission main under the James River. The transmission main would be routed along Route 711 and Interstate 288 supplying both the Route 711 and Flat Rock Service Areas. A WBS is anticipated since the hydraulic grade line in the adjacent water system is anticipated to be lower than the Flat Rock Water System. An EST will also be required to supply fire flow and meet storage requirements. A chloramine booster station will also likely be needed due to the length of pipe and resulting water age, which can be located at the EST or WBS site. An agreement would have to be signed with the supplying partner to provide water supply. The County would purchase finished water from the supplying partner similar to the existing water supply agreement with Chesterfield. A new supply connection with a regional partner does not give the County ownership of any amount of water.

Alternatively, if Chesterfield is able to increase the water supply allocation to the County, an additional interconnection with Chesterfield could be constructed at Robious Road to serve the Route 711 Service Area and provide additional redundancy back to the Flat Rock Water System. This interconnection is not a prerequisite for receiving additional water from Chesterfield. Coordination with Chesterfield will be needed to gauge interest and confirm the WBS requirements based on the new interconnection. The water

transmission main from Route 711 to Route 60 would follow the same route as the new supply connection with Henrico alternative.

If the County decides to build a water treatment plant on the James River in the future, the infrastructure constructed as part of the new supply connection can be used including the transmission main, WBS and EST. Furthermore, the easements procured for the water transmission main can be utilized for the Dutoy Creek WWTP outfall relocation further discussed in **Section 8.2.1.2** and the Route 711 PS further discussed in **Section 8.2.2.1**. Additional area should be included in the easements for the future parallel transmission line.

7.2.1.4 Route 522 Water Supply Project

The 2014 Master Plan included the Route 522 Water Supply Project as an option. This would include a connection point with the Virginia Department of Corrections (VDOC) along Route 522 at James River, a new WBS (near James River and Route 522), and a new 0.5 MG EST (near Route 522 and Route 60). A 16-inch waterline would need to be constructed along Route 522 to the Courthouse Service Area and then along Route 60 to the Flat Rock Service Area. A long stretch of the finished water main would be constructed in a rural area of the County, not within the WSSA where projected development is expected or desired. The connection with a regional partner offers more flexibility to serve all three service areas; therefore, the Route 522 Water Supply Project option has not been further evaluated.

7.2.2 Route 711 Service Area

The Route 711 Service Area is currently served by the FBUC and has a maximum day capacity of 180,000 GPD. It is assumed that the FBUC is currently at maximum capacity and any future development will require a new water source. The proposed new connection with a regional partner will supply future development in this area. The demand projections predict development in the Route 711 Service Area in 2035. It is assumed that any distribution infrastructure would be paid for by developers.

7.2.3 Flat Rock Service Area

Additional demands to the Flat Rock Service Area will be supplied by the proposed connection with a regional partner. The 20-inch water transmission main will run along Interstate 288 and tie-in to the existing water transmission main that runs along Route 60. The Flat Rock Service Area is anticipated to exceed its supply allocation from Chesterfield between the years 2030 and 2035. Since approximately 70% of the water usage is due to flushing or non-revenue water, it is recommended that measures be undertaken by the County to reduce this. The actual year that additional water supply will be required will be dependent on how successfully the County can reduce non-revenue water and optimize flushing.

It is recommended that the following steps be taken by the County to reduce water usage:

1. Water System Audit
   The purpose of the audit is to determine the sources of unaccounted for water (non-revenue water) in the distribution system.

2. Chloramine Booster Station Evaluation
   The construction of a chloramine booster station is anticipated, based on limited available information, to reduce flushing requirements because it would maintain disinfectant residual for a longer water age. Although the addition of a chloramine booster station would increase water system operational and maintenance requirements, it would be worthwhile if water supply could be conserved. It is recommended that a detailed study be conducted to evaluate the feasibility and benefits of a chloramine booster station.

3. Construct loop from existing water line at intersection of Carter Gallier Blvd and Old Church Road along Old Church Road to connect to existing water line on Judes Ferry Rd (near Powhatan High School). Adding this loop will help reduce water age along Carter Gallier Blvd and will reduce the need for flushing at the end of the pipe at the intersection of Carter Gallier Blvd and Old Church Road.

If Chesterfield is not able to increase the maximum day water allocation to the County through the Route 60 connection, the construction of a connection with a regional partner will be required to serve the projected MDD.

7.2.4 Courthouse Service Area

The Courthouse Service Area is currently served by Aqua and has a maximum day capacity of 176,000 GPD. The existing demands of the Courthouse Service Area are not fully known since Aqua, a private company, manages the supply and distribution system. The Courthouse service area is anticipated to increase average day water demand by approximately 79,300 GPD (55 GPM) by the year 2040. It is anticipated that the service area will exceed the existing permitted maximum day capacity by the year 2030. It is assumed that Aqua will be able to increase their permitted maximum day capacity to serve this additional demand.

The Aqua system was not included in the water system model since it is not owned or operated by the County. If the Fighting Creek WWTP is taken offline and pumped to the Flat Rock wastewater system, then a parallel waterline extending to the Courthouse system from the Flat Rock system should be evaluated and future master plans should consider connecting the two systems.

7.3 Water Storage

Equalization storage is needed to meet daily peak demands and at a minimum should be equal to 20 percent of the maximum day demand over 24 hours. The increase in storage requirement over time is a direct result of the increased equalization requirement due to the increase in system demand. Based on the direction provided by the County, system storage required for fire flow is equal to 240,000 gallons, which is the volume of water needed for the County's design standard of a 2,000 GPM, 2-hour duration fire event in a non-residential area. The storage required through the end of the planning period is summarized in **Table 7-3.**

Table 7-3. Water Storage Requirements

Water Storage Requirement (MG)					
	Existing	2030	2035	2040	2045
Flat Rock Service Area Storage Required	0.273	0.319	0.475	0.512	0.532
Courthouse Service Area Storage Required	0.264	0.271	0.273	0.295	0.295
Route 711 Service Area Storage Required	0.276	0.276	0.285	0.344	0.355
Total Storage Required	0.812	0.866	1.032	1.151	1.183

7.3.1 Route 711 Service Area

The Route 711 Service Area has been projected by County staff to need water service by the year 2035. A 0.5 MG EST is proposed in **Section 7.3.3**.

7.3.2 Courthouse Service Area

The Courthouse Service Area is currently served by one 0.01 MG GST and one 0.04 MG GST for a total of 0.05 MG of storage. The County owns a non-potable 0.5 MG EST located at 3977 Old Buckingham Road that is used for fire protection of the schools. This tank could be converted to a potable EST to meet the system's storage and fire flow requirements.

7.3.3 Flat Rock Service Area

The Flat Rock Service Area is currently being served by the Flat Rock EST. To meet the storage requirements through the end of the planning period, it is recommended that a 0.5 MG EST be constructed at the high point elevation near Dragonnade Trail along the proposed transmission main from connection with a regional partner.

7.4 Water Distribution System

The improvements recommended for the water distribution system are generally required to address one or more of the following issues:

- Improvements needed to meet the growing system demands in areas already served.
- Improvements desired to improve system reliability and/or service.
- Improvements needed to provide service to new areas within the Water Service Area(s).

As discussed in **Section 6** of this report, a model of the County's water distribution system was used to evaluate system improvements required to address these three criteria. Extended Period Simulations (EPS) were performed using projected MDDs, and results of these EPS simulations identified storage deficiencies, low or high pressure areas, and low fire flow areas.

7.4.1 Route 711 Service Area

The Route 711 water system does not currently have existing public water distribution system infrastructure. As part of a water supply project, the County will construct a water transmission main from the connection with a regional partner, WBS, chloramine booster station and EST. It is assumed that any distribution system infrastructure would be paid for by developers.

7.4.2 Courthouse Service Area

The Courthouse Service Area contains a significant amount of small diameter piping within the distribution system and limited system storage; therefore, the existing infrastructure does not supply the targeted fire flow of 2,000 GPM for a 2-hour duration for non-residential areas. This is of importance because the Courthouse Service Area includes commercial properties, several schools, and County administration buildings. If the County builds infrastructure to supply proposed new development in the Courthouse area, the distribution system should be sized to provide adequate fire flow. Furthermore, the condition of the existing distribution system is unknown. If the County acquires the Courthouse system, additional infrastructure improvements may be required since the age and condition of the existing system is unknown.

7.4.3 Flat Rock Service Area

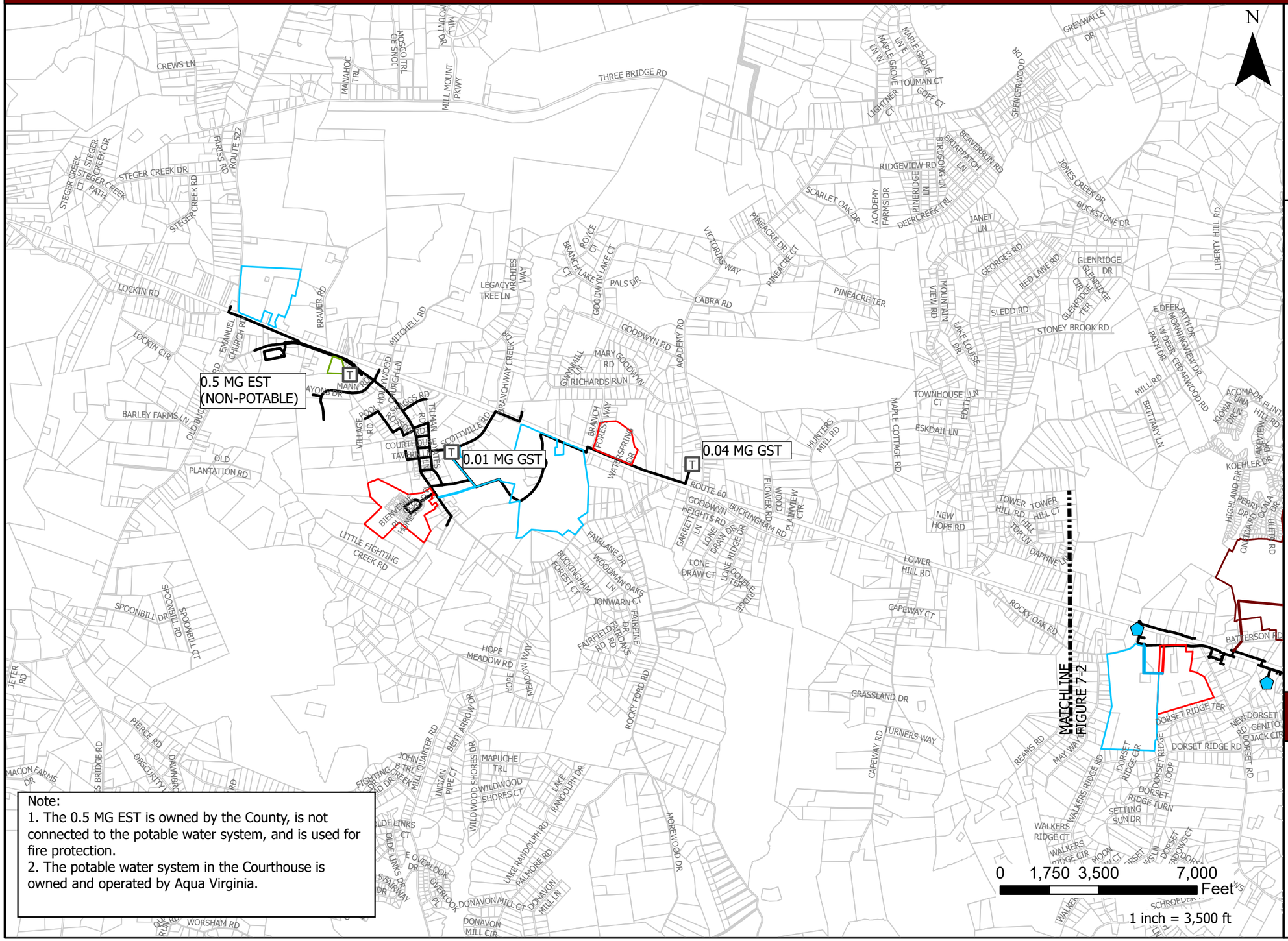
Based on the water demand projections, the Flat Rock Service Area will require additional water supply between 2030 and 2035. This will necessitate the interconnection with a regional partner to serve the Route 711 and Flat Rock Service Area. It is assumed that any distribution system infrastructure off of the main transmission line would be paid for by developers.

7.5 Water Improvement Program

A summary of the recommended water system improvements is provided on the following pages. For ease of discussion, water system improvements are broken out into the three service areas, Courthouse, Flat Rock, and Route 711. The proposed water improvements are shown on **Figure 7-1**, **Figure 7-2**, and **Figure 7-3.**

Descriptions of the proposed water system improvements, organized by service area, are provided on the following pages. The description lists the requirements for the improvements, the timing of the improvement, and a general description of the improvement. Additional details on costs associated with the water improvement program are provided in **Section 9** of this Master Plan Update.

FIGURE 7-1. Water System Improvements



Legend

- Existing WBS
- Existing Tanks
- Chesterfield Connection Point
- Existing Water Main
- Existing Autoflusher

Future Water Mains
- 2030
- 2035
- 2040
- 2045

Future Connection Point
- 2035

Future WBS
- 2035

Future Tank
- 2035

Area of Future Development
- 2030
- 2035
- 2040
- 2045

Note:
1. The 0.5 MG EST is owned by the County, is not connected to the potable water system, and is used for fire protection.
2. The potable water system in the Courthouse is owned and operated by Aqua Virginia.

