UTILITY
MASTER PLAN

GOOCHLAND COUNTY, VIRGINIA

Prepared for:
Goochland County Department of Public Utilities
1800 Sandy Hook Road
Goochland, Virginia 23063

Prepared by:
Dewberry Engineers Inc.
4805 Lake Brook Drive, Suite 200
Glen Allen, Virginia 23060

August 2020

Table of Contents

Chapter 1 Executive Summary

1.1 Purpose and Scope

The purpose of this Utility Master Plan is to provide the Goochland County (Goochland) Department of Public Utilities (DPU) 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.

The County has made great strides to improve upon the already excellent service it provides to the citizens of Goochland County over the last 5 years. Through the various improvements including the Chloramine Booster Station, waterline extensions, pressure zone optimization, operational changes, flushing programs, and comprehensive water quality sampling program, DPU continues to provide high-quality customer service.

This Plan provides a comprehensive evaluation of the County's water and wastewater systems within the Goochland Courthouse and Eastern Goochland Service Areas and identifies the recommended improvements projected to be required through the Year 2045.

The general approach for development of this Plan 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 Public Utilities, Administration, and Planning Departments to gather information and develop concurrence regarding the methodologies used to develop the Plan.
3. Obtain information from Goochland County on proposed land use, targeted growth areas, and future population predictions.
4. Develop demand projections through 2045 and distribute the demand projections throughout the Goochland Courthouse and Eastern Goochland Service Areas in areas projected to be developed during several future time steps. Note that data from Fiscal Year (FY) 2019 (July 2018 to June 2019) was used as the baseline year for demand projections, since this time frame was the latest year that complete data was available when the population demand projections were developed.
5. Modeling of the water and wastewater systems to identify Capital Improvement Projects (CIPs) needed to accommodate the projected growth within the County.
6. Development of the Utility Master Plan to summarize project activities and provide costs and recommendations for CIPs and Renewal and Replacement (R&R) throughout the planning period.

1.2 Existing Water System

There are two existing public water systems within Goochland County, the Goochland Courthouse Water System and the Eastern Goochland Water System.

1.2.1 Goochland Courthouse Water System

The Goochland Courthouse Water System (GCWS) is owned and operated by Goochland County and is currently supplied by one connection point to the Virginia Department of Correction's (VDOC) water system. Goochland County currently has a maximum daily allocation of 1,000,000 gallons per day (gpd) through this connection point. This system consists of more than 11 miles of waterlines, ranging in diameter from 2 to 12 inches, and is generally located within the Courthouse Village.

Storage within the GCWS is provided through the Goochland Courthouse Elevated Storage Tank, which has 300,000 gallons of total storage. This tank, along with the water supplied from VDOC, provides water to meet daily peak water demands and supplies water to meet fire flow demands.

For the period between July 2018 and July 2019 (baseline time period for this report since it was the most recent data available when the population and demand projections were developed), the County provided water service to 270 residential and commercial customers as follows:

- Residential customers: 187
- Commercial customers: 83
- Total customers: 270

In FY2019, water service was provided by the County to meet an annual average demand of approximately 71,800 GPD within the GCWS. This total does not account for flushing and unmetered water usage within the system.

1.2.2 Eastern Goochland Water System

The Eastern Goochland Water System (EGWS) is owned and operated by Goochland County and is currently supplied by four system interconnections to Henrico County's (Henrico) water distribution system. Through a water supply agreement with Henrico County, Goochland currently has a capacity of 5.25 million gallons per day (MGD). EGWS consists of approximately 60 miles of waterlines, ranging in diameter from 2 to 24 inches, and is generally located within the Rockville Area, Centerville Village, West Creek Area, and River Road Communities.

The majority of the EGWS serves the Tuckahoe Creek Service District (TCSD), which was established in the Eastern Goochland Service area to create the utility infrastructure to allow more intense development within the State Route 288 and easternmost Interstate 64 corridors. The 2035 Comprehensive plan calls for utility capacity to be targeted toward commercial, residential, and office uses within the TCSD.

The EGWS is divided into four (4) pressure zones, and has one elevated water storage tank, one hydro-pneumatic tank, and two booster stations that provide water supply and fire flow to the Eastern Goochland Service Area.

For the period between July 2018 to July 2019 (FY19), the EGWS provided water service to 1,510 residential and commercial customers as follows:

- Residential customers: 1,313
- Commercial customers: 197
- Total customers: 1,510

In FY2019, water service was provided by the County to meet a daily average demand of approximately 802,100 GPD within the EGWS. This total does not account for flushing and unmetered water usage within the system.

1.3 Existing Wastewater Systems

Goochland County provides public wastewater service to the Goochland Courthouse and Eastern Goochland Service Areas.

1.3.1 Goochland Courthouse Wastewater System

The Goochland Courthouse Wastewater Collection System is owned and operated by Goochland County, however the wastewater treatment is currently provided by the VDOC Virginia Correctional Center for Women Wastewater Treatment Plant (VCCW WWTP). Based on the current agreement, Goochland County has a maximum day capacity of 136,000 gpd at the VCCW WWTP.

This system consists of approximately 7 miles of gravity sanitary sewer (ranging in diameter from 8 to 12 inches), nearly 1 mile of force main (ranging in diameter from 2 to 4 inches), and three (3) wastewater pump stations.

For the period between July 2018 to July 2019 (baseline time period for this report since it was the most recent data available at the time the population and demand projections were developed), the County provided wastewater service to 113 residential, commercial, and public/municipal customers as follows:

- Residential customers: 61
- Commercial customers: 52
- Total customers: 113

In FY2019, the Goochland Courthouse Wastewater Collection System collected and conveyed an average flow of 55,200 gpd to the VCCW WWTP.

1.3.2 Eastern Goochland Wastewater System

The Eastern Goochland Wastewater Collection System is owned and operated by Goochland County, however wastewater treatment is currently provided by the City of Richmond and Henrico County. This system consists of approximately 56 miles of gravity sanitary sewer (ranging in diameter from 6 to 42 inches), 14 miles of force main (ranging in diameter from 2 to 48 inches), and five (5) wastewater pump stations.

Wastewater treatment for the Eastern Goochland Wastewater Collection System is currently provided by Henrico County and the City of Richmond through a joint agreement. Based on this agreement, Goochland County currently has a maximum daily capacity of 15 MGD for the Eastern Goochland Pump Station. Goochland County also has a separate agreement with Henrico County for an average daily capacity of 0.69 MGD for flows from the Lower Tuckahoe Pump Station.

For the period between July 2018 and July 2019 (baseline time period for this report since it was the most recent data available when the population and demand projections were developed), the County provided wastewater service to 1,276 residential and commercial customers as follows:

- Residential customers: 1,143
- Commercial customers: 133
- Total customers: 1,276

In FY2019, the Eastern Goochland Wastewater Collection System collected and conveyed a total average daily flow of approximately 490,400 gpd to Henrico County and the City of Richmond.

1.4 Future Demand Projections

Future demand projections in Goochland County were evaluated to predict water and wastewater demands and identify system improvements required to meet future needs. Recommended improvements within the planning period (2020-2045) were identified based on land use phasing and the development and geographic distribution of demand projections throughout the Goochland Courthouse Service Area (GCSA) and Eastern Goochland Service Area (EGSA). These projections were developed utilizing methodologies consistent with the provisions of Goochland County's 2035 Comprehensive Plan, Capital Impacts Study, and input from the County's Public Utilities, Administration, Economic Development, and Planning Departments.

The proposed projects identified in this UMP were developed based on these projections and should be periodically adjusted based on actual growth patterns within the GCSA and EGSA. This is particularly true of any project planned for more than 3 years in the future.

1.5 System Modeling

Water and wastewater system digital hydraulic models were developed for all of Goochland's Public Utility systems in order to evaluate system conditions throughout the planning period and to identify improvements required to meet future needs. InfoWater Suite 10.0, developed by Innovyze, was used to model the water systems and InfoSewer Suite 7.6, also developed by Innovyze, was used to model the wastewater systems.

Following initial setup, each model was calibrated to better reflect actual system conditions. Average and peak flow 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 the development of the water and wastewater system improvement programs contained in this UMP.

1.6 Water System Improvements

A water system analysis was conducted for each water system to evaluate improvements currently needed as well as those required for projected future growth through the end of the planning period in 2045.

The County generally constructs major infrastructure projects required to provide adequate water supply to a broad geographic area while the private sector typically constructs waterlines required to provide water service to a site-specific area. 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 the water supply, water storage, and water distribution infrastructure needed to ensure adequate supply and pressures throughout the planning period. A brief overview of improvements is provided in the following sections.

1.6.1 Existing Water Distribution System Improvements

The water models for both the Goochland Courthouse and Eastern Goochland Water Systems were utilized to identify and evaluate weaknesses in the system and develop system improvements to address these weaknesses. Projects generally address three criteria: domestic pressures, fire flow availability, and water age.

1.6.1.1 Goochland Courthouse Service Area

The Goochland Courthouse Water System provides adequate water supply to all existing customers based on the existing system analysis; however, improvements will be necessary to attain the County's goal of providing fire flow availability for a 2-hour, 1,500 gpm fire event for a majority of the system. Improvements are herein recommended to upsize existing piping, construct loops to increase the fire flow availability, and make improvements the existing booster station.

From an operational standpoint, the continued operation of auto-flushers at certain dead-end lines is recommended to further reduce system water age.

1.6.1.2 Eastern Goochland Service Area

Based on the existing system analysis, the Eastern Goochland System currently provides adequate water supply to all existing customers. However, several areas are not currently meeting the County's goals for domestic pressures, fire flow availability, and water age. These areas include portions of the River Road corridor and the Lanier Industrial Park. To address this, water main upsizing and looping is recommended to increase system capacity to meet the County's fire flow availability goal in those areas.

The Centerville Elevated Water Storage Tank has adequate capacity to provide the required storage for the existing system demands. However, additional storage and pumping facilities will be required to meet fire flow requirements and improve domestic pressures throughout the system as the system develops throughout the planning period.

The continued operation of auto-flushers at dead-end lines, implementation of the unidirectional flushing program, and execution of a comprehensive water quality sampling program is recommended to further reduce system water age.

1.6.2 Water Supply

An evaluation of the planning period from 2020 to 2045 indicated that as the population grows within the water service areas, the County's current water supply allocation will be not be sufficient to meet maximum day demands through the end of the planning period. The County has an agreement with Henrico County to provide up to a maximum day capacity of 25 MGD and an agreement with the VDOC to ultimately provide up to a maximum day capacity of 1 MGD. It is anticipated that the County will have to share the cost of expanding the water treatment plant and transmission facilities of Henrico County in order to have access to the needed capacity for the EGSA.

1.6.3 Water Storage and Booster Pump Capacity

1.6.3.1 Goochland Courthouse Service Area

Based on demand projections, the 300,000 gallon Goochland Courthouse Elevated Water Storage Tank's capacity will be adequate to provide domestic and fire storage through the planning period. The existing VDOC-owned River Road West Booster Station will need to be upgraded in order to provide the desired fire flow of 1,500 gpm for a 2-hour period to most of the Courthouse system. It is recommended that the County construct either a booster station upgrade of the VDOC-owned facility or a new Goochland County-owned booster station by 2025 that will meet capacity needs through the end of the planning period.

1.6.3.2 Eastern Goochland Service Area

Based on the storage tank evaluation, the existing 1 million gallon Centerville Tank is sufficient to provide the required storage through 2025. In order to provide the Eastern Goochland Service Area with the required storage, additional storage volume will be needed to meet the recommended storage capacity. The construction of water storage facilities is recommended at various locations throughout the water system. Phased implementation is also recommended, starting with a 1,000,000 gallon storage tank near the Lanier Industrial Park area by 2035, followed by a 1,500,000 gallon storage tank near the intersection of Hockett Road and Patterson Avenue by 2045.

Water booster pump station upgrades will be necessary to provide the required water supply and fire flow through the planning period. A major upgrade to the River Road Booster Pump Station is needed in order for the station to supply the fire flow goal of 1,500 gpm for 2-hours to the River Road High Pressure Zone. The provision of fire flow will require the River Road booster pumps to operate at a higher flow rate. As currently configured, this will drop upstream pressures in Rivergate below 35 psi. To avoid this, a booster station upgrade will be required. A new 500,000 gallon ground storage tank will be required to buffer flows without negatively affecting the low pressure side of the booster station.

The construction of water pumping facilities is recommended throughout the water system at different phases starting with a 500,000 gallon ground storage tank and pumping facility to serve the future Rockville pressure zone area by 2030, and a 500,000 gallon ground storage tank and pumping facility to serve the West Creek area by 2030. The future Rockville pressure zone is also recommended to be served through an additional metered interconnection with Henrico County along Quarry Hill Road. Additionally, the pumps at the Centerville Booster Pump Station will need to be upsized to meet maximum day demands.

1.6.4 Water Distribution

The improvements recommended to serve future development within the water distribution system are generally required to address one or more of the following issues:

- Meet growing system demands in areas already served.
- Increase system reliability and/or service.
- Provide service to new areas or existing subdivisions within the Water Service Area(s).
- Increase fire flow availability.

1.7 Wastewater System Improvements

Wastewater system hydraulic models were also developed to evaluate the improvements needed for the existing system as well as those which will be needed to provide service for future growth through the end of the planning period in 2045.

In general, the wastewater improvement program involves improvements including upgrades, expansions and extensions to treatment capacity, pump stations and force mains, and gravity interceptor pipes.

1.7.1 Wastewater Discharge Capacity

An evaluation of the planning period from 2020 to 2045 indicates that as the population grows within the service areas, the County will be required to obtain additional wastewater discharge allocations to meet peak system demands through the end of the planning period.

1.7.1.1 Goochland Courthouse Service Area

The County currently has an agreement in place with VDOC to discharge a maximum month average flow rate of 136,000 GPD to the wastewater treatment facilities located at the Virginia Correctional Center for Women (VCCW) on River Road West. Based on future demand projections, the VCCW WWTP will require an expansion to provide treatment and disposal of wastewater through the end of the planning period in 2045. VDOC previously completed a study that estimates the WWTP improvements totaling approximately $3 million will be required in order to provide the County with a 330,000 GPD allocation. This allocation will satisfy the County's projected needs through at least the planning year 2030, and potentially further, depending on the actual growth rate of the Goochland Courthouse Service Area. The actual and peak wasterwater flows conveyed to the VCCW WWTP should be analyzed on a yearly basis to better determine if and when an expansion beyond the 330,000 GPD allocation will be needed.

1.7.1.2 Eastern Goochland Service Area

For the Eastern Goochland Service Area, there are currently two active agreements concerning wastewater discharge: one with Henrico County (Henrico) and one with the City of Richmond (Richmond).

Through an agreement with the City of Richmond, dated June 1, 2002, Goochland County may convey up to the initial contracted wastewater treatment maximum month average capacity of 5 MGD with an allowable peak hour conveyance capacity of 1.33 times the maximum month average capacity (6.65 MGD). Goochland County has the option of purchasing additional wastewater treatment capacity or up to a maximum month average of 8 MGD without being required to participate in upgrading the existing WWTP. As part of the agreement, additional wastewater treatment capacity up to a maximum monthly average of 15 MGD is available but will require upgrades to Richmond's wastewater treatment plant and the renegotiation of capacity charges. The existing agreement does not allow for Goochland to exceed a maximum month average of 15 MGD and a peak hour flow of 20 MGD. Based on the loading projections, the County has adequate wastewater treatment capacity within the limits of the existing agreement to meet the projected 2045 sewer loadings.

Henrico County is currently under contract to provide Goochland County with a maximum monthly average wastewater treatment capacity of up to 0.69 MGD from the Lower Tuckahoe Pump Station. Based on the future wastewater loading projections, this capacity is adequate to meet the County's need through the end of the planning period in 2045.

1.7.2 Wastewater Collection and Conveyance Capacity

The sewer model was utilized to evaluate the capacity of the existing Goochland Courthouse sewer collection system. Based on this analysis, the system has adequate capacity for the current wastewater flows, with the exception of the gravity interceptor between the Valley View Pump Station forcemain discharge and the VDOC WWTP. In order to prevent surcharging, it is recommended this portion of the gravity system be upsized. Additionally, Valley View Pump Station requires both pumps to be operating simultaneously to keep up with peak sewer flows. In order to maintain full redundancy for current flows, it is recommended that the forcemain and the pumps be upsized. A developer-funded project is currently underway to increase the forcemain size from 4-inch to 6-inch; however, until the pumps and forcemain are upsized, the County has an adequate contingency plan in the event a pump fails. The contingency plan includes the use of a diesel backup pump to allow for bypass pumping. This reduces the urgency of upsizing the pumps.

Based on the analysis of the existing Eastern Goochland wastewater collection system, the existing system has capacity for projected sewer flow rates until 2035. Anticipated improvements between 2035 and

the end of the planning period include the installation of parallel interceptors along Tuckahoe Creek ranging in diameter from 24-inch to 30-inch diameter.

1.8 Implementation

The implementation plan outlined in this Master Plan 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 and demands.

Costs were developed based on a benchmarking of recently completed projects in the Richmond metro-area. Cost information was gathered on a variety of projects' bid tab data that have either been constructed, are currently under construction, or have been bid on in the past 10 years (2010-2020), as well as projects from surrounding municipalities. This bid tab data was adjusted for inflation to 2020 dollars and categorized by project type and the size of the project. A cost per linear foot or per gallon was calculated for each project, and averaged together with other projects of the same size and type. For any unit costs that were missing historical project data, the unit cost was interpolated between available historical data.

Table 1-1 provides a summary of the anticipated total approximate costs of the CIP projects countywide. **Tables 1-2** and **1-3** outline the projected water and wastewater system improvements by service area, summarizing the following information:

- Name of system improvement.
- Budgetary cost estimate in 2019 dollars because this is the most recent complete fiscal year.
- Year of project completion. For the purpose of this report, projects estimated to be within the 1-5 year time frame are listed by individual year of completion. Beyond the near term of 1-5 years, projects are listed in the estimated time period ranges of either 5-10 years, 10-15 years, or 15-25 years. This allows the majority of the projects to remain development driven. This keeps the plan nimble and allows the County to adjust CIP projects as needed to better react to an ever-changing development landscape.

Table 1-1

CIP Project Type	Fiscal Year			
	2020 - 2025	**2025 - 2030**	**2030 - 2035**	**2035 - 2045**
Water	$13,415,000	$21,011,000	$21,415,000	$7,362,000
Wastewater	$13,836,000	$3,615,000	$16,324,000	$7,784,000
Grand Total	**$27,251,000**	**$24,626,000**	**$37,739,000**	**$15,146,000**

Table 1-2 Courthouse Service Area Water and Wastewater CIP Projects

Water Improvement Project			Size (in)	Length (ft)	Fiscal Year							
Project ID	**CIP ID**	**Project Description**			**2021**	**2022**	**2023**	**2024**	**2025**	**2025 - 2030**	**2030 - 2035**	**2035 - 2045**
wGC-2025-01	344	Sandy Hook Rd/Fairground Rd Water Main Extension	12"	1,600					$ 240,000			
wGC-2025-02	338	Middle/High School Water Main Loop	8"	800					$ 126,000			
wGC-2025-03	338	Bridle Rdg Water Main Loop	12"	800					$ 147,000			
wGC-2025-04	338	Thoroughbred Pkwy Water Main Extension	8"	3,300					$ 347,000			
wGC-2025-05	340	J. Sargeant Reynolds Water Main Extension	12"	700				$ 145,000				
wGC-2025-06	342	River Road West Water Main Upgrade	16"	7,300					$ 1,424,000			
wGC-2025-07	346	River Road West BPS							$ 1,645,000			
wGC-2025-08	-	Greenbriar Branch Dr Water Main Extension	12"	2,800					$ 410,000			
wGC-2030-01	-	Fairground Rd Water Main Extension	12"	2,000						$ 300,000		
wGC-2035-01	-	Bulldog Way Water Main Extension	12"	2,700							$ 405,000	
wGC-2035-02	-	Scott Road Water Main Extension	12"	11,200							$ 1,680,000	
		Courthouse Service Area Water Improvements Subtotal			**$ -**	**$ -**	**$ -**	**$ 145,000**	**$ 4,339,000**	**$ 300,000**	**$ 2,085,000**	**$ -**
Wastewater Improvement Project			**Size (in)**	**Length (ft)**	**Fiscal Year**							
Project ID	**CIP ID**	**Project Description**			**2021**	**2022**	**2023**	**2024**	**2025**	**2025 - 2030**	**2030 - 2035**	**2035 - 2045**
sGC-2025-01	454	Valley View Force Main Upgrade	6"	1,400				$ 173,000				
sGC-2025-02	454	Valley View Sewer Pump Station - 0.5 MGD						$ 1,688,000				
sGC-2025-03	456	Valley View Ln Gravity Main Upgrade	15"	1,500			$ 394,000					
sGC-2025-04	458	Courthouse Wastewater Treatment Plant[1]			$ 750,000	$ 6,000,000						
sGC-2025-05	-	Bucknell Ln Gravity Main Extension	8"	1,400					$ 211,000			
sGC-2030-01	-	Fairground Rd Gravity Main Extension	8"	4,300						$ 634,000		
sGC-2035-01	-	Scott Rd/Gathright Dr Gravity Main Extension	12"	6,600							$ 1,467,000	
sGC-2035-02	-	River Road Sewer Pump Station - 0.3 MGD									$ 563,000	
sGC-2035-03	-	River Road Force Main	4"	3,300							$ 207,000	
		Courthouse Service Area Wastewater Improvements Subtotal			**$ 750,000**	**$ 6,000,000**	**$ 394,000**	**$ 1,861,000**	**$ 211,000**	**$ 634,000**	**$ 2,237,000**	**$ -**
		Courthouse Service Area Improvements Grand Total			**$ 750,000**	**$ 6,000,000**	**$ 394,000**	**$ 2,006,000**	**$ 4,550,000**	**$ 934,000**	**$ 4,322,000**	**$ -**