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FIGURE 7-2. Water System Improvements

7,400 LF 8" WATER LINE TO PARCEL 41-5 (F4)

2,500 LF 8" LOOP AT OLD CHURCH RD

0.5 MG FLAT ROCK EST

WATER BOOSTER STATION

MATCHLINE FIGURE 7-1

MATCHLINE FIGURE 7-3

0.5 MG EST

2,800 LF OF 12" WATER LINE TO PARCEL 43-57 (F12)

38,500 LF OF 20" TRANSMISSION MAIN

1,400 LF OF 20" WATER LINE TO PARCEL 43-61 (F14)

1,700 LF OF 8" WATER LINE TO PARCEL 41-17 (F1)

5,600 LF OF 8" WATER LINE TO PARCEL 41-19B (F2)

5,600 LF OF 12" WATER LINE TO PARCEL 54-15 (F18)

N

0 1,750 3,500 7,000 Feet

1 inch = 3,500 ft

Legend

- Existing WBS
- Existing Tanks
- Chesterfield Connection Point
- Existing Water Main
- Existing Autoflusher

Future Water Mains
- 2030
- 2035
- 2040
- 2045

Future Connection Point
- 2035

Future WBS
- 2035

Future Tank
- 2035

Area of Future Development
- 2030
- 2035
- 2040
- 2045

MASTER PLAN UPDATE

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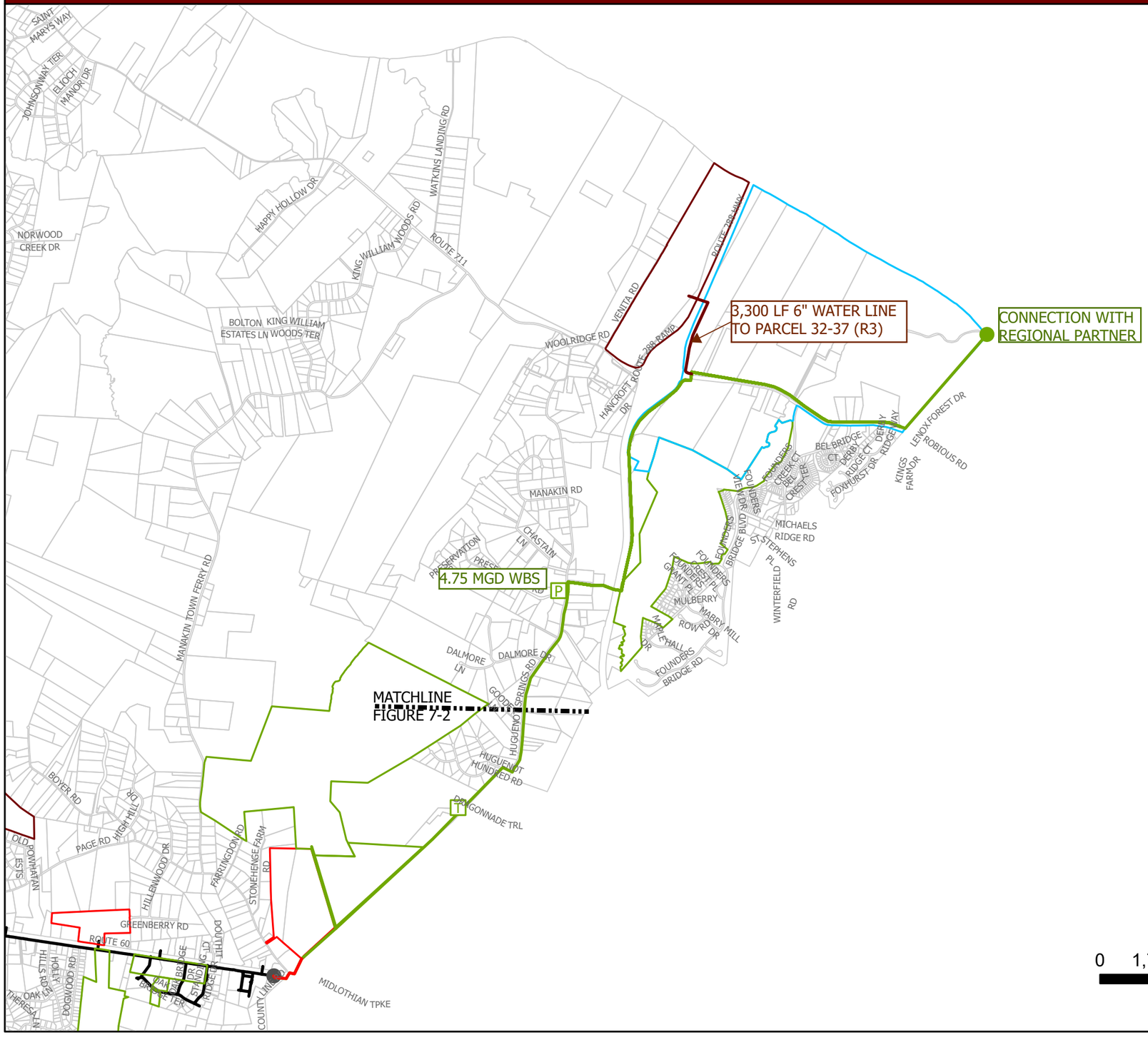
FIGURE 7-3. Water System Improvements



Legend

- Existing WBS
- Existing Tanks
- Chesterfield Connection Point
- Existing Water Main
- Existing Autoflusher

Future Water Mains

- 2030
- 2035
- 2040
- 2045

Future Connection Point

- 2035

Future WBS

- 2035

Future Tank

- 2035

Area of Future Development

- 2030
- 2035
- 2040
- 2045

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COURTHOUSE AREA

See Figure 7-1

Courthouse Water

- Continue to be served by private utility Aqua.

FLAT ROCK AREA

See Figure 7-2

Flat Rock Water

- New Supply Connection with Regional Partner which includes extension of the transmission main to the County, WBS, chloramine booster station, 0.5 MG EST, and 20-inch water transmission main from the Connection to the existing transmission main at the Powhatan/Chesterfield line at Route 60.
- The following service lines are anticipated to be paid for by developers:
    - Construct water line to service Parcel 43-61 (F14)
    - Construct water line to service Parcel 41-19B (F2)
    - Construct water line to service Parcel 43-57 (F12)
    - Construct water line to service Parcel 54-15 (F18)
    - Construct water line to service Parcel 41-17 (F1)
    - Construct water line to service Parcel 41-5 (F4)

ROUTE 711 AREA

See Figure 7-3

Route 711 Water

- The following service lines are anticipated to be paid for by developers:
    - Construct water line to service Parcel 32-37 (R3)

8. Wastewater System Improvements

8.1 General

This section of the Master Plan Update presents an overview of system improvements that are proposed to provide wastewater service within the County's WSSA through the Year 2045.

The proposed sewer improvements map, included in **Appendix B** of this report, provides a graphical presentation of the recommended wastewater system improvements. Improvements shown on this plate are color coded by the year that the improvement is needed and that corresponds to the wastewater system cost estimates for cross-referencing.

In general, the wastewater improvement program involves improvements to treatment capacity, pump stations and force mains and gravity interceptor pipes. A brief overview of improvements is provided in the following subsections. More detailed descriptions of individual CIPs are provided at the end of this section.

8.2 Wastewater Treatment

There are three wastewater service areas within the County that will require wastewater treatment and disposal facilities. The Flat Rock and Courthouse service areas have existing wastewater treatment facilities while the Route 711 service area is served by FBUC. Based on future demand projections, all three service areas will require upgrades or addition of wastewater treatment facilities to provide treatment and disposal of wastewater through the end of the planning period in 2045.

8.2.1 Wastewater Treatment Evaluation

There are a few key issues that will need to be addressed to allow the County to expand their wastewater treatment facilities. The below sections discuss these issues in more detail.

8.2.1.1 Nutrient Removal

The County is in the Chesapeake Bay Watershed, therefore available nutrient load allocations are a limiting factor in the expansion of the existing wastewater treatment facilities to serve future demands. Current nutrient load allocations for the County wastewater treatment facilities are based on certificate to construct (CTC) design flows that were approved by VDEQ before July 1, 2005. The nutrient loads are then calculated based on design flow and limits for phosphorus and nitrogen. If nitrogen and phosphorus limits were not included in the permits then DEQ assumes a nitrogen load allocation based on 18.7 mg/L Total Nitrogen concentration and a phosphorus allocation based on 2.5 mg/L Total Phosphorus Concentration. Based on these assumptions, the WWTPs have the following nutrient load allocations:

Table 8-1. Available Nitrogen Allocations

Source	Allocation
Dutoy Creek WWTP[1] (lb/yr)	10,661
Fighting Creek WWTP[2] (lb/yr)	5,696
Total (lb/yr)	**16,357**

1. Calculated based on a 0.25 MGD CTO design flow and a total nitrogen limit of 14.0 mg/L.
2. Calculated based on a 0.10 MGD CTO design flow and a total nitrogen limit of 18.7 mg/L.

Table 8-2. Available Phosphorus Allocations

Source	Allocation
Dutoy Creek WWTP[1] (lb/yr)	1,904
Fighting Creek WWTP[2] (lb/yr)	761
Total (lb/yr)	**2,665**

1. Calculated based on a 0.25 MGD CTO design flow and a total phosphorus limit of 2.5 mg/L.
2. Calculated based on a 0.10 MGD CTO design flow and a total phosphorus limit of 2.5 mg/L.

As the wastewater treatment facilities require expansion to accommodate increasing wastewater flows, they will also require nutrient removal upgrades to not exceed the designated nitrogen and phosphorus allocations. If Limit of Technology (LOT) nutrient removal facilities were installed at the wastewater treatment plants, the existing facilities could be expanded up to a combined flow rate of 1.79 MGD without requiring additional nutrient offsets.

Although reuse is not needed at this time to obtain additional nutrient offsets for plant expansion over the planning period, it is recommended that the County look for reuse opportunities with new development. This will help build up additional nutrient capacity and would reduce the potable water supply requirements.

8.2.1.2 Outfall Locations

An additional challenge for wastewater treatment facility expansion are the more stringent heavy metals limits that are in effect due to the existing outfalls' locations in low-flow receiving streams. The heavy metal limits were initially difficult to meet; however, after some modifications were made at the plants and a major source of zinc in the wastewater collection system was identified and eliminated, these limits have been consistently achieved. Based on input from the Virginia Department of Environmental Quality (VDEQ), minimal change in permit limits (other than what is required to meet the nutrient load allocations) are expected at the current outfall locations.

For the Dutoy Creek WWTP, the effluent limits are toxicity-based limits and minimal changes are expected. Additionally, changes to the limits for CBOD, TKN, or DO are not anticipated. VDEQ has noted that due to the low flow in the receiving stream, the WWTP is likely out of compliance. One solution is relocating the Dutoy Creek WWTP outfall to the James River. Relocation of the outfall would include construction of an effluent pump station at the Dutoy Creek WWTP and force main from Dutoy Creek WWTP to a new outfall on the James River. The undertaking of this project would come at significant cost to the County. Prior to starting this project, a stream study is recommended for the existing receiving stream to potentially revise the permitted effluent requirements and allow the County to continue discharging through the existing outfall. However, depending on the results of the study, the outfall may still need to be relocated.

Similarly, for the Fighting Creek WWTP, due to the fact that there is no flow in the receiving stream, effluent limits would be applied at the end of pipe; therefore, toxicity-based limits would be unchanged regardless of flow. VDEQ anticipates that the CBOD, TKN, and DO limits would also remain the same.

It should be noted that the anticipated future effluent limits are estimates and VDEQ does not guarantee them. It is anticipated that Fighting Creek WWTP will be converted into a pump station, pumping flows to the Dutoy Creek WWTP. If the Dutoy Creek WWTP outfall needs to be relocated, it makes sense to take advantage of the potential finished waterlines being extended from that portion of the County and run the outfall to the James River near the intersection with Route 288.

8.2.2 Wastewater Treatment Facility Expansion

8.2.2.1 Route 711 Service Area

The construction of a new wastewater treatment plant for the Route 711 Service Area is not ideal as this would add a third small plant that the County would have to operate and maintain. Based on this, the option of a new wastewater treatment plant to serve this area was not considered further.

8.2.2.2 Courthouse Service Area

In order to serve the Courthouse Service Area through the end of the planning period in 2045, the Fighting Creek WWTP will require expansion to 0.11 MGD. It is recommended that the Fighting Creek WWTP be taken offline and the wastewater flows from the Courthouse Service Area be re-routed to the Flat Rock Service Area. This provides significant benefit to the County as it allows the consolidation of the two County WWTPs which will reduce operations and maintenance costs. Additionally, the cost of upgrading one WWTP (Dutoy Creek WWTP) to serve both systems will be more economical.

1. *Take Fighting Creek WWTP offline and Divert Flow to Dutoy Creek WWTP*
   This option would consist of taking the Fighting Creek WWTP offline and constructing a new pump station to pump the Courthouse Service Area wastewater flows to the Flat Rock Service Area gravity sewer to be treated by the Dutoy Creek WWTP. The new pump station would pump through a new 6-inch force main that would be routed north to Route 60, then east along Route 60 to the existing Flat Rock gravity sewer system. Alternatively, the Fighting Creek WWTP Influent Pump Station (IPS) could be modified to pump to the Flat Rock Service Area. To be conservative, budgetary cost estimate includes construction a new pump station and force main.

8.2.2.3 Flat Rock Service Area

The Dutoy Creek WWTP will be expanded to serve the Route 711, Courthouse, and Flat Rock Service Areas. Nutrient loads from both the Fighting Creek and Dutoy Creek WWTPs will be aggregated to allow the use of the nutrient load allocations from Fighting Creek WWTP for the expansion of the Dutoy Creek WWTP. The first expansion of Dutoy Creek WWTP to 0.5 MGD will be required between the years 2030 and 2035. The second expansion to 0.75 MGD will be required between the years 2035 and 2040. The third expansion will be required prior to the year 2040. Alternatively, Dutoy Creek WWTP could expand from 0.5 MGD to 1.0 MGD in the year 2035. The exact timing will depend on the conversion of Fighting Creek WWTP to divert flows to Dutoy Creek WWTP and construction of the Route 711 PS.