[1] Cost shown to reflect FY20 CIP. Project already in Progress.

Table 1-3 East End Service Area Water and Wastewater CIP Projects

Water Improvement Project			Size (in)	Length (ft)	Fiscal Year							
Project ID	CIP ID	Project Description			2021	2022	2023	2024	2025	2025 - 2030	2030 - 2035	2035 - 2045
wEG-2025-01	352	Lanier Industrial Park Improvements	16"	700					$ 166,000			
wEG-2025-02	-	Rockville Road Water Main Extension	16"	6,300					$ 1,214,000			
wEG-2025-03 (12")	-	Manakin Rd Waterline Extension	12"	4,300					$ 632,000			
wEG-2025-03 (16")	-	Manakin Rd Waterline Extension	16"	2,000					$ 375,000			
wEG-2025-04	416	Saddle Creek Water Main Loop	12"	2,700				$ 401,000				
wEG-2025-05	-	Wilkes Ridge Pkwy Water Main Extension	12"	2,400					$ 355,000			
wEG-2025-06	272	Plaza Drive Water Installation	16"	1,400					$ 254,000			
wEG-2025-07	-	Huguenot Hills Water Service	12"	4,200					$ 623,000			
wEG-2025-08 (12")	-	Blair Rd/Patterson Ave Water Main Extension	12"	1,400					$ 213,000			
wEG-2025-08 (16")	-	Blair Rd/Patterson Ave Water Main Extension	16"	3,800					$ 725,000			
wEG-2025-09	410	Blair Rd Water Main Extension	12"	3,000					$ 449,000			
wEG-2025-10	356	Rivergate Water Main Loop	12"	700					$ 142,000			
wEG-2025-11	358	River Rd Control Valve							$ 300,000			
wEG-2025-12	360	Randolph Square Water Main Upgrade	8"	1,400					$ 167,000			
wEG-2025-13	-	Patterson Ave/Creekmore Rd Water Main Extension	12"	3,000					$ 448,000			
wEG-2030-01	-	Rockville BPS - 3 MGD and Chloramine Booster Station		400						$ 4,933,000		
wEG-2030-02	-	Quarry Hill Rd Water Main	16"	5,500						$ 1,068,000		
wEG-2030-03	-	Ashland Rd Control Valve								$ 300,000		
wEG-2030-04	442	Tuckahoe Creek Pkwy Waterline	24"	4,500						$ 1,343,000		
wEG-2030-05	426	Ridgefield BPS - 7 MGD and Chloramine Booster Station								$ 11,510,000		
wEG-2030-06	-	Ridgefield Control Valve								$ 300,000		
wEG-2030-07	418	Hockett Rd Water Main Extension	16"	6,500						$ 1,257,000		
wEG-2030-08	406	River Road BPS Upgrade - 1.5 MGD							$ 2,467,000			
wEG-2030-09	-	West Creek Control Valve								$ 300,000		
wEG-2035-01	414	Lanier Industrial Park Elevated Tank									$ 4,950,000	
wEG-2035-02	424	Ashland Rd Water Main Extension	16"	4,600							$ 894,000	
wEG-2035-03	-	Lanier Industrial Park Water Main Extension	16"	13,600							$ 2,635,000	
wEG-2035-04	-	Rockville Rd Control Valve									$ 300,000	
wEG-2035-05	-	Three Chopt Road Water Main Extension	12"	9,100							$ 1,362,000	
wEG-2035-06	420	Centerville BPS Upgrade									$ 75,000	
wEG-2035-07	-	Fleetwood Ln/Mosaic Connection Water Main Extension	12"	9,700							$ 1,453,000	
wEG-2035-08	-	Hockett Rd Water Main Extension	24"	15,800							$ 4,716,000	
wEG-2035-09 (12")	428	Patterson Ave Water Main Extension	12"	1,100							$ 180,000	
wEG-2035-09 (24")	428	Patterson Ave Water Main Extension	24"	3,200							$ 953,000	
wEG-2035-10	408	River Rd High Water Main Extension	12"	10,100							$ 1,512,000	
wEG-2035-11	-	Benedictine PRV									$ 300,000	

Table 1-3 East End Service Area Water and Wastewater CIP Projects

wEG-2045-01	-	West Creek Business Park Water Main Extension	12"	11,700								$ 1,748,000
wEG-2045-02	354	Country Club Lane Water Main Extension	24"	8,100								$ 2,426,000
wEG-2045-03	438	Hockett Rd Elevated Tank										$ 3,188,000
		East End Service Area Water Improvements Subtotal			**$ -**	**$ -**	**$ -**	**$ 401,000**	**$ 8,530,000**	**$ 21,011,000**	**$ 19,330,000**	**$ 7,362,000**

Table 1-3 East End Service Area Water and Wastewater CIP Projects

Wastewater Improvement Project			Size (in)	Length (ft)	Fiscal Year							
Project ID	**CIP ID**	**Project Description**			**2021**	**2022**	**2023**	**2024**	**2025**	**2025 - 2030**	**2030 - 2035**	**2035 - 2045**
sEG-2025-01	-	Sycamore Creek Gravity Main Extension	12"	1,500					$ 337,000			
sEG-2025-02	266	Hugenot Hills Sewer Service - 8"	8"	12,100		$ 1,813,000						
sEG-2025-03	266	Hugenot Hills Sewer Service - 12"	12"	2,300		$ 511,000						
sEG-2025-04	266	Hugenot Hills Sewer Service - 15"	15"	6,400		$ 2,089,000						
sEG-2025-05*	274	Plaza Drive Sewer Service	8"	1,400					$ 215,000			
sEG-2025-06*	276	Biggs Drive Sewer Service	8"	600					$ 135,000			
sEG-2025-07*	280	Broad Street/Rt. 288 Sewer Service	8"	1,800					$ 270,000			
sEG-2030-01	-	Hockett Rd Sewer Pump Station - 1 MGD								$ 1,875,000		
sEG-2030-02	-	Rt. 288 Force Main	8"	1,700						$ 188,000		
sEG-2030-03	-	Hockett Rd/Paula Ln Gravity Sewer Extension	12"	4,100						$ 918,000		
sEG-2035-01	-	Ashland Rd/Little Tuckahoe Creek Gravity Main Extension	12"	1,900							$ 422,000	
sEG-2035-02	-	Ashland Rd/Three Chopt Rd Gravity Sewer Extension	12"	3,900							$ 868,000	
sEG-2035-03	-	Three Chopt Rd Gravity Main Extension	12"	2,400							$ 528,000	
sEG-2035-04	-	River Road Gravity Main Extension (Sewer Service to Mosaic)	12"	11,300							$ 2,531,000	
sEG-2035-05	-	Lanier Industrial Park Gravity Main Extension	18"	4,000							$ 1,306,000	
sEG-2035-06	-	Lanier Industrial Park Sewer Pump Station - 2 MGD									$ 3,000,000	
sEG-2035-07	-	Lanier Industrial Park Force Main	12"	3,300							$ 495,000	
sEG-2035-08	-	Ashland Rd/Little Tuckahoe Creek Gravity Main Extension	24"	11,400							$ 4,937,000	
sEG-2045-01	-	Quarry Hill Rd Gravity Main Extension	12"	4,000								$ 882,000
sEG-2045-02	462	Tuckahoe Creek/Sanctuary Dr Interceptor Upgrade	30"	6,200								$ 3,333,000
sEG-2045-03	-	Tuckahoe Creek/I-64 Parallel Gravity Interceptor	24"	8,300								$ 3,569,000
		East End Service Area Wastewater Improvements Subtotal			**$ -**	**$ 4,413,000**	**$ -**	**$ -**	**$ 957,000**	**$ 2,981,000**	**$ 14,087,000**	**$ 7,784,000**
		East End Service Area Improvements Grand Total			**$ -**	**$ 4,413,000**	**$ -**	**$ 401,000**	**$ 9,487,000**	**$ 23,992,000**	**$ 33,417,000**	**$ 15,146,000**

Chapter 2 Introduction

2.1 Purpose

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

This Utility Master Plan is based on the best information available at this time. The plan serves as a road map for the County's Department of Public 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 Utility Master Plan involved extensive coordination with the Goochland County Department of Public Utilities 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 development of the Utility Master Plan also involved coordination with Henrico County Departments of Public Utilities, City of Richmond Department of Public Utilities, and the Virginia Department of Corrections. This coordination was important to ensure that the Utility Master Plan incorporated the latest information available and meets the overall needs of the County.

The general approach for development of the Utility Master Plan incorporated the following steps:

1. Collect and review available information on the County's existing water and wastewater systems.
2. Obtain information from Goochland County on proposed land use, targeted growth areas, and population projections through the planning period.
3. Develop demand projections through 2045 and distribute the demand projections throughout the Goochland Courthouse and Eastern Goochland Service Areas in areas projected to be developed during several future time steps. Note that data from July 2018 to June 2019 was used as the baseline year for demand projections, since this time frame was the latest year that complete data was available when the population demand projections were developed.

4. Model the water and wastewater systems to identify Master Plan Capital Improvement Projects (CIPs) that will address existing system deficiencies as well as growth within the County.
5. Develop the Utility Master Plan 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 **Chapter 7** and **Chapter 8**. The implementation plan for these improvements, outlining cost estimates and implementation schedules for each individual project, is included in **Chapter 9**.

Chapter 3 Existing Water System

This chapter of the Utility Master Plan provides an overview of Goochland County's existing water system.

3.1 Water System Overview

There are two existing public water systems within Goochland County; the Goochland Courthouse Water System (GCWS) and the Eastern Goochland Water System (EGWS). More detailed information on the County's water supply facilities, storage facilities, and pumping facilities is provided in the following sections.

3.2 Goochland Courthouse Water System

The Goochland Courthouse Water System is owned and operated by Goochland County and is currently supplied by a single connection point to Virginia Department of Correction's (VDOC) water distribution system along River Road West (State Route 6). Based on the water supply agreement, Goochland County currently has a maximum day water allocation of 1,000,000 gallons per day (GPD) with VDOC**.** This system consists of approximately 11 miles of waterlines, ranging in diameter from 2 to 12 inches, and is generally located within the Courthouse Village.

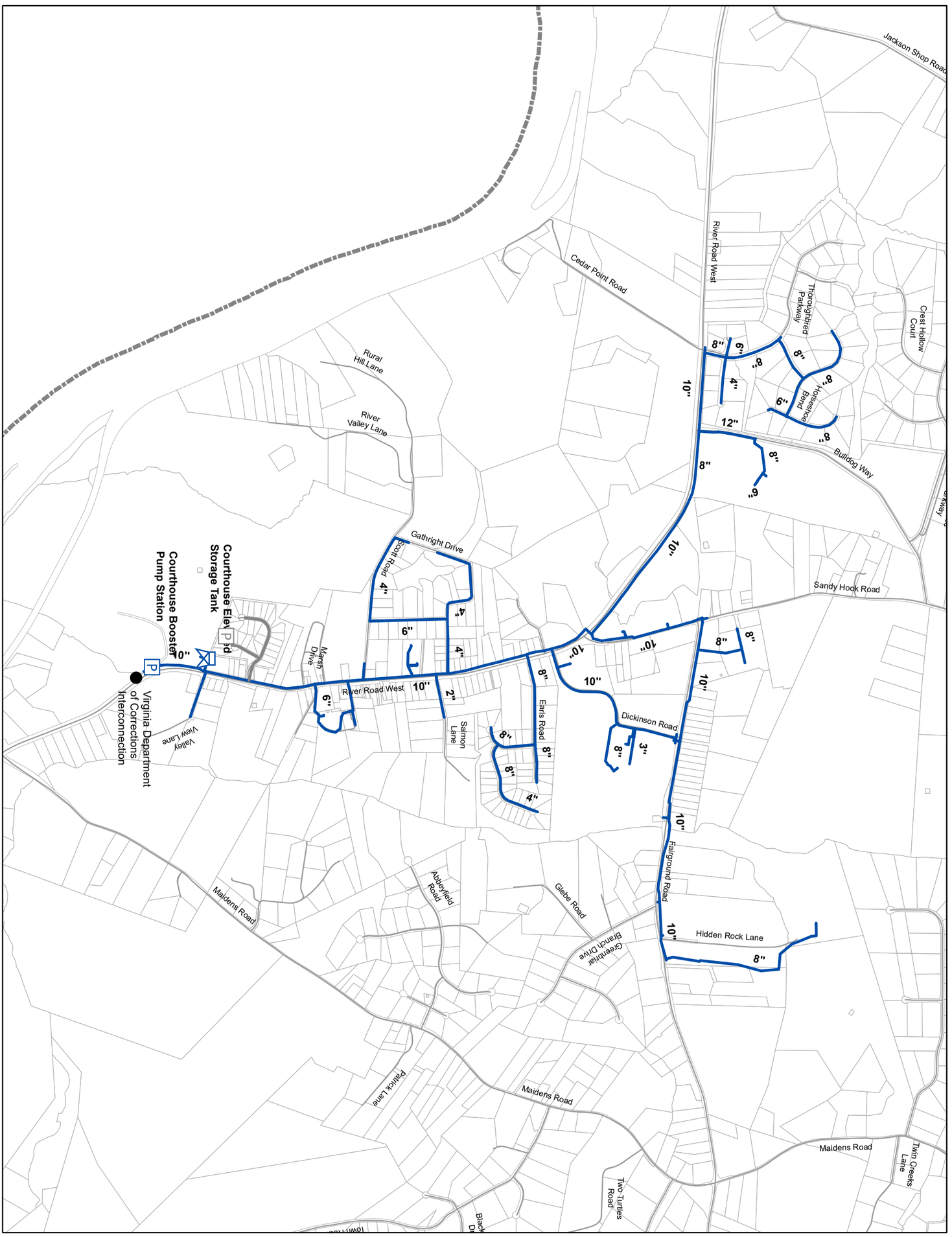
Storage within the GCWS is provided by the Goochland Courthouse Elevated Storage Tank, which has 300,000 gallons of total storage and is filled by a water booster pump station owned and operated by VDOC located along River Road West. This tank, along with the water supplied from VDOC provides water to meet maximum day water demands and supplies water to meet fire flow demands.

For the period between July 2018 to June 2019 (baseline time period for this report since it was the most recent data available when the population and demand projections were developed), the County provided water service to 270 residential and commercial customers as follows:

- Residential customers: 187
- Commercial customers: 83
- Total customers: 270

In FY2019, water service was provided by the County to meet an annual average demand of approximately 71,800 GPD within the GCWS. This total does not account for flushing and unmetered water usage within the system.

A plan schematic of the existing Goochland Courthouse Water System is shown in Figure 3-1.



Key Plan

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 1,500 feet	COURTHOUSE AREA EXISTING WATER SYSTEM	3-1
PROJ. NO. 50109629	PROJECT UTILITY MASTER PLAN UPDATE GOOCHLAND COUNTY, VA		

3.3 Eastern Goochland Water System

The Eastern Goochland Water System (EGWS) is owned and operated by Goochland County and is currently supplied by four system interconnections to Henrico County's (Henrico) water distribution system. Through a water supply agreement, Goochland County currently has a maximum day capacity of 5.25 million gallons per day (MGD) from Henrico**.**

The EGWS primarily serves the Tuckahoe Creek Service District (TCSD) which was established in the Eastern Goochland Service Area to create the utility infrastructure to allow more intense development within the State Route 288 and easternmost Interstate 64 corridors. The County's 2035 Comprehensive Plan calls for utility capacity to be targeted toward commercial, light industrial, and office uses within the TCSD.

The EGWS is divided into four (4) pressure zones and consists of approximately 60 miles of waterlines, ranging in diameter from 2 to 24 inches, and is generally located within the Rockville Area, Centerville Village, West Creek Area, and River Road Communities. Starting at the northern end of the system, the Centerville Pressure Zone is supplied with water at the Broad Street connection. The Centerville Booster Pump Station, located just downstream of the water supply connection, pumps water from Henrico into the Centerville Elevated Water Storage Tank.

Just south of the Centerville Pressure Zone, the West Creek Pressure Zone is supplied by three connections: two connections from Henrico (at Patterson Avenue and Ridgefield Avenue) and a PRV station at the Route 288 and Route 250 interchange. The Route 288 PRV Station includes a 4-inch PRV that serves normal flows and pressures in the West Creek Pressure Zone and a 16-inch PRV that allows a redundant water supply feed from the Centerville Pressure Zone to the West Creek Pressure Zone in the event of an emergency.

The River Road area is served by two pressure zones; River Road Low and River Road High Pressure Zones. The River Road Low Pressure Zone is supplied directly by a Henrico water supply connection on River Road. This pressure zone does not contain a storage tank and relies solely on storage within Henrico County's water distribution system.

The River Road High Pressure Zone is connected to the West Creek Pressure Zone and is served by the River Road Booster Station, which maintains system pressures and supplies water within the zone. Storage is provided by a 10,000 gallon hydro-pneumatic tank located at the River Road Booster Station. Table 3-1 and Table 3-2 below summarize the storage and booster pumping capacities currently available in the EGWS.

Table 3-1 Eastern Goochland Water System Tank Summary

Tank	Capacity (Gal.)	Tank Type	Overflow Elevation/ HGL Setpoint (ft)
Centerville	1,000,000	Elevated (composite)	400
River Road	10,000	Hydro-pneumatic	395 (80 psi max)