Table 8-3. Dutoy Creek WWTP Expansion Timeframes

Year	Existing	2030	2035	2040	2045
Total Projected Average Daily Flow Rate for All Service Areas[1] (MGD)	0.125	0.224	0.527	0.794	0.862
Design Flow (MGD)	0.25	0.50	0.75	1.00	1.00

1. Combined wastewater flow rates from the Courthouse, Flat Rock and Route 711 Service Areas. Route 711 flow rates include existing Founder's Bridge Utility Company estimated flow rate.

Table 8-4. Dutoy Creek WWTP Expansion Summary

Flow Tier	0.5 MGD	0.75 MGD	1.0 MGD
Upgrade Year	2030	2035	2040
General Summary of Required Upgrades	• Upgrade Influent Pump Station • SBR Modifications • Add Post EQ Tank • Modify Filters • Add UV Bank • Add Alum and Caustic Feed	• Upgrade Influent Pump Station • Add SBR Tank • Add Filter Disks • Add UV Bank • Add Digester Tank • Add Dewatering Building	• Upgrade Influent Pump Station • Add SBR Tank • Add Filter Disks • Add UV Bank • Add Carbon Source Feed

8.3 Wastewater Collection and Conveyance

A summary of the wastewater collection system improvements is provided in a similar format to the water system improvements discussed in **Section 7**. For ease of discussion, wastewater system improvements are broken out into the same three service areas that are used in the water system improvement program. These service areas are the Flat Rock, Courthouse, and Route 711, as shown in **Figure 2-1.** Water and Sewer Service Areas. The Proposed Wastewater Improvements maps included in **Figure 8-1** through **Figure 8-3** show wastewater improvements by service area.

8.3.1.1 Route 711 Service Area

The Route 711 Service Area does not currently have existing public wastewater collection system infrastructure. As part of a wastewater disposal project, the County will construct a pump station and force main to pump the wastewater flows that are generated within the proposed service area to the Dutoy WWTP System for treatment. It is assumed that any additional wastewater collection and conveyance infrastructure would be paid for by developers.

The construction of a new wastewater treatment plant for the Route 711 Service Area is not ideal as this would add a third small plant that the County would have to operate and maintain. Based on this, the option of a new wastewater treatment plant to serve this area was not considered further.

1. *Pump Station and Force Main to Dutoy Creek WWTP Collection System*
   This option would require that a pump station and a 6-inch force main be constructed to transfer wastewater flows south to the existing Flat Rock wastewater collection system.

Refer to **Figure 8-3** for an exhibit showing the wastewater service option for the Route 711 Service Area.

8.3.1.2 Courthouse Service Area

Based on an analysis of the existing wastewater collection system, the existing system has capacity for projected sewer flowrates through the end of the planning period in 2045. Based on recommendations contained in the wastewater section, the Fighting Creek WWTP will be converted into a pump station and a force main will be routed to the Flat Rock wastewater collection system.

8.3.1.3 Flat Rock Service Area

New pump stations will be required to convey wastewater from the proposed development areas into the existing Flat Rock Sewer Conveyance System and ultimately to the Dutoy Creek WWTP. The following sewer pump stations and force mains are proposed.

1. Oakbridge Pump Station

   The Oakbridge PS is proposed to convey wastewater flows from the Oakbridge Business Park (F15, F16, and F17), Parcel 42-79 (F9), Parcel 42-74 (F10), and surrounding areas to the existing force main along Route 60. The PS will be sized for an initial capacity of 350 GPM expandable to 525 GPM to serve Parcel 54-15 (F18). A 6-inch force main will be constructed from the pump station to the 8-inch existing force main along Route 60.

2. Powhatan East Pump Station

   The Powhatan East PS is proposed to convey wastewater flows from the proposed Route 711 PS, Parcel 43-57 (F12), Parcel 43-62 (F13), and Parcel 43-61 (F14). A 10-inch force main is proposed along an existing easement to the gravity sewer upstream of Dutoy WWTP. It is anticipated that the gravity sewer will need to be upsized from this connection to the Dutoy WWTP. The proposed capacity based on the projected flows is 1400 GPM. This is anticipated to be paid for by the developer.

3. Parcel 43-57 (F12) Pump Station

The Parcel 43-57 PS is proposed to convey wastewater from Parcel 43-57 to the Powhatan East PS. The proposed capacity based on the projected flows is 180 GPM. A 4-inch force main will be constructed from the PS to the proposed Powhatan East PS.

4. Parcel 54-15 (F18) Pump Station

The Parcel 54-15 PS is proposed to convey wastewater from Parcel 54-15 to the Oakbridge PS. The proposed capacity based on the projected flows is 175 GPM. A 4-inch force main will be constructed from the PS to the proposed Oakbridge PS.

5. Gravity Sewer from Parcel 41-5

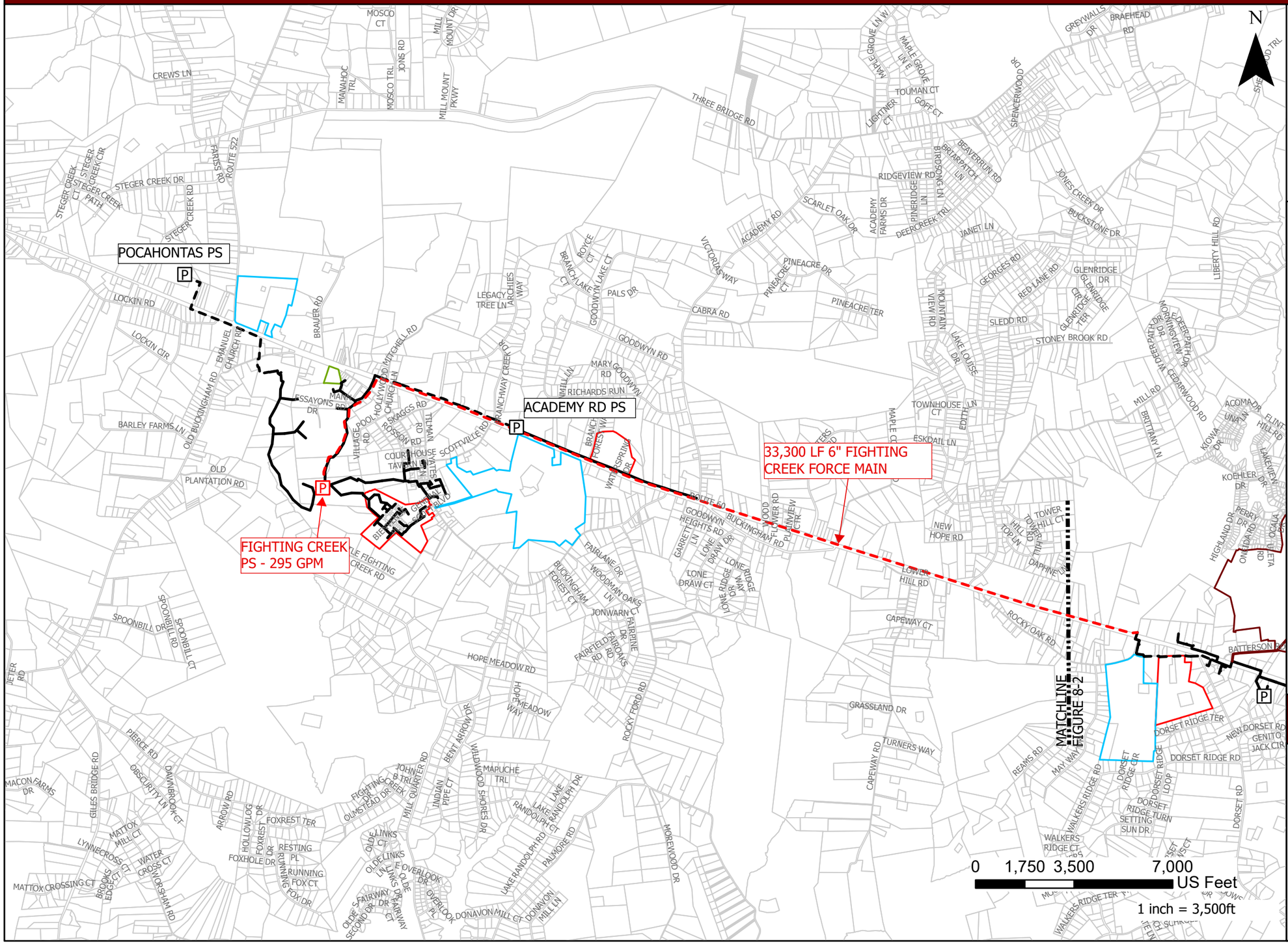
Sewer from Parcel 41-5 and connecting to the existing sewer system. This is anticipated to be paid for by the developer.

8.4 Wastewater System Improvement Program

A summary of the recommended wastewater system improvements is provided on the following pages. For ease of discussion, wastewater system improvements are broken out into the three service areas, Courthouse, Flat Rock, and Route 711. The proposed wastewater improvements are shown on **Figure 8-1**, **Figure 8-2**, and **Figure 8-3**.

Descriptions of the proposed wastewater system improvements, organized by service area, are provided on the following pages. The description lists the requirements for the improvements, the timing of the improvement, and a general description of the improvement. Additional details on costs associated with the water improvement program are provided in **Section 9** of this Master Plan Update.

FIGURE 8-1. Wastewater System Improvements



Legend

- Wastewater Treatment Plant
- Existing Pump Station
- Existing Force Main
- Existing Gravity Main

Future Outfall
- 2030

Future Pump Station
- 2030
- 2035
- 2040

Future Force Main
- 2030
- 2035
- 2040

Future Gravity Sewer
- 2030
- 2035
- 2045

Area of Future Development
- 2030
- 2035
- 2040
- 2045

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FIGURE 8-2. Wastewater System Improvements

3,000 LF 12" GRAVITY SEWER FROM PARCEL 41-5

DUTOY EFFLUENT PS - 2400 GPM

48,300 LF 12" DUTOY EFFLUENT FORCE MAIN

8,400 LF 4" PARCEL 43-57 FORCE MAIN

PARCEL 43-57 PS - 180 GPM

MATCHLINE FIGURE 8-3

MATCHLINE FIGURE 8-1

FLAT ROCK PS

FRISBY'S PS

1,600 LF 10" POWHATAN EAST FORCE MAIN

POWHATAN EAST PS - 1400 GPM

2,700 LF 6" OAKBRIDGE FORCE MAIN

4,700 LF 12" GRAVITY SEWER TO OAKBRIDGE PS

OAKBRIDGE PS - 350 GPM

7,800 4" PARCEL 54-15 FORCE MAIN

PARCEL 54-15 PS - 175 GPM

Dutoy WWTP

DUTOY WWTP

2,100 LF 20" GRAVITY SEWER REPLACEMENT

3,100 LF 24" GRAVITY SEWER REPLACEMENT

0 500 1,000 2,000 US Feet

0 1,750 3,500 7,000 US Feet

1 inch = 3,500ft

N

COUNTY OF POWHATAN VIRGINIA 1777

Legend

- Wastewater Treatment Plant
- Existing Pump Station
- Existing Force Main
- Existing Gravity Main

Future Outfall
- 2030

Future Pump Station
- 2030
- 2035
- 2040

Future Force Main
- 2030
- 2035
- 2040

Future Gravity Sewer
- 2030
- 2035
- 2045

Area of Future Development
- 2030
- 2035
- 2040
- 2045

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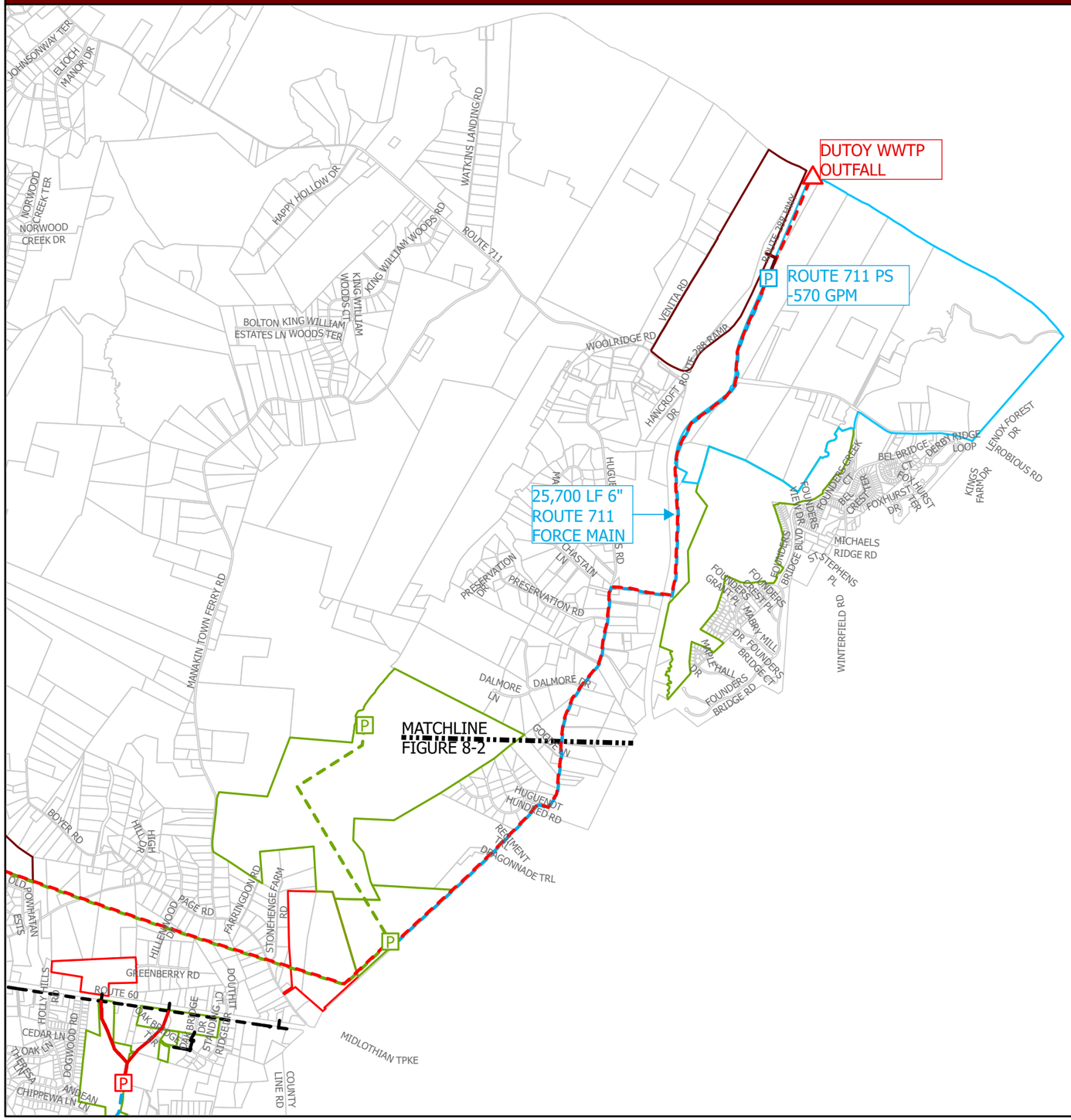
FIGURE 8-3. Wastewater System Improvements