Table 3-2 Eastern Goochland Water System Booster Pump Station Summary

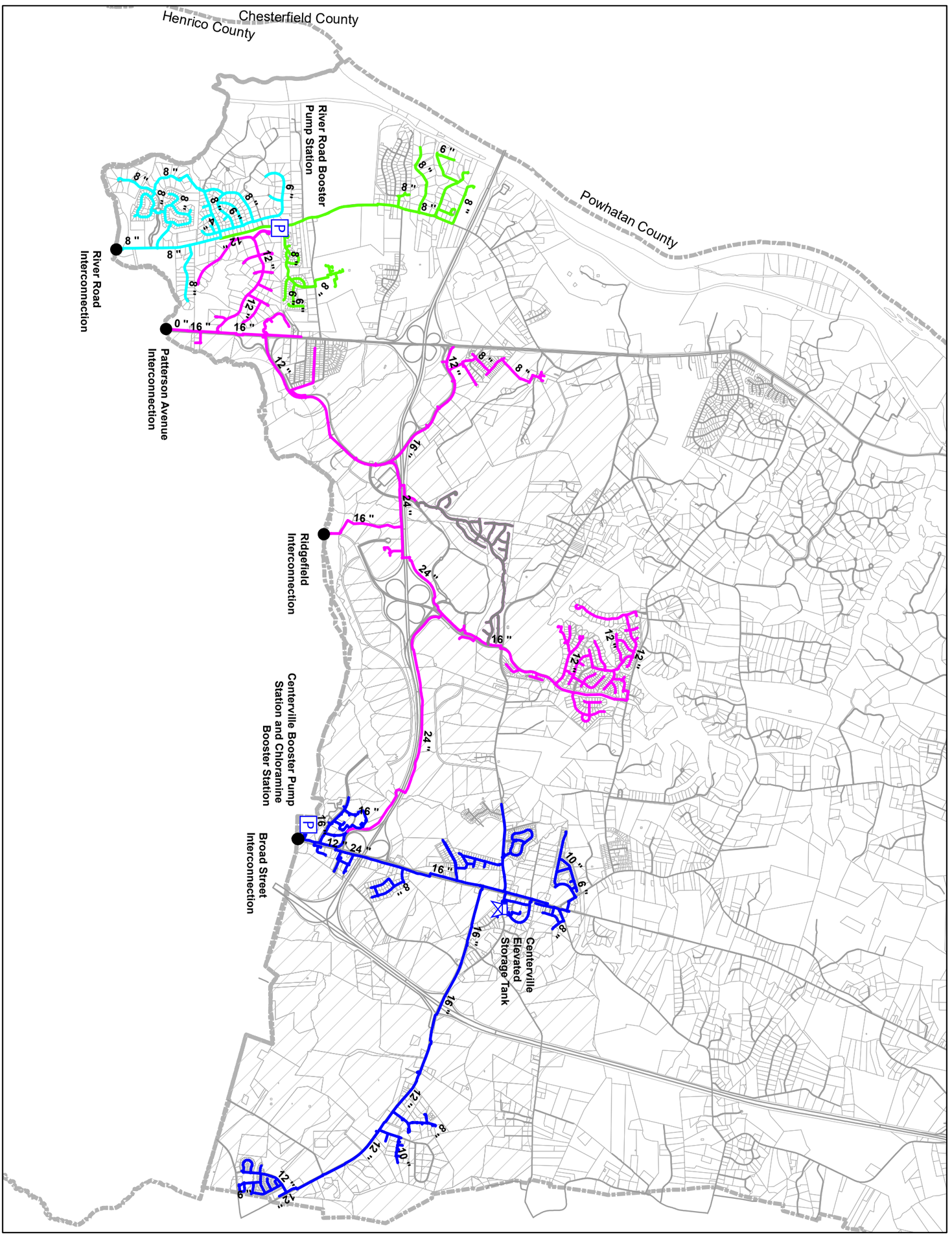
Booster Pump Station	No. of Pumps	Design Flow per Pump (gpm)	Design Head (ft)	Firm Capacity (gpm)
Centerville	3	1,300	110	2,600
River Road	3	480	90	960

For the period between July 2018 to June 2019, the County provided water service to 1,510 **residential** and commercial customers as follows:

- Residential customers: 1,313
- Commercial customers: 197
- Total customers: 1,510

In FY2019, water service was provided by the County to meet an annual average demand of approximately 802,100 GPD within the EGWS. This total does not account for flushing and unmetered water usage within the system.

A plan schematic of the existing Eastern Goochland Water System is shown in Figure 3-2.



Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 4,500 feet	EASTERN GOOCHLAND AREA EXISTING WATER SYSTEM	3-2
PROJ. NO. 50109629	PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA		

Chapter 4 Existing Wastewater System

This chapter of the Master Plan provides an overview of Goochland County's existing wastewater system.

4.1 Wastewater System Overview

There are two existing public wastewater systems within Goochland County; the Goochland Courthouse wastewater system and the Eastern Goochland wastewater system. More detailed information on the County's wastewater collection, pumping, conveyance, and disposal facilities is provided in the following sections.

4.2 Goochland Courthouse Wastewater System

The Goochland Courthouse Wastewater Collection System is owned and operated by Goochland County and wastewater treatment is currently provided by VDOC Virginia Correctional Center for Women Wastewater Treatment Plant (VCCW WWTP). Based on the current agreement, Goochland County has a maximum month average capacity of 136,000 gpd at the VCCW WWTP.

This system consists of approximately 7 miles of gravity sanitary sewer, ranging in diameter from 8 to 12 inches, 0.25 miles of 4-inch force main, and three (3) wastewater pump stations.

4.2.1 Wastewater Pump Stations

The Goochland Courthouse Wastewater Collection System mostly consists of gravity sewer but also includes the following three (3) pump stations:

The Administration Pump Station is a small pump station located at the County Administration Building. This pump station collects the wastewater from the Administration Building and Goochland Elementary School facility and pumps it into the 8-inch gravity sewer main along Sandy Hook Road.

The Valley View Pump Station is located near the southeastern end of the Goochland Courthouse service area near Valley View Lane and serves to pump nearly all the wastewater collected within the Goochland Courthouse service area to the VCCW WWTP. This pump station consists of two (2) submersible pumps designed to pump approximately 100 gallons per minute at 130 feet of head. The pumps lift wastewater out of a 5-foot diameter wetwell and discharge flow through approximately 1,400 linear feet of 4-inch force main to an 8-inch gravity sewer located near the intersection of River Road West and Valley View Lane.

The Swann's Inn Pump Station is located near the southwestern end of the Goochland Courthouse service area in the Swann's Inn Estates residential development, located along River Road West. The pump station serves to pump all of the wastewater from the Swann's Inn development into the gravity main that discharges into the VCCW WWTP.

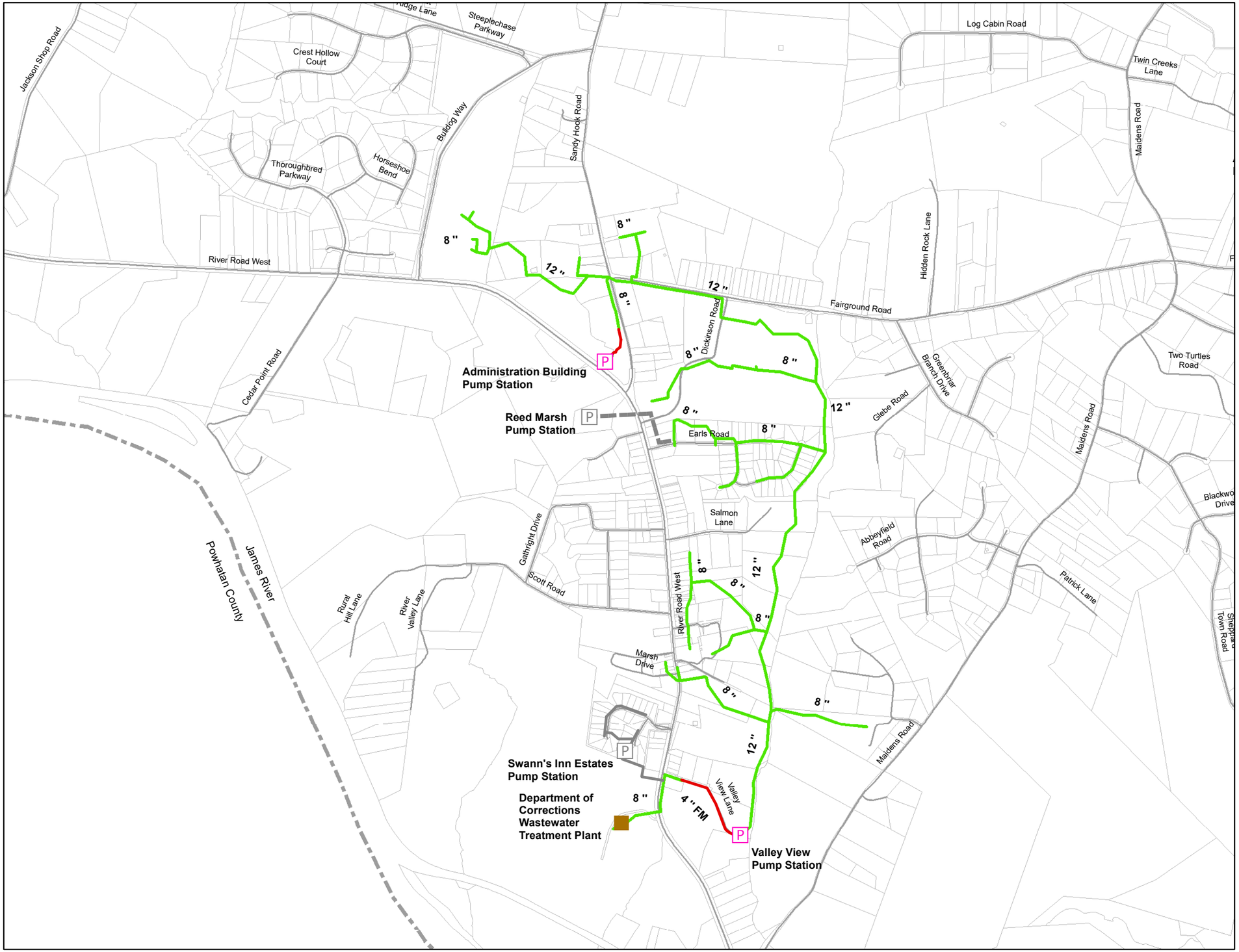
4.2.2 Flow Summary

For the period between July 2018 to June 2019 (baseline time period for this report since it was the most recent data available when the population and demand projections were developed), the County provided wastewater service to 113 residential and commercial (including public/municipal) customers as follows:

- Residential customers: 61
- Commercial customers: 52
- Total customers: 113

In FY2019, the Goochland Courthouse Wastewater Collection System collected and conveyed an average flow of 55,200 gpd to the VCCW WWTP.

A plan schematic of the existing Goochland Courthouse Wastewater System is shown in Figure 4-1.



N
W E
S

Legend

- Gravity Main
- Force Main
- P Pump Station
- Discharge Location
- Under Construction

Key Plan

FIGURE NO. 4-1

TITLE COURTHOUSE AREA EXISTING WASTEWATER SYSTEM

SCALE 1 inch = 1,500 feet

PROJECT UTILITY MASTER PLAN UPDATE GOOCHLAND COUNTY, VA

DATE 05/2020

PROJ. NO. 50109629

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

4.3 Eastern Goochland Wastewater System

The Eastern Goochland Wastewater Collection System is owned and operated by Goochland County and wastewater treatment is currently provided by the City of Richmond and Henrico County. This system consists of approximately 56 miles of gravity sanitary sewer, ranging in diameter from 6 to 42 inches, 14 miles of force main, ranging in diameter from 2 to 48 inches, and five (5) wastewater pump stations.

Wastewater treatment for the Eastern Goochland Wastewater Collection System is currently provided by Henrico County and the City of Richmond through agreements with both localities. Based on the agreement with the City of Richmond, Goochland County currently has a maximum month average capacity of 5 MGD for the Eastern Goochland Pump Station. Goochland County also has an agreement with Henrico County for a maximum month average capacity of 0.69 MGD for the Lower Tuckahoe Pump Station.

4.3.1 Wastewater Pump Stations

The Eastern Goochland Wastewater Collection System mostly consists of gravity sewer but also includes five (5) pump stations.

The Eastern Goochland Pump Station (EGPS) is located at the eastern end of the Eastern Goochland Service Area along Patterson Avenue. This facility receives wastewater from the Tuckahoe Creek Service District, West Oak and Rivergate neighborhoods, and Henrico County. The pump station currently consists of three (3) dry-pit submersible pumps that operate at approximately 4,500 gallons per minute at 210 feet of head for a total installed capacity of approximately 13 MGD. The pump station has room to add an additional three (3) pumps for a total of six (6) pumps and an ultimate firm capacity of approximately 33 MGD. The pump station includes two (2) influent grinder channels and a two-compartment wetwell. The pumps lift wastewater out of the wetwell and pump flow through approximately 46,300 linear feet of 48-inch force main to the Maple Avenue Meter Vault, where motorized valves allow the discharge of wastewater to either the City of Richmond or Henrico County collection systems.

The Route 623 Pump Station is located off of Ashland Road and serves the Lanier Industrial Park and Rockville Commerce Center. This pump station consists of two (2) submersible pumps that operate at approximately 700 gallons per minute at 28 feet of head. The pumps lift wastewater from a 6½ foot diameter wetwell and discharge flow through approximately 4,900 linear feet of 8-inch force main, routed under Interstate 64, to gravity sewer located southwest of the intersection of Interstate 64 and Ashland Road.

The West Oak Pump Station is located off of Woodfern Road, which connects to West Oak Drive, and serves the West Oak neighborhood, Hope Church, and several businesses along Patterson Avenue. This pump station consists of two (2) submersible pumps that operate at approximately 250 gallons per minute

at 75 feet of head. The pumps lift wastewater out of a 6-foot diameter wetwell and discharge flow through approximately 1,040 feet of 6-inch force main to gravity sewer located on Kellington Lane.

The Lower Tuckahoe Pump Station is located off of Hillpoint Road and serves the southern end of the River Road Communities. This pump station consists of two submersible pumps that operate at approximately 250 gallons per minute at 82 feet of head. The pumps lift wastewater out of a 6-foot diameter wetwell and discharge flow through approximately 3,110 feet of 6-inch force main and connect into the 30-inch force main for Henrico County's River Road Pump Station.

The Kinloch Pump Station is located directly south of Woodcove Court in the Kinloch Estates residential development, located along Tuckahoe Creek Parkway. The pump station serves to pump all of the wastewater from the southern end of the Kinloch development into the gravity main that serves the rest of the Kinloch residential area. This pump station consists of two (2) submersible pumps designed to pump approximately 317 gallons per minute at 116 feet of head. The pumps lift wastewater out of an 8-foot diameter wetwell and discharge flow through approximately 1,200 feet of 4-inch force main to the main Eastern Goochland sewer basin.

It is recommended to perform draw down tests at all existing pump stations to confirm the operating conditions are consistent with the design points described above in order to determine firm, installed capacities.

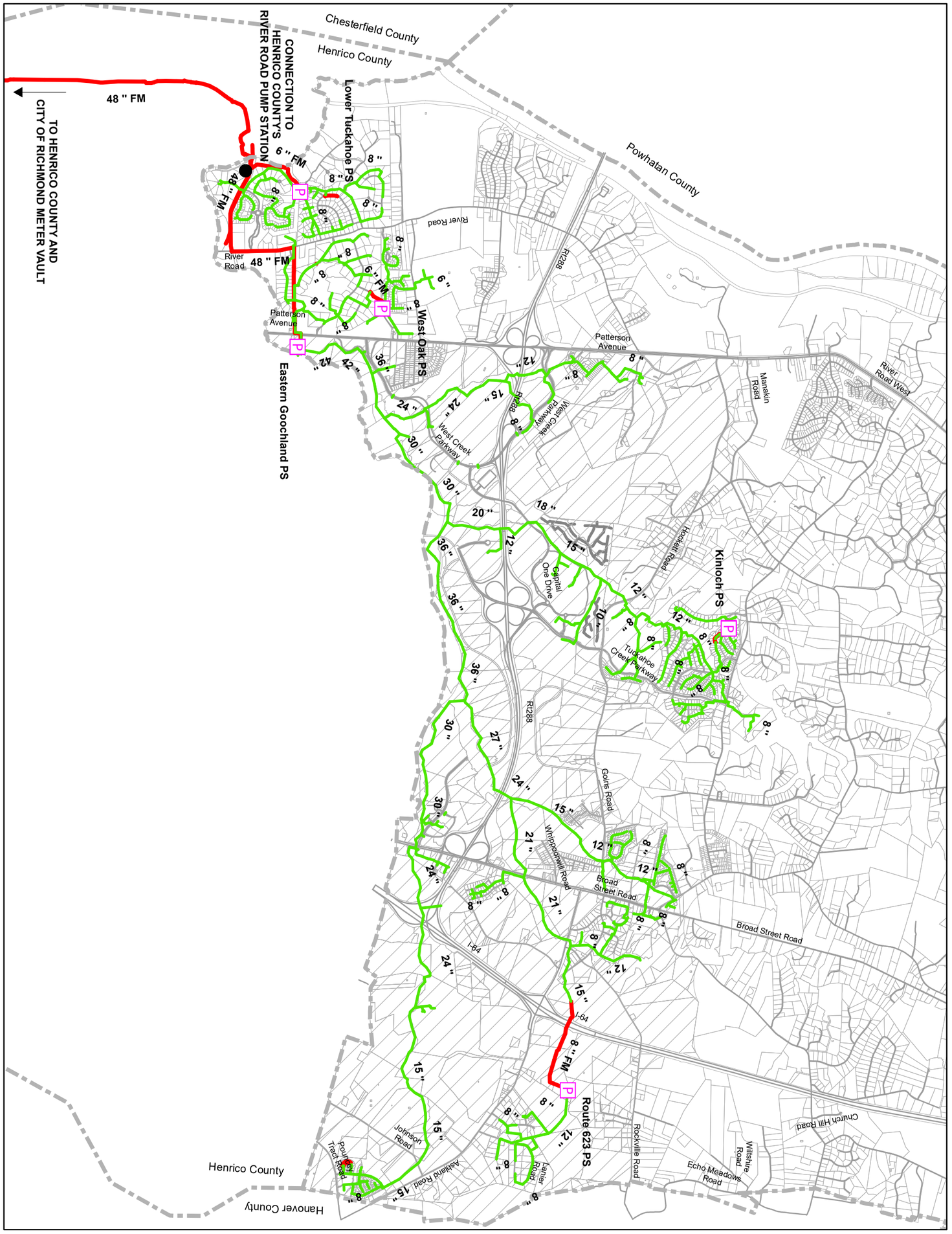
4.3.2 Flow Summary

For the period between July 2018 and July 2019 (baseline time period for this report since it was the most recent data available when the population and demand projections were developed), the County provided wastewater service to 1,276 residential and commercial customers as follows:

- Residential customers: 1,143
- Commercial customers: 133
- Total customers: 1,276

In 2019, the Eastern Goochland Wastewater Collection System collected and conveyed an average flow of approximately 490,400 gpd to Henrico County and the City of Richmond.

A plan schematic of the existing Eastern Goochland Wastewater System is shown in Figure 4-2.



Key Plan

Legend

- P Pump Station
- Gravity Main
- Existing TCSD
- Under Construction

S E W N

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 4,500 feet	EASTERN GOOCHLAND AREA EXISTING WASTEWATER SYSTEM	4-2
PROJ. NO. 50109629	PROJECT	UTILITY MASTER PLAN UPDATE GOOCHLAND COUNTY, VA	

Chapter 5 Future Demand Projections

5.1 General

Future planned growth in Goochland County was evaluated and future demand projections developed to identify water and wastewater system improvements required to meet future needs associated with the projected growth of population within the Goochland Courthouse Service Area (GCSA) and Eastern Goochland Service Area (EGSA).

This Master Plan addresses future conditions and identifies required water and wastewater system improvements based on the development and geographic distribution of population and on demand projections within the GCSA and EGSA for the planning period, which is defined as the Years 2020 through 2045. Note that data from July 2018 to June 2019 was used as the baseline year for demand projections for Year 2020, since this time frame was the latest year that complete data was available when the population demand projections were developed. Anticipated demands for developments with plan approval were incorporated into the existing system demands.

Proposed projects are based on future demand projections. The timing of projects will need to be adjusted based on actual growth patterns within the GCSA and EGSA. This is particularly true of projects more than 3 years in the future.

5.2 Existing Water Demands and Sewer Loadings

In order to develop future demand projections, it is important to first research existing water demands. Baseline demands are estimated based on water meter data from the existing water customers including residents, and commercial/industrial developments. Another source of system demand includes manual flushing, which is conducted by the County periodically to improve water quality at dead end lines.

5.2.1 Existing Water Demands

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, aging meters, and unmetered connections.

Water meter and billing data from FY2019 was provided by Goochland County for all water customers. The average daily water usage at each meter (including rented hydrant meters) was totaled and equaled approximately 71,800 gpd in GCSA and approximately 802,100 gpd in EGSA.

These demands were compared with monthly billing data from VDOC and Henrico County at the master meters. During this same period, the monthly billing data indicated an average water supply by VDOC of

approximately 78,100 gpd, which indicates that approximately 6,300 gpd or 8% of the water entering the GCSA is unaccounted for. The daily meter and monthly billing records provided by Henrico showed an average water usage of approximately 936,400 gpd, which indicates that approximately 134,300 gpd or 14% of the water entering the EGSA is unaccounted for. It should be noted that some of the unaccounted-for water includes activities such as unmetered routine flushing.