N

0 1,750 3,500 7,000 US Feet

1 inch = 3,500ft

Legend

- Wastewater Treatment Plant
- Existing Pump Station
- Existing Force Main
- Existing Gravity Main

Future Pump Station
- 2030
- 2035
- 2040

Future Outfall
- 2030

Future Force Main
- 2030
- 2035
- 2040

Future Gravity Sewer
- 2030
- 2035
- 2045

Area of Future Development
- 2030
- 2035
- 2040
- 2045

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COURTHOUSE AREA

See Figure 8-1

Courthouse Wastewater

- Take Fighting Creek WWTP offline and Divert Flow to Dutoy Creek WWTP with the construction of a PS and force main.

FLAT ROCK AREA

See Figure 8-2

Flat Rock Wastewater

- Construct the Powhatan East PS to convey flow from the proposed Route 711 PS, proposed Parcel 43-57 PS, Parcel 43-62 and Parcel 43-61 to the Dutoy Creek WWTP. The receiving gravity sewer upstream of Dutoy WWTP will need to be upsized.
- Construct Oakbridge PS and force main to serve the Oakbridge Business Park, proposed development on Parcel 42-79, Parcel 42-74, Parcel 54-15, and surrounding areas. It is assumed that any collection system infrastructure would be paid for by developers.
- Construct the Dutoy WWTP Effluent PS and force main to relocate the plant outfall to the James River near Route 288.
- The following service lines are anticipated to be paid for by developers:
    - Parcel 43-57 (F12) PS
    - Parcel 54-15 (F18) PS
    - Gravity Sewer from Parcel 41-5

Route 711 AREA

See Figure 8-3

Route 711 Wastewater

- Construct PS and Force Main to Dutoy Creek WWTP Collection System.

9. Implementation

The implementation plan outlined in this section of the Master Plan Update establishes the steps associated with the design and construction of water and wastewater improvements that are projected during the planning period. Timing of the proposed projects will depend on the actual rate of development.

Table 9-1 and **Table 9-3** include the projected water and wastewater system improvements, when planning, permitting, and engineering should begin, and the projected timeframe that the project will need to be completed. Planning, permitting, engineering, and construction must be started at least 3 to 5 years ahead of the time of completion (actual timeframe dependent on project complexity). **Table 9-3** was developed assuming that the new supply connection regional partner would be Henrico. However, a new supply connection with Chesterfield at Robious Road may be an alternative and the projected timeframe is included in **Table 9-4**.

Table 9-2, **Table 9-5**, and **Table 9-6** outline the projected water and wastewater system improvements, summarizing the following information:

- Name of system improvement
- Budgetary cost estimate in 2025 dollars
- Year by which project needs to be completed by to serve increased demand within the system.
- Cost includes 15% contractor overhead and profit, 25% construction contingency, and 15% engineering fees.

Table 9-1. Wastewater Improvement Project Implementation Schedule

Project	Begin Planning, Permitting and Engineering	Projected Project Completion
Dutoy Creek WWTP Expansion		
0.5 MGD	**2025**	**2030**
0.75 MGD	2030	2035
1.0 MGD	2035	2040
Dutoy Creek WWTP Effluent PS, Force Main, and Outfall Relocation	**2025**	**2030**
Take Fighting Creek WWTP Offline and Divert Flow to Dutoy Creek WWTP with the Construction of a PS and Force Main	**2025**	**2030**
*Powhatan East PS and Force Main**	2035	2040
Route 711 PS and Force Main (Contingent on the construction of Powhatan East PS and Force Main)	2040	2045
Oakbridge PS and Force Main	2027	2030
Parcel 43-57 (F12) PS and Force Main (Contingent on construction of the Powhatan East PS and Force Main)*	2032	2035
*Parcel 54-15 (F18) PS and Force Main**	2037	2040

**Anticipated to be completed and paid for by developers*

Table 9-2. Wastewater Improvement Estimated Cost by Fiscal Year

	Fiscal Year			
Wastewater Improvements	**2030**	**2035**	**2040**	**2045**
Courthouse Service Area				
Take Fighting Creek WWTP Offline, Divert Flow to Dutoy Creek WWTP, PS, Force Main, Gravity Sewer Upgrade Upstream of Dutoy WWTP	$13,520,000			
Flat Rock Service Area				
Dutoy Effluent WWTP Effluent PS, Force Main and Outfall Relocation		$40,320,000		
Dutoy Creek WWTP 0.50 MGD Expansion	$12,000,000			
Dutoy Creek WWTP 0.75 MGD Expansion		$10,000,000		
Dutoy Creek WWTP 1.0 MGD Expansion			$8,000,000	
Oakbridge PS and Force Main	$6,737,000			
*Powhatan East PS, Force Main, Gravity Sewer Upgrade Upstream of Dutoy WWTP**		*$15,870,000*		
Parcel 43-57 (F12) PS and Force Main - Contingent on construction of the Powhatan East PS and Force Main*		*$3,280,000*		
*Parcel 54-15 (F18) PS and Force Main**			*$3,100,000*	
Gravity Sewer from Parcel 41-5				*$1,550,000*
Route 711 Service Area				
Route 711 PS and Force Main - Contingent on construction of the Powhatan East PS and Force Main			$8,970,000	
Developer Total	-	$19,150,000	$3,100,000	$1,550,000
COUNTY TOTAL	**$32,257,000**	**$50,320,000**	**$16,970,000**	**-**

**Anticipated to be paid for by developers*

Table 9-3. Water Improvement Project Implementation Schedule – New Water Supply Connection with Henrico

Project	Begin Planning, Permitting and Engineering	Projected Project Completion
New Supply Connection (If Chesterfield is unable to provide additional supply allocation to the County.)	**2025**	**2035**
Loop at Old Church Road and Judes Ferry Road	2027	2030
*Water line to Parcel 41-19B (F2)**	2027	2030
*Water line to Parcel 43-57 (F12)**	2027	2030
*Water line to Parcel 54-15 (F18)**	2037	2040
*Water line to Parcel 41-17 (F1)**	2037	2040
*Water line to Parcel 41-5 (F4)**	2042	2045
*Water line to Parcel 32-37 (R3)**	2042	2045

**Anticipated to be completed and paid for by developers*

Table 9-4. Water Improvement Project Implementation Schedule – Additional Connection to Chesterfield

Project	Begin Planning, Permitting and Engineering	Projected Project Completion
Additional Connection with Chesterfield at Robious Road	2030	2035

Table 9-5 was developed assuming that the new supply connection regional partner would be Henrico.

The Courthouse Service Area is currently served by Aqua and has a maximum day capacity of 176,000 gpd. It is anticipated that the service area will exceed Aqua's current permitted maximum day capacity by the year 2030 and their permitted capacity will need to be increased.

Table 9-6 was developed as an alternative to the new supply connection with Henrico. This table includes the cost to add a second interconnection to Chesterfield at Robious Road. The main difference in cost is that the James River crossing would no longer be required. An analysis of the interconnection with Chesterfield will be needed to determine WBS and EST requirements. Coordination with Chesterfield will be needed to gauge interest and confirm the WBS requirements based on the new interconnection. It is not known if system improvements would be required on the Chesterfield side of the interconnection. The water transmission main from Route 711 to Route 60 would follow the same route as the new supply connection with Henrico alternative. **Table 9-6** assumes that a WBS and EST will be required. The other water improvement projects are still applicable to this alternative.

Table 9-5. Water Improvement Estimated Cost by Fiscal Year – Connection with a New Regional Partner

	Fiscal Year			
Water Improvements	**2030**	**2035**	**2040**	**2045**
Flat Rock Service Area				
Connection to Regional Partner				
Extend Waterline to Powhatan including James River Crossing		$25,000,000		
20-inch Transmission Main from Connection to Route 60		$31,530,000		
Water Booster Station with Chloramine Booster Station		$11,700,000		
0.5 MG Elevated Storage Tank		$4,930,000		
Loop at Old Church Road and Judes Ferry Road	$1,090,000			
*Water line to Parcel 43-61 (F14)**	*$1,150,000*			
*Water line to Parcel 41-19B (F2)**	*$400,000*			
*Water line to Parcel 43-57 (F12)**		*$1,210,000*		
*Water line to Parcel 54-15 (F18)**			*$2,410,000*	
*Water line to Parcel 41-17 (F1)**			*$570,000*	
*Water line to Parcel 41-5 (F4)**				*$2,410,000*
Route 711 Service Area				
*Water line to Parcel 32-37 (R3)**				*$780,000*
Developer Total	$1,550,000	$1,210,000	$2,980,000	$3,190,000
COUNTY TOTAL	**$1,090,000**	**$73,160,000**	**-**	**-**

**Anticipated to be paid for by developers*

Table 9-6. Water Improvement Estimated Cost by Fiscal Year – Additional Connection with Chesterfield

	Fiscal Year			
Water Improvements	**2030**	**2035**	**2040**	**2045**
Flat Rock Service Area				
Additional Connection to Chesterfield at Robious Road				
20-inch Transmission Main from Connection to Route 60		$28,250,000		
Water Booster Station with Chloramine Booster Station		$11,700,000		
0.5 MG Elevated Storage Tank		$4,930,000		
Loop at Old Church Road and Judes Ferry Road	$1,090,000			
*Water line to Parcel 43-61 (F14)**	*$1,150,000*			
*Water line to Parcel 41-19B (F2)**	*$400,000*			
*Water line to Parcel 43-57 (F12)**		*$1,210,000*		
*Water line to Parcel 54-15 (F18)**			*$2,410,000*	
*Water line to Parcel 41-17 (F1)**			*$570,000*	
*Water line to Parcel 41-5 (F4)**				*$2,410,000*
Route 711 Service Area				
*Water line to Parcel 32-37 (R3)**				*$780,000*
Developer Total	$1,550,000	$1,210,000	$2,980,000	$3,190,000
COUNTY TOTAL	**$1,090,000**	**$44,880,000**	**-**	**-**

**Anticipated to be paid for by developers*

9.1 Implementation Scenarios

In each of the following scenarios, the County secures sufficient water capacity to meet the projected demand for the next 20 years, resolves DEQ corrective action plans at Fighting Creek WWTP and Dutoy Creek WWTP, and invests in the wastewater treatment infrastructure that allows the desired growth identified in the Comprehensive Plan as well as accommodating all known data center projects. The following three scenarios are not inclusive of all potential scenarios and projects. Timing and requirements of the proposed projects will depend on the actual rate of development. The three scenarios are:

- Scenario 1: Additional Water Supply from Chesterfield Through existing Route 60 Waterline
- Scenario 2: Additional Water Supply from Chesterfield with 2nd Interconnection at Robious Road
- Scenario 3: New Water Supply Interconnection with Henrico County

Scenario 1 is summarized in **Table 9-7**. Scenario 1 assumes that Chesterfield will increase the water supply agreement to meet the growing demands of the County through the existing interconnection at Route 60. This scenario does not supply additional water to the Route 711 Service Area and assumes that the FBUC will continue to supply the area. For sewer, this scenario assumes that the stream study will be completed and the County's two WWTPs, Dutoy Creek and Fighting Creek, will be able to meet permit limits at the existing outfalls. The Dutoy Creek WWTP will be upgraded to a treatment capacity of 0.5 MGD. This scenario assumes that sewer service will not be extended to Route 711 and the Fighting Creek WWTP will continue to serve the Courthouse Service Area.

Table 9-7. Scenario 1: Additional Water Supply from Chesterfield through the Route 60 Interconnection

Area	Action Step	Infrastructure Cost
Water	Reach an agreement to purchase an additional 2 MGD from Chesterfield	$0
Sewer	Work with an engineering firm to study possible process improvements at both WWTPs and an environmental firm to complete stream studies of Fighting Creek and Dutoy Creek.	$200,000
Sewer	Design and complete a construction project that expands Dutoy Creek WWTP's capacity to 0.50 MGD.	$12,000,000
TOTAL		**$12,200,000**

Scenario 2 is summarized in **Table 9-8**. Scenario 2 assumes that Chesterfield will increase the water supply agreement to meet the growing demands of the County and a second interconnection with Chesterfield will be constructed at Robious Road. The second interconnection will serve the Route 711 Service Area and provide additional redundancy back to the Flat Rock System. For sewer, this scenario assumes that the Dutoy Creek WWTP will be upgraded to a permitted capacity of 0.5 MGD and the outfall will be relocated to the James River. This scenario assumes that sewer service will not be extended to Route 711 and the Fighting Creek WWTP will continue to serve the Courthouse Service Area.