It is recommended that Goochland County conduct a water system accountability study in both the Goochland Courthouse and Eastern Goochland Service Areas to determine the sources of unaccounted for water. During FY2019, GCDPU found and repaired several leaks on the water system which would account for some of the unaccounted-for water lost. In addition to the water accountability study, it is recommended that the County perform a billing comparison at the beginning of every year to gauge how much water is lost every year. This will allow the County to gauge whether the unaccounted-for water is increasing or decreasing on a yearly basis.

5.2.2 Existing Sewer Loadings

A similar analysis was conducted for wastewater flow rates. Sewer billing data from FY2019 was provided by Goochland County for all of the sewer customers. The average daily sewer loading for each consumer was totaled and equaled approximately 47,600 gpd in GCSA. In EGSA, average daily sewer loading within the Lower Tuckahoe Pump Station drainage area were estimated at 39,200 gpd. The Eastern Goochland Pump Station was estimated to receive an average daily sewer loading of 382,700 gpd.

These loadings were compared with monthly billing data from VDOC and Henrico County. During this same period, the monthly billing data indicated a daily average wastewater flowrate to the VDOC VCCW WWTP of approximately 55,200 gpd, which indicates that approximately 7,600 gpd or approximately 14% of the wastewater leaving the GCSA is unaccounted for loading. A portion of the unaccounted for loadings can be attributed to the County's 'summer sewer' billing policy where sewer usages for residential customers are only based on the January/February billing cycle for each year.

The Eastern Goochland Pump Station received flow from both Goochland and Henrico Counties. Goochland and Henrico have an agreement in place that states Henrico will divert a minimum average daily flow rate of 1 MGD to the EGPS; however, Goochland does not have a way to measure wastewater flow into the Eastern Goochland Pump Station before the wastewater from Goochland County mixes with wastewater from Henrico County. Based on an agreement with Henrico County, it is assumed that 400,000 GPD of the flow entering the Eastern Goochland Pump Station is from Goochland County. Since there is no way to meter Goochland flow into the Eastern Goochland Pump Station, the actual unaccounted-for flow to this pump station is unknown.

During this same period, Henrico's monthly billing data indicated an average wastewater flowrate from Lower Tuckahoe Pump Station (LTPS) to Henrico of approximately 93,100 gpd, which indicates that approximately 54,000 gpd or approximately 58% of the wastewater leaving the LTPS is unaccounted for loading.

Goochland County recently installed a flow measurement device to record influent flow from Goochland County to the Eastern Goochland Pump Station. This will allow the County to have a better understanding of how its system functions and can then quantify the amount of inflow and infiltration that enters the system during rain events. It is recommended that the County perform a billing comparison study at the beginning of each year to compare data from flow meters to billing data. Additionally, it is recommended that Goochland County conduct an inflow and infiltration study in both the Goochland Courthouse and Eastern Goochland Service Areas, particularly in the Lower Tuckahoe subdivision, to determine the sources of unaccounted for flow. This study would include a combination of flow monitoring, smoke testing and closed-circuit television (CCTV) inspection.

5.3 Development of Future Water Demands

Several workshops were held with Goochland County staff to develop the future development projections. During these workshops, areas of anticipated future growth were identified, such as residential neighborhoods, industrial parks, and commercial developments and timeframes as to when those areas would need water service. It was assumed that certain larger areas would need to be developed in phases due to their size and would span more than one-time step as examined in this Master Plan. Each development area was assigned a development density based on anticipated future land use zoning.

It should be noted that all future development proposed in the EGSA was assumed to be incorporated into the TCSD, per the request of the County. Future water demands, recommended improvements, and CIP projects have been organized based on these targeted growth areas and county delineated village boundaries.

5.3.1 Residential Water Demands

Several factors were utilized to calculate future residential water demands, including the useable area of each growth area, anticipated land use zoning density, and information contained in the Comprehensive Plan (2035) and Capital Impacts Study. Unit demands for proposed developments were developed based on a benchmarking of similar developments. Unit demands consider an assumed percentage of developable area meant to account for various features throughout the County, such as water bodies, wetlands, poor soils, or extreme elevation changes.

The residential areas were assumed to have a density between 2 to 5 units per acre based on feedback from County staff, or the existing number of units in the subdivision if the area was already a developed neighborhood. The Capital Impact Study (2018) assumed capita rates of 2.39 people per unit for Eastern Goochland, and 2.23 people per unit for Courthouse. These two factors were used to calculate an anticipated population per future residential growth area.

The Virginia Department of Health has capacity guidelines for water demands to use as a standard when designing waterlines and they recommend using 100 gpd per capita residential demand. This factor was manually calculated for both the Eastern Goochland service area and the Courthouse service area and resulted in 130 gpd per capita for the Eastern Goochland service area, and 80 gpd per capita for the Courthouse service area. To calculate this factor for each service area, the total water demand in each service area was divided by the number of connections to the system, yielding the approximate demand per unit. The demand per unit was then divided by the assumed persons per household, resulting in the different usage factors. The persons per household was 2.39 for the Eastern Goochland service area, and 2.23 for the Courthouse service area.

Using the size of each growth area, a percentage of developable land within the area, a density of units based on anticipated zoning, a capita rate per unit, and a daily water demand per capita, the total residential water demand was calculated for each targeted growth area or existing neighborhood.

5.3.2 Commercial Water Demands

Future commercial demands were calculated based on a benchmarking of planning level demands from neighboring municipalities and calculating unit demands based on similar land uses. Commercial demands were calculated as either typical commercial, office (light commercial), or industrial demands. Typical commercial demands were calculated with a demand per acre factor of 1,000 gpd. This unit demand was then multiplied by the acreage of the parcels slated for commercial development in order to produce the demands. The office/light commercial demands were calculated from either a demand per acre or demand per square footage unit demand. The office demand per acre factor was set at 500 gpd, and the demand of 200 gpd per 1,000 square foot of office space. The office demand per acre was calculated in a similar manner to the residential demand factor – the average daily demand from each address that was determined to be office or light commercial was divided by the acreage of the corresponding parcel.

Similarly, in order to determine the water demand for each anticipated commercial/industrial growth area, it was assumed that a percentage of the area would actually be developable based on the 2035 Comprehensive Plan. This is due to various features throughout the county, such as streams, ponds, and extreme elevation changes.

In the case of new developments, it was assumed that the parcel could be fully built out over multiple time steps to become partially or fully developed by the end of this Master Plan. A percentage of the total demand for the growth area was then applied to determine the demand for the partially developed area for each time step.

5.3.4 Water Demand Factors

Maximum day demand projections were estimated based on reviewing supply data from Goochland and Henrico Counties for the Eastern Goochland water system. Based on this data, the maximum day factor was estimated to be approximately 2 times the average daily demand for the overall system. A maximum day factor of 2 was assumed for existing demands and planning purposes for the Goochland Courthouse Service Area.

For the peak hour factor, a diurnal pattern was used in the water model to simulate the increase and decrease in demands throughout a typical day. This was applied on top of the maximum day demands. These peak hour factors varied between 0.5 and 2.5 for existing demands. For future demand projections, standard diurnal patterns from the American Water Works Association (AWWA) were utilized based on classification. These peak hour factors ranged between 0.16 and 1.9, with different patterns for residential and commercial.

5.3.5 Demand Calibration

To calibrate the projected water demands, it is essential to understand the anticipated growth within the County and within the GCSA and EGSA. Goochland County provided county-wide population data and growth projections for 2017 through 2027, as determined in the Capital Impacts Study. Since some of the time steps for this Master Plan fell beyond the years of predicted populations, population was predicted by extrapolation between years 2027 and 2045.

Projected county-wide population growth was compared with population growth estimates developed during the future demand projection planning. This resulted in an anticipated increase in number of people within the service area for each time step.

The following table summarizes the predicted population based on information provided by Goochland County:

Table 5-2 County-Wide Population Projections

Year	County-Wide Population
2020	25,505
2025	29,292
2030	33,078
2035	36,863
2040	40,648
2045	44,433

The population increase for each time step is given below:

Table 5-3 County-Wide Population Increase

Time Step	County-Wide Population Increase	Assumed Population Increase within the Water and Wastewater Service Areas (Based on Demand Projections)
2020 - 2025	3,787	5,907
2025 - 2030	3,786	4,178
2030 - 2035	3,785	4,254
2035 - 2045	7,570	3,815

As shown in **Table 5-3**, the projected population increase based on demand projections was higher than the predicted County-wide population increase projection in 3 out of 4 planning time steps. This was discussed with County staff and it was decided that the demand projections developed as part of this Utility Master Plan were more likely accurate than the previous county-wide population projections; therefore, revisions were made to the demand projections.

5.4 Wastewater Demand Projections

Wastewater demand projections were developed by assuming that 100% of the projected water usage at residential connections would enter the sewer collection system. For commercial/industrial wastewater demand projections, it was also assumed that 100% of projected water usage would enter the sewer collection system, with the exception of meters that were designated “irrigation” or “hydrant” by Goochland County. Those meters were ignored when calculating wastewater demand, assuming that none of the water used as irrigation would enter the sewer system.

In addition to flows in the sewer collection system that result from water consumption, other sources of unaccounted sewer flow can occur within the system. One major contributor to additional flow is inflow and infiltration. Inflow results from open point sources that allow direct surface water to flow into the system, such as an open or broken cleanout ,open or missing manhole covers and deteriorating manhole

covers. Infiltration results from ground water that seeps through the sewer pipes at loose connections, poorly constructed joints or manhole connections, and old pipe.

Similar to water demand projections, it is necessary to apply a peak hour factor to the sewer flows in the system to account for variation of flows throughout the day. This is critical to analyze the capacity of existing infrastructure and for sizing future upgrades and expansions. The peak factor was derived from an equation that incorporated average daily sewer flow to both treatment plants, assumed water demand per capita, and population. In order to determine what an acceptable peak hour factor (k) would be for this system, the following equation was used:

$$k = (18 + \sqrt{P})/(4 + \sqrt{P})$$

Where,
P=Population in thousands

The equivalent population was determined by dividing the average daily flow by an assumed 100 GPD/capita, based on the Virginia Department of Environmental Quality Sewage Collection and Treatment Regulations.

Henrico County and Goochland County have an agreement to provide Henrico County with up to 13 MGD peak hour flow at the Eastern Goochland Pump Station. Escalation in peak hour flow due to growth in Henrico County was added in each time step at even increments with the full 13 MGD peak hour flow occurring at the end of the planning period in 2045.