Table 9-8. Scenario 2: Additional Water Supply from Chesterfield with the 2nd Interconnection at Robious Road

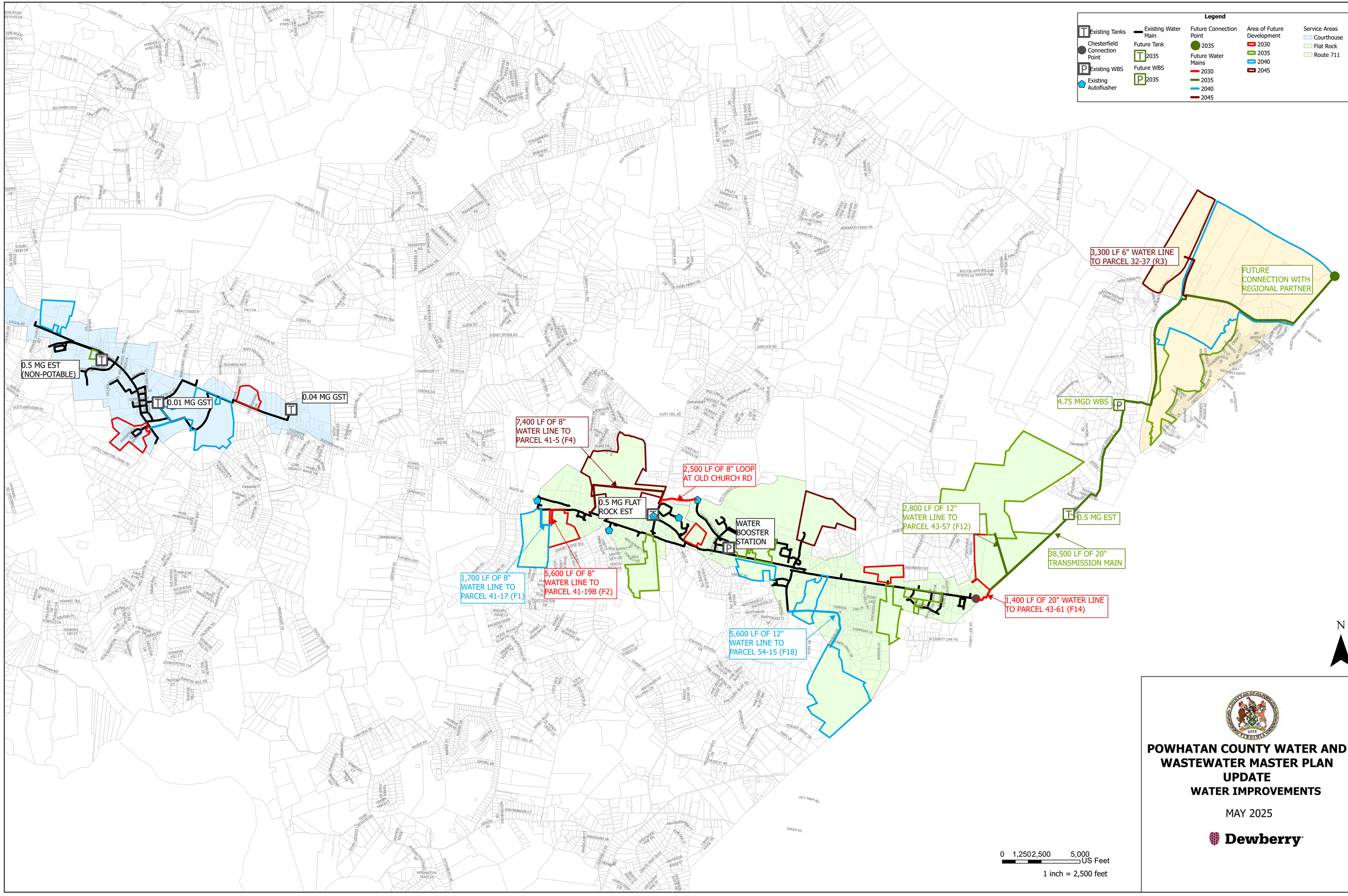
Area	Action Step	Infrastructure Cost
Water	Reach an agreement to purchase an additional 2 MGD from Chesterfield	$0
Water	Agree to an additional interconnection to Chesterfield at Robious Road looping the Route 711 and Route 60 service areas.	$44,880,000
Sewer	The Robious Road connection project presents the County with the opportunity to extend Dutoy Creek WWTP's outfall and address exceedances at Dutoy Creek WWTP.	$40,320,000
Sewer	Design and complete a construction project that expands Dutoy Creek WWTP's capacity to 0.50 MGD.	$12,000,000
TOTAL		**$97,200,000**

Scenario 3 is summarized in **Table 9-9**. Scenario 3 assumes that a water supply agreement and interconnection will be made with Henrico. The interconnection will be able to provide water to the Route 711 and Flat Rock service areas For sewer, this scenario assumes that the Dutoy Creek WWTP will be upgraded to a permitted capacity of 0.5 MGD and the outfall will be relocated to the James River. This scenario assumes that sewer service will not be extended to Route 711 and the Fighting Creek WWTP will continue to serve the Courthouse Service Area.

Table 9-9. Scenario 3: New Water Supply Interconnection with Henrico County

Area	Action Step	Infrastructure Cost
Water	Reach an agreement to purchase water capacity from Henrico. The County should seek water capacity that would serve anticipated demand beyond the 20-year master plan period due to the high cost of the project.	$73,160,000
Sewer	The Henrico water connection project presents the County with the opportunity to extend Dutoy Creek WWTP's outfall and address exceedances at Dutoy Creek WWTP.	$40,320,000
Sewer	Design and complete a construction project that expands Dutoy Creek WWTP's capacity to 0.50 MGD.	$12,000,000
TOTAL		**$125,480,000**

Appendix A
Proposed Water Improvements Map



POWHATAN COUNTY WATER AND WASTEWATER MASTER PLAN UPDATE
WATER IMPROVEMENTS

MAY 2025

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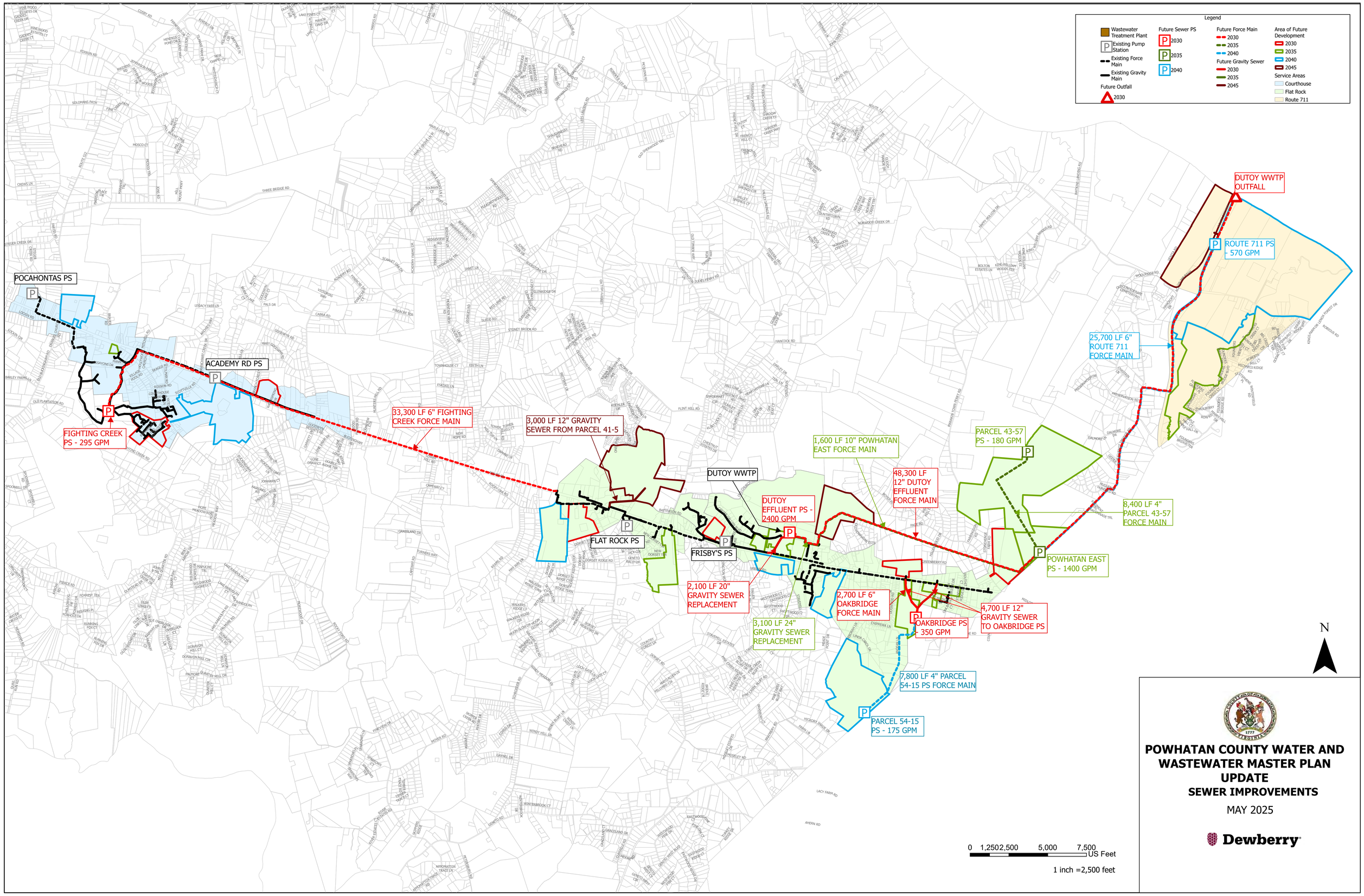
Appendix B
Proposed Sewer Improvements Map



POWHATAN COUNTY WATER AND WASTEWATER MASTER PLAN UPDATE
SEWER IMPROVEMENTS

MAY 2025

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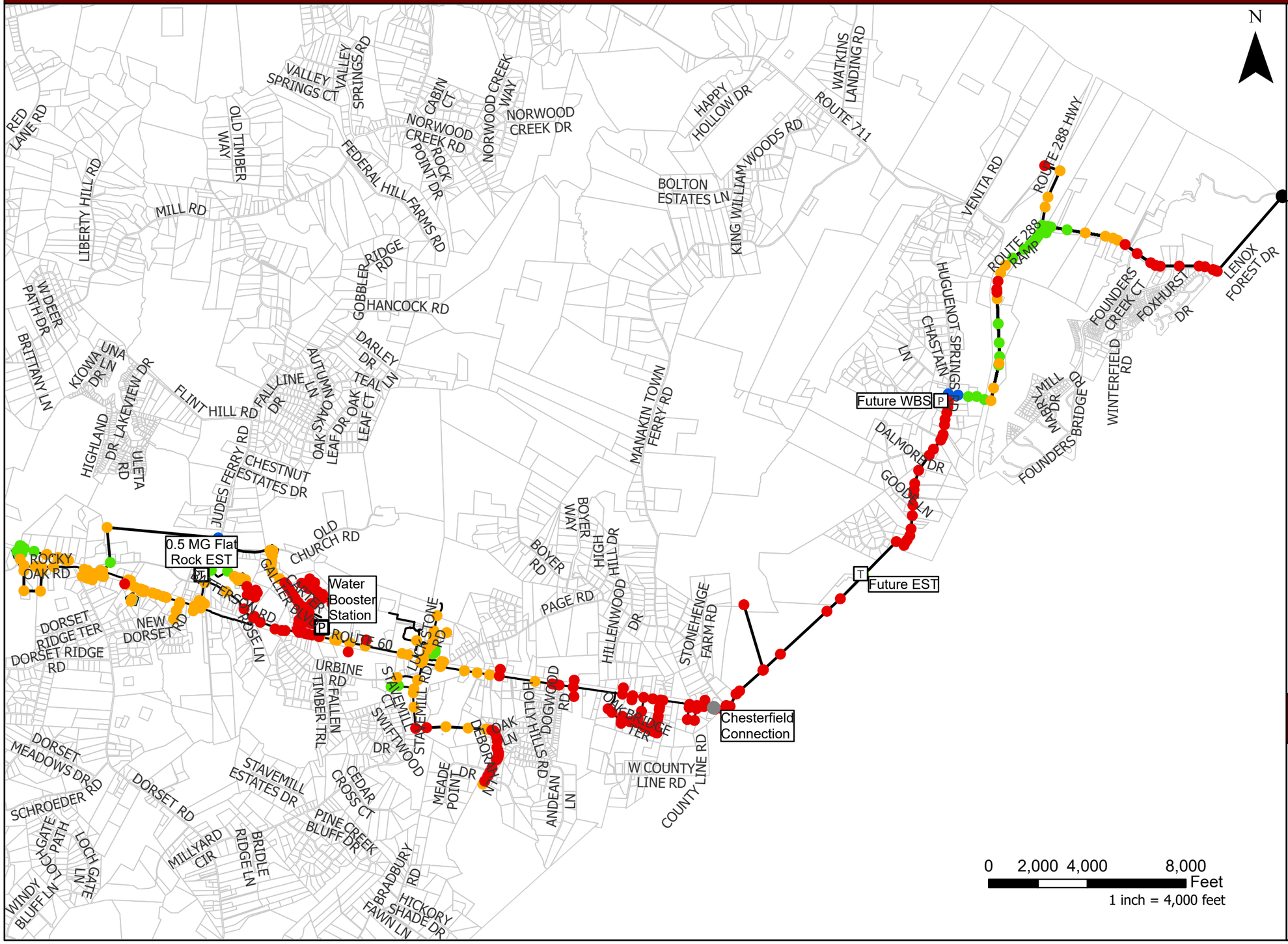
Appendix C
Water Model Results: Pressure, Water Age, and Fire Flow

Appendix C Water Model Results: Pressure, Water Age, and Fire Flow

C-1: 2045 Peak Hour Pressure served by New Water Supply Connection Only
C-2: 2030 Maximum Water Age without Autoflushers
C-3: 2030 Maximum Water Age with Old Stage Road Loop and without Autoflushers
C-4: 2030 Maximum Water Age with Autoflushers
C-5: 2045 Maximum Water Age with Existing Autoflushers
C-6: 2045 Maximum Water Age without Existing Autoflushers

FIGURE C-1. 2045 Peak Hour Pressure



Legend

- Future Tank
- Future WBS
- Future Supply Connection Point
- Chesterfield Connection Point
- Water Booster Station
- Tanks

Minimum Pressure*

- 40 - 50 psi
- 50 - 65 psi
- 65 - 80 psi
- Greater than 80 psi
- Existing Autoflusher
- Waterline

* 2045 Peak Hour Demand with New Supply Connection Only

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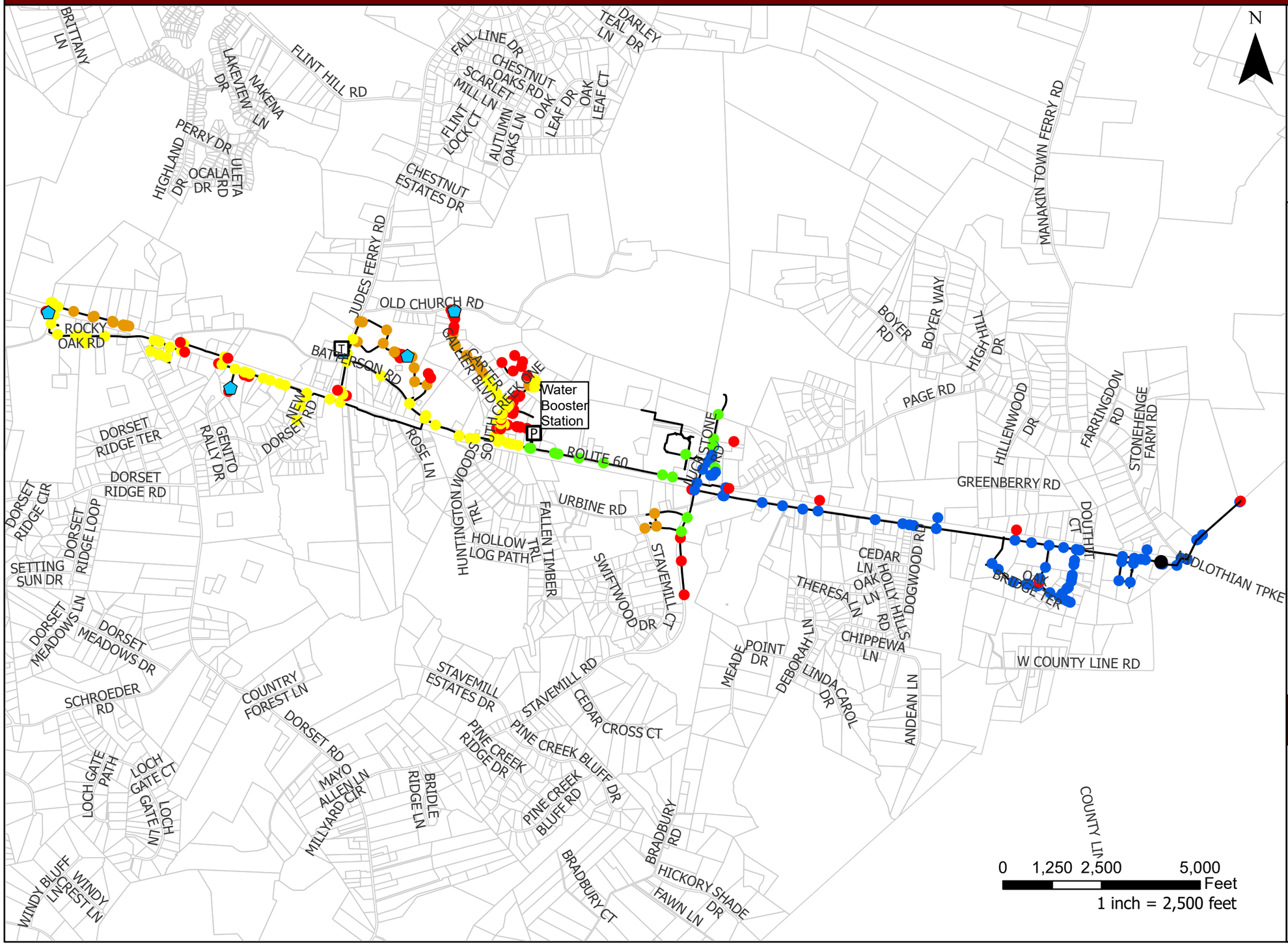
FIGURE C-2. 2030 Maximum Water Age without Autoflushers



Legend

Maximum Water Age*

- 0-3 days
- 3-7 days
- 7-10 days
- 10-14 days
- >14 days
- Chesterfield Connection Point
- [P] Water Booster Station
- [T] Tanks
- Existing Autoflusher
- Waterline

*Assumes baseline water age at Chesterfield connection of 0 days

Demand: 2030 ADD

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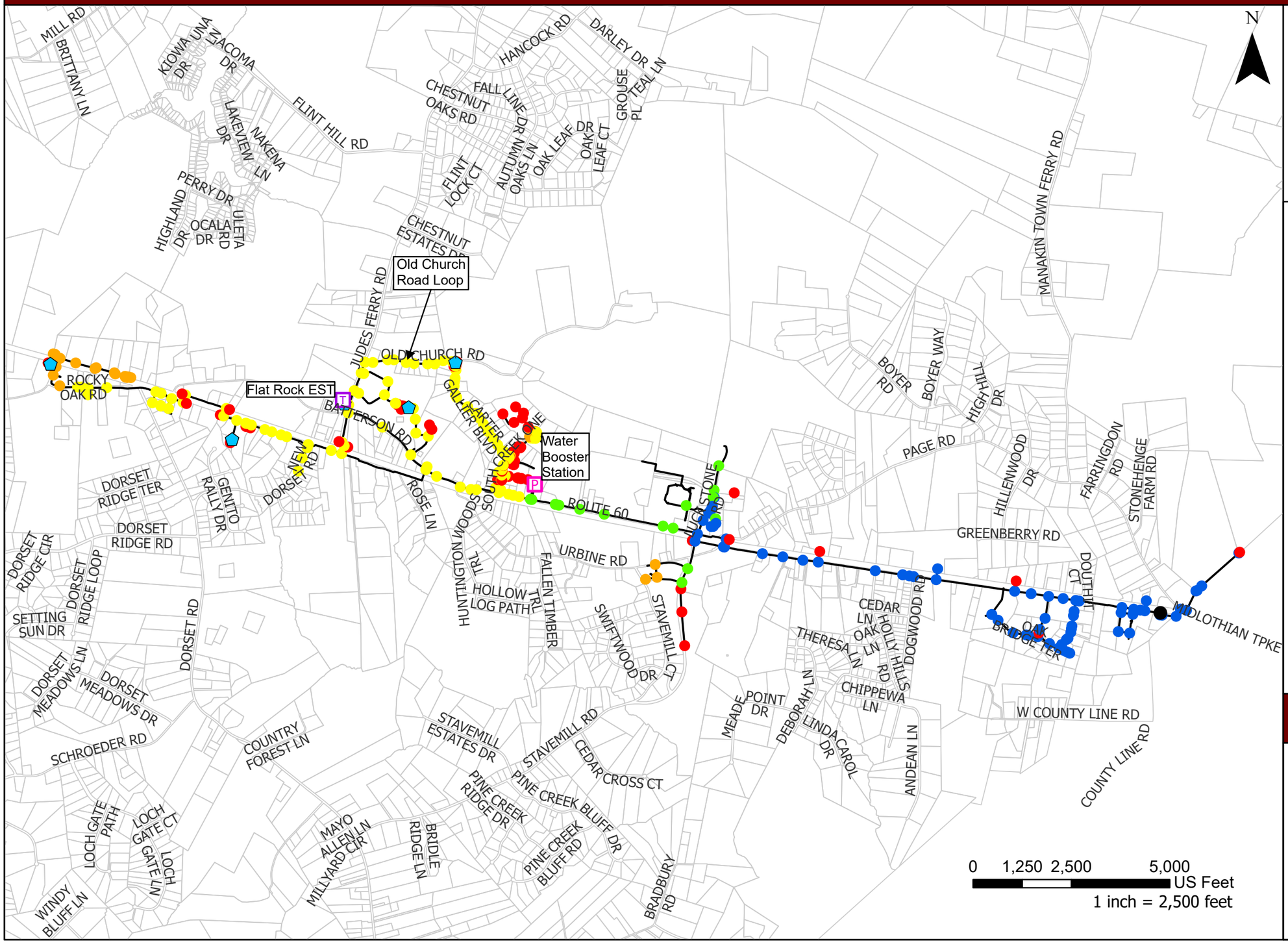
FIGURE C-3. 2030 Maximum Water Age with Old Stage Road Loop and without Autoflushers



Legend

Maximum Water Age*

- 0-3 days
- 3-7 days
- 7-10 days
- 10 - 14 days
- >14 days
- Chesterfield Connection Point
- Water Booster Station
- Tanks
- Existing Autoflusher
- Waterline

*Assumes baseline water age at Chesterfield connection of 0 days

Demand: 2030 ADD

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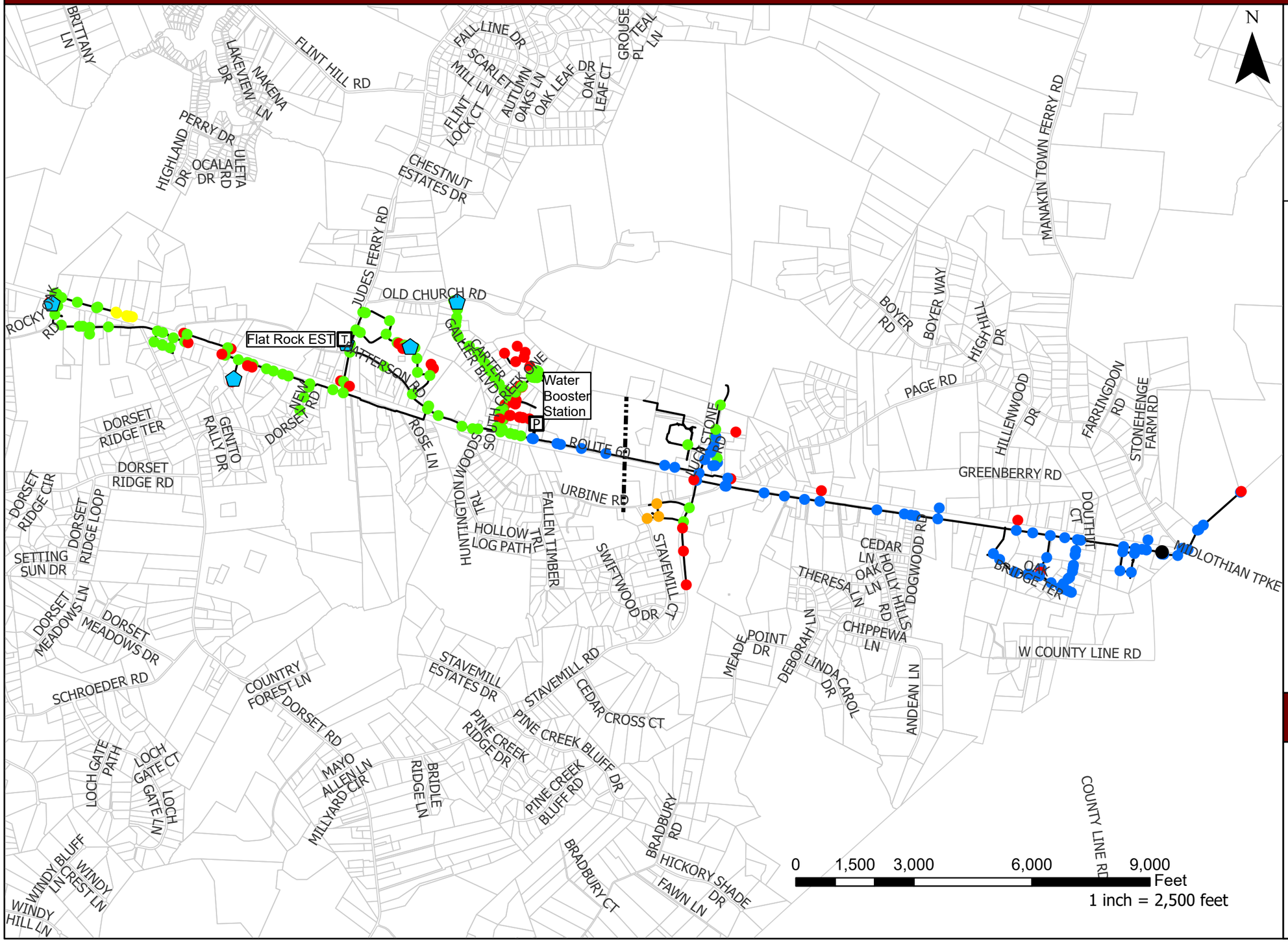
FIGURE C-4. 2030 Maximum Water Age with Autoflushers



Legend

Maximum Water Age*

- 0-3 days
- 3-7 days
- 7-10 days
- 10-14 days
- >14 days
- Chesterfield Connection Point
- P Water Booster Station
- T Tanks
- Existing Autoflusher
- Waterline

*Assumes baseline water age at Chesterfield connection of 0 days

Demand: 2030 ADD

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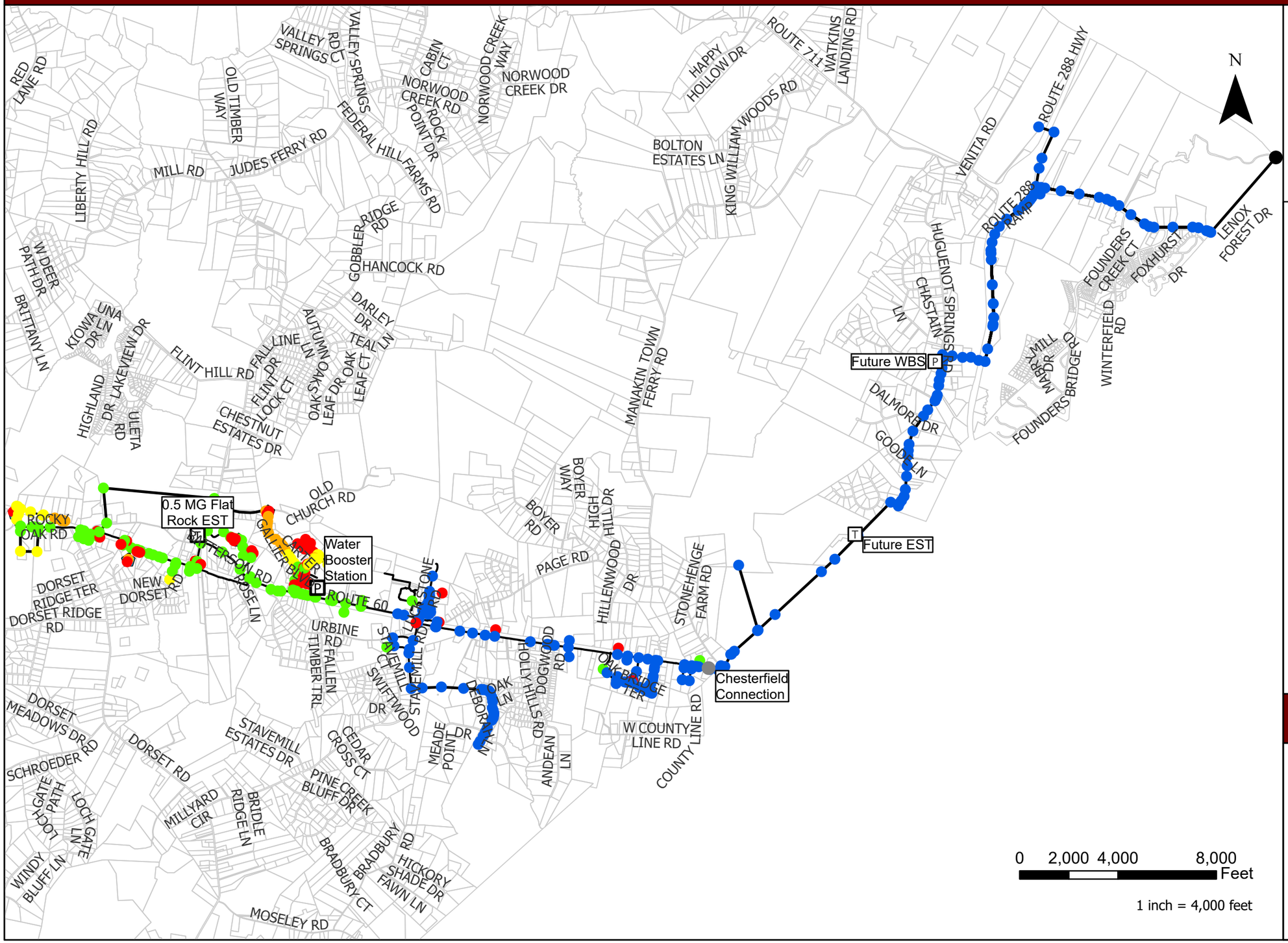
FIGURE C-5. 2045 Maximum Water Age with Autoflushers



Legend

Maximum Water Age*

- 0-3 days
- 3-7 days
- 7-10 days
- 10-14 days
- >14 days
- Future Tank
- Future WBS
- Future Suppy Connection Point
- Chesterfield Connection Point
- Water Booster Station
- Tanks
- Existing Autoflusher
- Waterline

* Assumes baseline water age at New Supply Connection of 0 days
Demand: 2045 ADD

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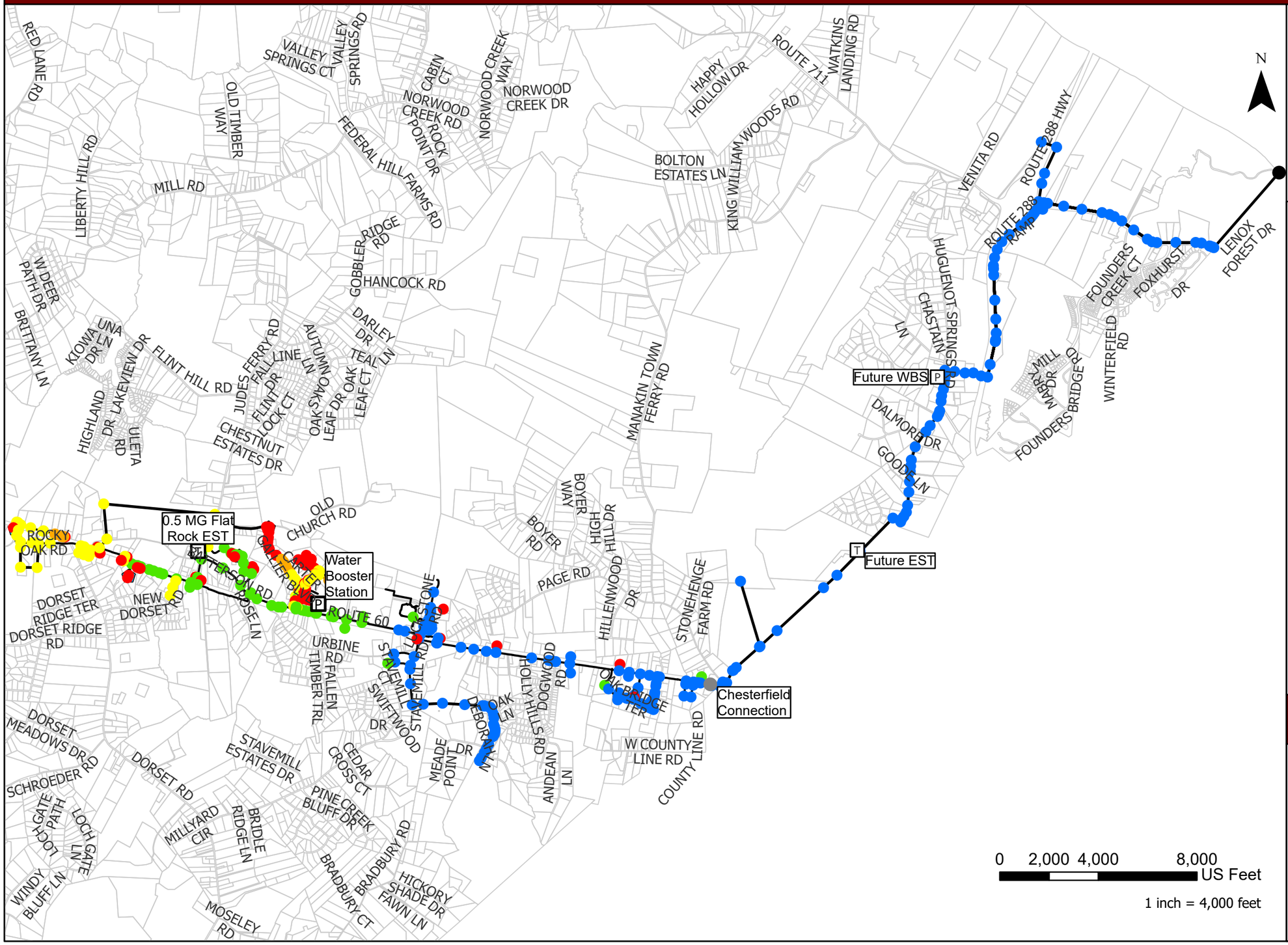
FIGURE C-6. 2045 Maximum Water Age without Autoflushers



Legend

Maximum Water Age*

- 0-3 days
- 3-7 days
- 7-10 days
- 10-14 days
- >14 days
- T Future Tank
- P Future WBS
- Future Supply Connection Point
- Chesterfield Connection Point
- P Water Booster Station
- T Tanks
- Existing Autoflusher
- Waterline

* Assumes baseline water age at New Supply Connection of 0 days
Demand: 2045 ADD

MASTER PLAN UPDATE

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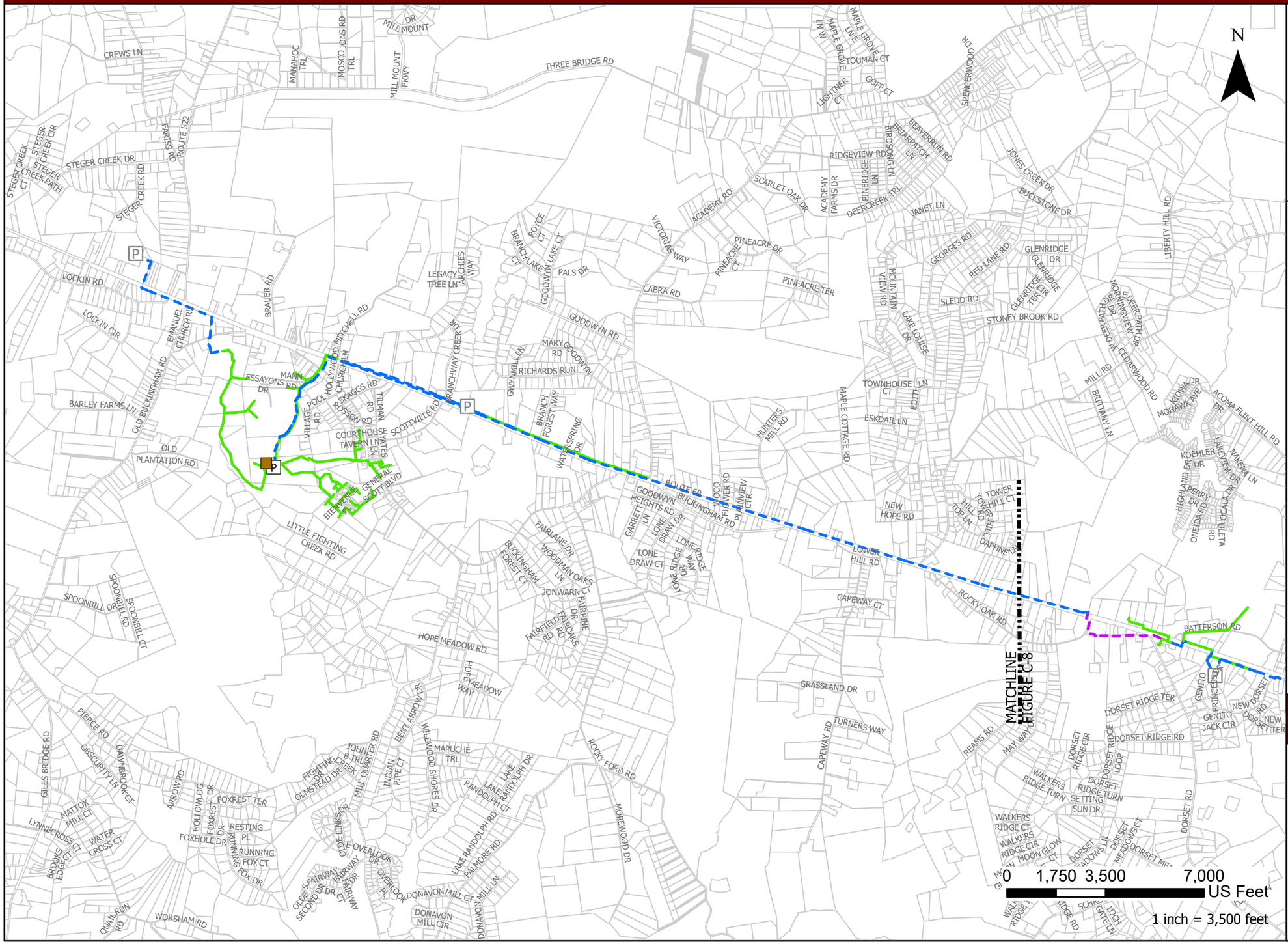
Appendix D
Wastewater Model Results

Appendix D Wastewater Model Results

D-1: 2045 Peak Hour Wastewater Results – Courthouse Service Area
D-2: 2045 Peak Hour Wastewater Results – Flat Rock Service Area
D-3: 2045 Peak Hour Wastewater Results – Route 711 Service Area

FIGURE D-1. 2045 Peak Hour Wastewater Results - Courthouse Service Area



Legend

- P Future Sewer PS
- P Existing Pump Station

Velocity

- 0-2 ft/s
- 2-5 ft/s
- 5-7 ft/s
- 7-8 ft/s
- >8 ft/s

Flow/Capacity

- <20%
- 20-40%
- 40-60%
- 60-80%
- Wastewater Treatment Plant

Demand: 2045 Peak Hour

MASTER PLAN UPDATE

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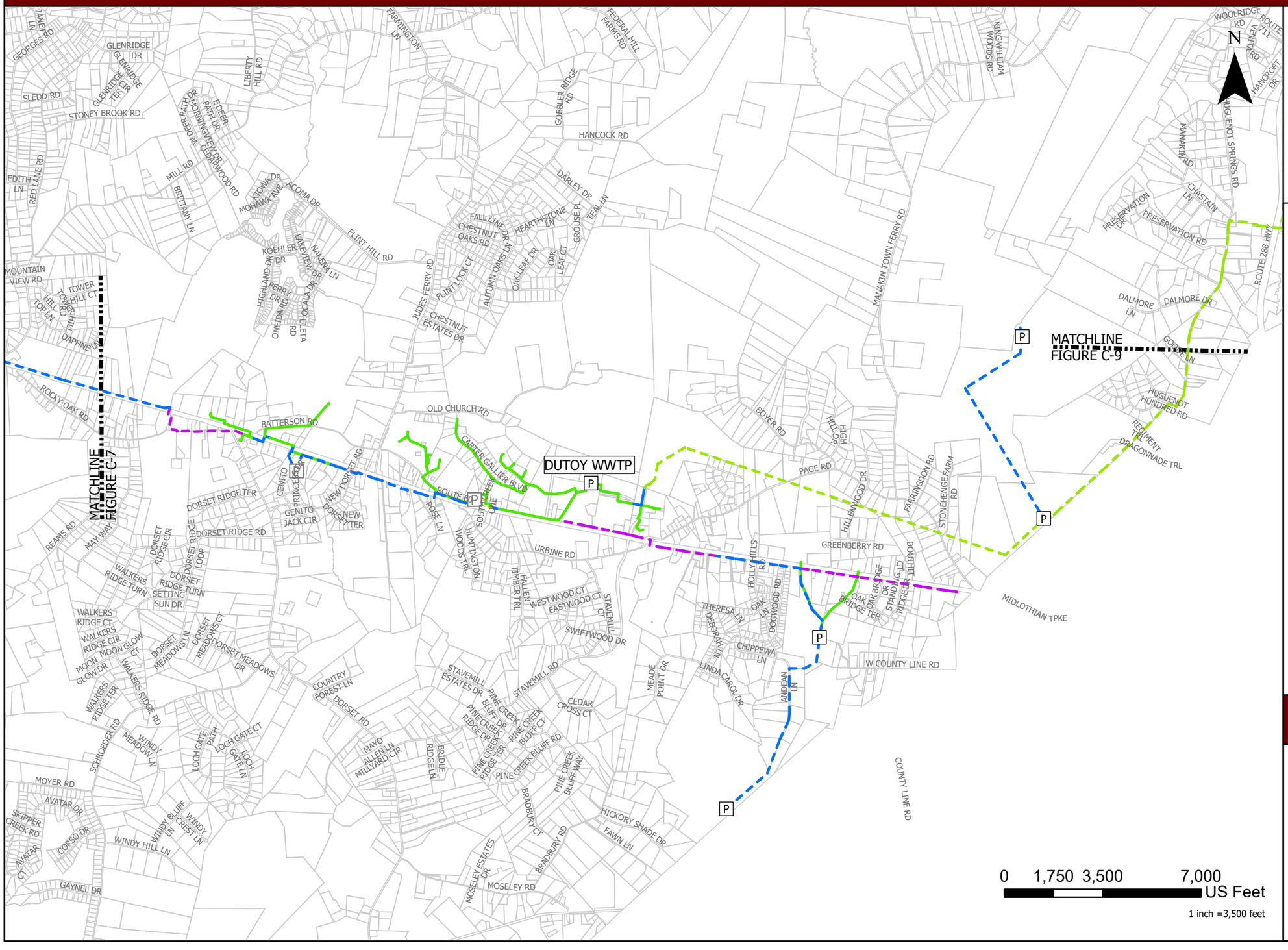
FIGURE D-2. 2045 Peak Hour Wastewater Results - Flat Rock Service Area



Legend

- P Future Sewer PS
- P Existing Pump Station

Velocity

- 0-2 ft/s
- 2-5 ft/s
- 5-7 ft/s
- 7-8 ft/s
- >8 ft/s

Flow/Capacity

- <20%
- 20-40%
- 40-60%
- 60-80%
- Wastewater Treatment Plant

Demand: 2045 Peak Hour

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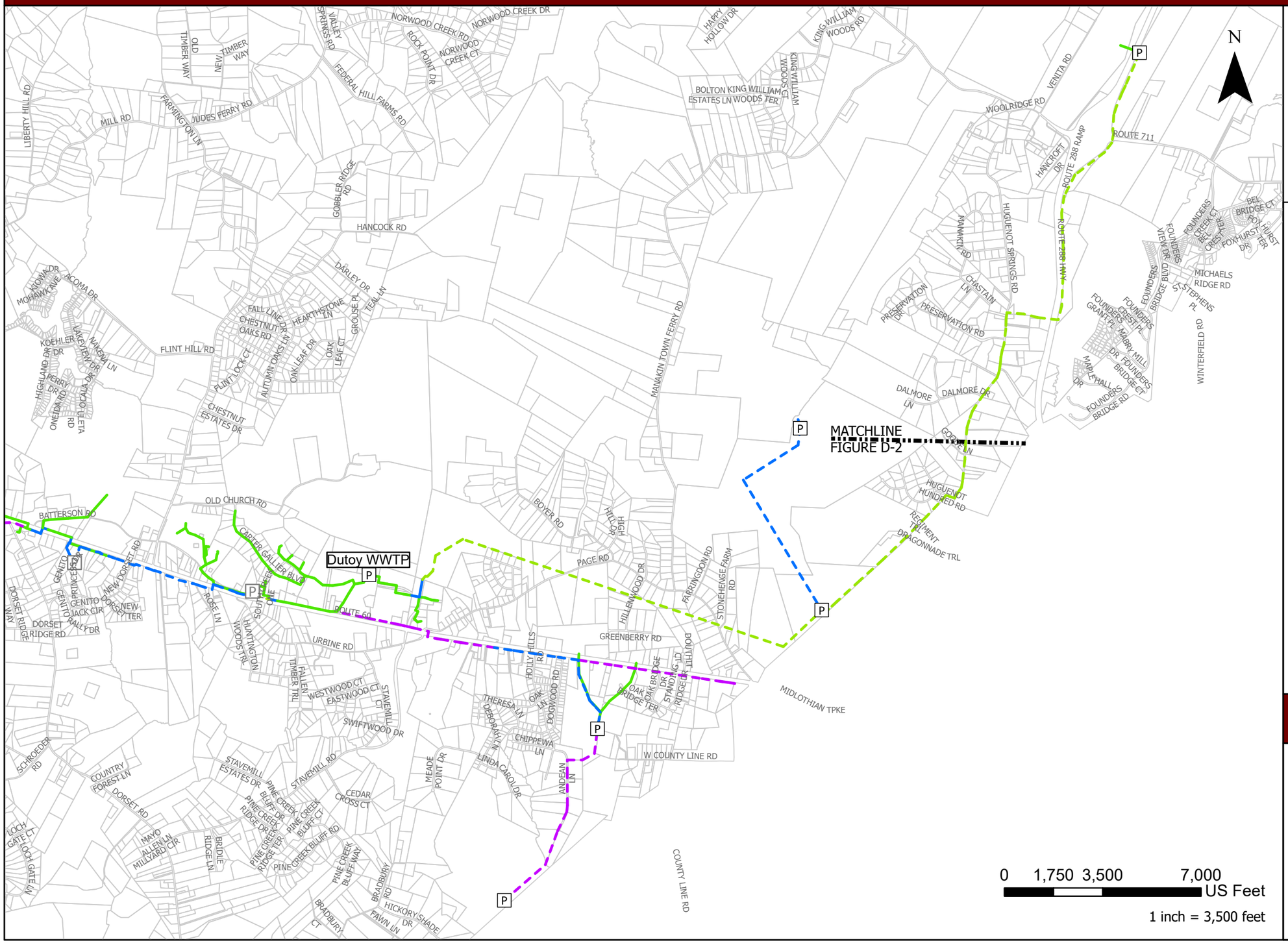
FIGURE D-3. 2045 Peak Hour Wastewater Results - Route 711 Service Area



Legend

- Future Sewer PS
- Wastewater Treatment Plant
- Existing Pump Station

Velocity

- 0-2 ft/s
- 2-5 ft/s
- 5-7 ft/s
- 7-8 ft/s
- >8 ft/s

Flow/Capacity

- <20%
- 20-40%
- 40-60%
- 60-80%

Demand: 2045 Peak Hour

MASTER PLAN UPDATE

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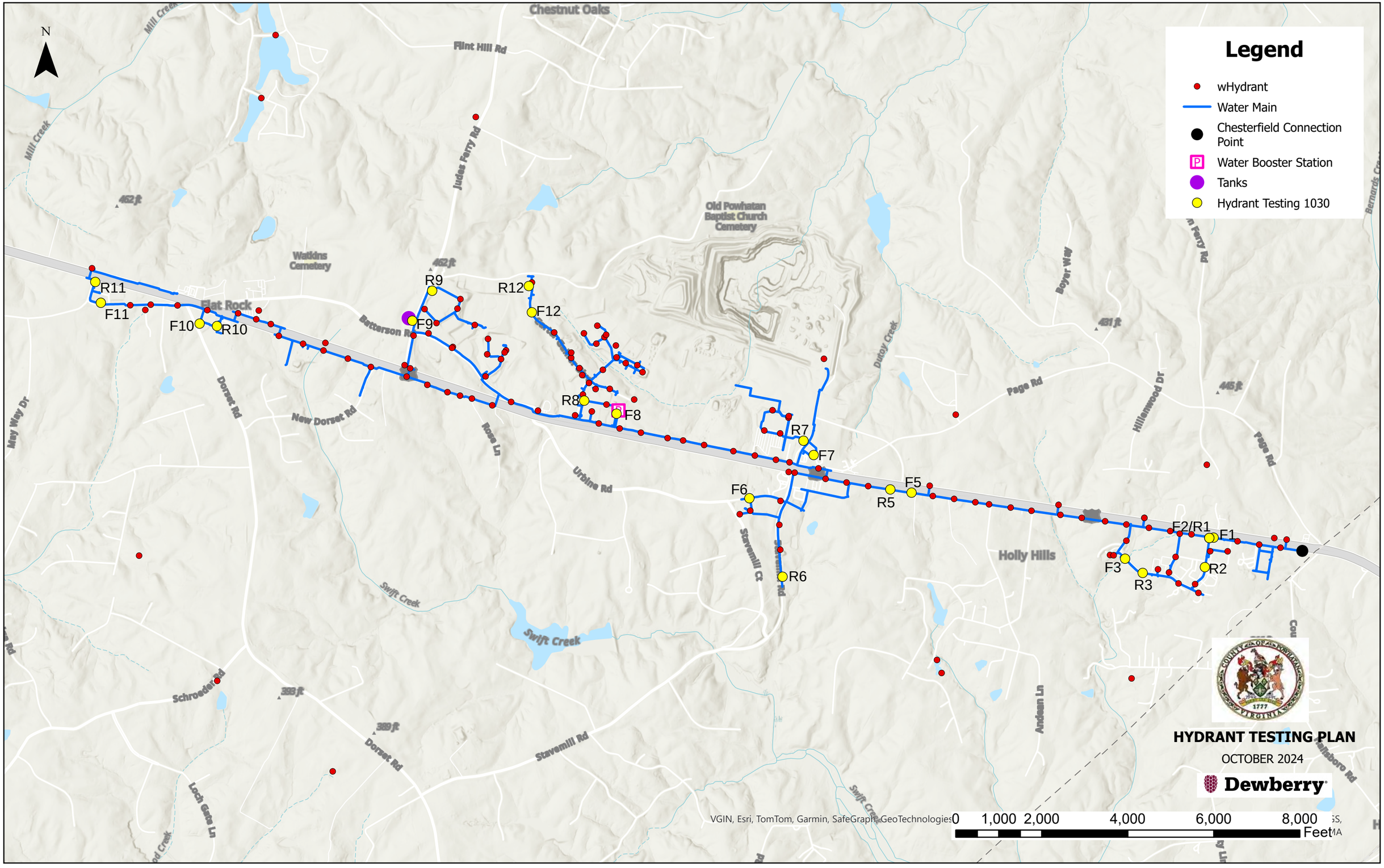
Appendix E
Hydrant Testing Map


N
Legend
wHydrant
Water Main
Chesterfield Connection Point
Water Booster Station
Tanks
Hydrant Testing 1030
Chestnut Oaks
Flint Hill Rd
Judes Ferry Rd
Old Powhatan Baptist Church Cemetery
Watkins Cemetery
Flat Rock
Dorset Rd
New Dorset Rd
Rose Ln
Urbine Rd
Stevemill Ct
Stevemill Rd
Holly Hills
Boyer Way
Dutoy Creek
Page Rd
Hillenwood Dr
Andean Ln
Swift Creek
Schroeder Rd
Loch Gate Ln
May Way Dr
Mill Creek
462 ft
481 ft
445 ft
389 ft
R11
F11
F10
R10
R9
F9
R12
F12
R8
F8
R7
F7
F6
R5
F5
R6
F2/R1
F1
F3
R3
R2
HYDRANT TESTING PLAN
OCTOBER 2024
Dewberry
VGIN, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies
0 1,000 2,000 4,000 6,000 8,000
Feet

Appendix F
Private Permitted Water and Wastewater Systems

N

Powhatan State Park Campground

Powhatan State Park

Beaumont CC

Café at Maidens

Powhatan CC

Moslow Wood Products

Tilman's Farm

The Mill at Fine Creek

Lucky's

Passion Community Church

Pocahontas Middle School

Blessed Sacrament-Huguenot

Blessed Sacrament-Huguenot

The Bridge Church

Goodwyn Lumber Company

Aqua Virginia

Plainview Business Center

Lake Shawnee Estates

Founder's Bridge

Cozy Acres Campground

Fairview Farm Events

Essene Home for Adults

Mill Quarter Plantation

Powhatan Wellness

Legend

Permitted Systems

- Wastewater
- Water

Service Areas

- Courthouse
- Flat Rock
- Route 711

0 2,000 4,000 8,000 12,000 Feet

1 inch equals 4,000 feet

POWHATAN COUNTY WATER AND WASTEWATER MASTER PLAN UPDATE

PRIVATE PERMITTED WATER AND WASTEWATER SYSTEMS

MARCH 2025

Dewberry