5.5 Demand Projections Summary

A summary of the system water and sewer demand projections for the Goochland Courthouse Service Area is shown in **Tables 5-4 and 5-5, respectively.** Refer to **Appendix A** for a detailed breakdown of demands.

Table 5-4 Courthouse Area Water Demands (gpd)

Demand Category	2020	2025	2030	2035	2045
Existing Residential Demands	30,100.00	30,100.00	56,300.00	61,600.00	115,100.00
Existing Commercial Demands	41,800.00	41,800.00	84,900.00	87,100.00	94,200.00
Proposed Residential Demands	-	26,200.00	5,400.00	53,600.00	-
Proposed Commercial Demands	-	43,200.00	2,300.00	7,100.00	-
Total	71,800.00	141,100.00	148,700.00	209,300.00	209,300.00

Table 5-5 Courthouse Area Sewer Loadings (gpd)

Demand Category	2020	2025	2030	2035	2045
Existing Residential Demands	11,300	11,300	42,800	48,100	101,700
Existing Commercial Demands	36,300	36,300	79,200	81,400	88,400
Proposed Residential Demands	0	31,500	5,400	53,600	0
Proposed Commercial Demands	0	42,900	2,200	7,100	0
Total	**47,600**	**121,900**	**129,500**	**190,100**	**190,100**

A summary of the system water and sewer demand projections for the Eastern Goochland Service Area ares shown in **Tables 5-6 and 5-7, respectively.** Refer to **Appendix A** for a detailed breakdown of demands.

Table 5-6 Eastern Goochland Area Average Water Demands (gpd)

Demand Category	2020	2025	2030	2035	2045
Existing Residential Demands	381,500	381,500	1,197,000	1,731,400	2,197,400
Existing Commercial Demands	420,700	420,700	940,400	1,140,100	1,390,600
Existing Industrial	0	0	0	0	1,151,400
Proposed Residential Demands	0	815,500	534,500	466,100	496,000
Proposed Commercial Demands	0	519,700	199,700	250,600	568,300
Proposed Industrial Demands	0	0	0	1,151,400	1,066,500
Total	802,100	2,137,300	2,871,400	4,739,400	6,870,000

Table 5-7 Eastern Goochland Area Sewer Loadings (gpd)

Demand Category	2020	2025	2030	2035	2045
Existing Residential Loadings	137,000	137,000	673,400	1,002,300	1,289,100
Existing Commercial Loadings	285,400	285,400	805,000	1,004,700	1,255,300
Existing Industrial Loadings	0	0	0	0	1,151,400
Proposed Residential Loadings	0	536,500	328,900	286,900	305,200
Proposed Commercial Loadings	0	519,600	199,800	250,600	568,300
Proposed Industrial Loadings	0	0	0	1,151,400	1,066,500
Total	**422,400**	**1,478,300**	**2,006,900**	**3,695,600**	**5,635,500**

Chapter 6 System Modeling

6.1 General

Goochland County's water and wastewater systems were modeled in order to predict and evaluate system conditions throughout the planning period and to identify improvements required to existing systems 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 **Chapter 5**. The models were calibrated to reflect actual existing conditions within the County.

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 Innovyze InfoWater Water Distribution Modeling Software. InfoWater is a water distribution system modeling package that includes a complete geographic information management system for water utilities. Its hydraulic analysis engine includes the capability to evaluate storage requirements, analyze water quality, approximate available fire flow, and calibrate large distribution networks, making it a useful tool for water system master planning activities.

6.2.1 Model Update

For the purposes of this Utility Master Plan, the existing water system model was updated utilizing data from the County's GIS and supplemented using available record drawing information, field verification of above ground features and approved plans. Elements that were included in the water system model consisted of the following:

- Water distribution lines ranging in diameter from 2" to 24"
- Water storage tanks
- Booster pump stations
- Water source connections (Henrico County for EGWS and VDOC for GCWS)
- Water meter locations (based on address)

Pipe modeling information was based on the updated GIS geodatabase provided by Goochland and updated by Dewberry. The GIS data provided by Goochland included lengths, diameters for the majority of the water pipes, and pipe material and year of installation for a minority of the pipes.

Junctions, or nodes, in the model were created automatically by the InfoWater at each change in pipe size, change in pipe direction, pipe intersections and any "break" in the GIS pipes, such as valves. Each junc-

tion was assigned an elevation in the model based on the 4-foot GIS topography contours provided by Goochland. These contours were converted to a raster image from which interpolated elevations were extracted and applied to each junction.

6.2.2 Model Demand Allocation

Two (2) sets of steady state demand were included in the model in order to simulate system conditions under both average and maximum day demands. The demands for each service connection were assigned to the nearest node based on geo-coded service address for existing consumers or assumed connection points for future development. A detailed summary of system demands is provided in **Chapters 3 and 5**.

Diurnal demand patterns were incorporated into the model to simulate the hourly fluctuations of water usage throughout an average day and maximum day. AWWA standard diurnal patterns were used for Residential and Commercial demands.

6.2.3 Model Calibration

The water distribution system model was calibrated to more accurately represent actual conditions using available meter billing data and SCADA (supervisory control and data acquisition) records. System operations calibrated as part of this Master Plan include demands, pipe hydraulic roughness coefficients, pump performance, and interconnections to adjacent municipalities.

Demand calibration included a detailed comparison of Goochland metered demand and Henrico SCADA and billing data. Differences between metered demands and the amount of water supplied on an average basis were assumed to be a result of unmetered water usage such as manual flushing by DPU to maintain adequate water quality and other water loss within the system. The unmetered demands were distributed uniformly throughout the system to more accurately reflect actual flows entering each system at source connections.

To ensure that a hydraulic model accurately calculates system headloss due to friction, the Hazen Williams pipe roughness coefficients must be estimated for each pipe to account for pipe roughness or friction loss. To aid in model calibration, the piping network was divided into roughness groups based on location, pipe diameter, approximate installation date, and available pipe material information. Each roughness group was assigned an initial pipe roughness coefficient based on best engineering judgment, with the final pipe roughness coefficients being determined during the automated calibration process. InfoWater utilizes an iterative algorithm to adjust the pipe roughness coefficients of the roughness groups to best fit the data from hydrant tests performed by DPU staff throughout the system.

Once calibrated demand and pipe roughness coefficients were incorporated in to model, simulated pump station performance was compared to available SCADA information to ensure accuracy. Typical minor

losses and roughness values were adjusted as needed at each pump station to ensure proper simulation of each pump station.

Finally, the points of interconnection to adjacent municipalities (Ridgefield, Patterson, and River Road) were modeled as pumping stations to more accurately account for fluctuations in available flow based on upstream headlosses, specifically during high flow events. The pump curves for the simulated booster stations were developed and calibrated using available SCADA information from Henrico and Goochland.

6.2.4 Model Scenarios

Once the model was calibrated, steady-state and extended period simulations (EPS) were run for each of the time increments (2020, 2025, 2030, 2035, and 2045) within the planning period, to evaluate system improvement requirements, and to identify and prioritize Utility Master Plan Capital Improvement Projects (CIPs).

Steady-state fire flow analyses were also performed to assess each system's ability to respond to a two (2) hour fire event during peak hour system demands, while maintaining the VHD-required minimum system wide pressure of 20 psi. Commercial and residential fire flows were simulated at strategic locations throughout each system to confirm system adequacy. Based on direction by the County, fire flows were initially modeled as 2-hour, 1,500 gpm events.

By evaluating the adequacy of the system at each time increment through the planning period, the timing of individual CIP requirements was determined. Water modeling results were used to develop the water system improvement program that is described in detail in **Chapter 7**.

6.3 Wastewater Model

Wastewater system modeling activities were conducted utilizing the Innovyze InfoSewer Modeling Software. InfoSewer is a sanitary modeling package that provides extensive scenario and facility management functionalities that make it a useful tool for analyzing existing and proposed sewer collection systems and their growth over time.

6.3.1 Model Update

For the purposes of this Master Plan, the existing sewer system model was updated, utilizing data from the County's GIS. The following elements were involved in the system model developed for this UMP:

- Gravity sewer lines 8-inches in diameter or greater (collection system), as determined to be necessary for accurate modeling

- Sanitary sewer pump stations
- Force main piping

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

6.3.2 Model Loading

Peak hour loadings were allocated to the model in order to accurately assess system capacity. In the model, meter readings for each service connection loadings were assigned to the nearest manhole based on geo-coded service address for existing consumers or assumed connection points for future development. A detailed summary of system demands is provided in **Chapters 4 and 5**.

6.3.3 Model Calibration

The wastewater collection and conveyance system models were calibrated to accurately represent existing function based on available billing data provided by Goochland. Loading calibration included a detailed comparison of Goochland, Henrico, and VDOC billing data. Differences in loadings on an average basis were assumed to be a result of inflow and infiltration. Adjustments were not made to sewer loading data as part of this Utility Master Plan. A separate memorandum was prepared to guide the County in identifying and addressing sources of inflow and infiltration.

6.3.4 Model Scenarios

Analyses were run for each of the time increments (2020, 2025, 2030, 2035, and 2045) within the planning period to evaluate system improvement requirements and identify Master Plan Capital Improvement Projects (CIPs).

A peak hour steady state analysis was used to evaluate system capacity during a peak hour event. Peaking factors for each sub-drainage basin were determined based on average day loading conditions and equivalent population data.

By evaluating modeled system flows at each of the time increments, the timing of individual CIP requirements was determined. These analyses were used to develop the wastewater system improvement program that is described in detail in **Chapter 8**.

Chapter 7 Water System Improvements

7.1 General

This chapter of the Master Plan presents an overview of system improvements that are proposed to provide water service within the County's water and sewer service areas through the Year 2045. In general, the County constructs projects required to provide adequate water supply to general areas, and the private sector constructs the required water infrastructure to serve their projects.

Overall, the water system improvements program involves upgrades and/or expansions to water supply, water storage, and water distribution to ensure adequate supply and system pressures throughout the planning period during a max day demand and fire flow conditions.

An overview of modeling results and recommended improvements is provided in the following sections and are shown in **Figures 7-1 through 7-18**. Detailed descriptions of the individual improvements shown on the exhibits are included at the end of this chapter.

7.2 Existing Water Distribution System Evaluation

As discussed in **Chapter 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: domestic pressures, fire flow availability, and water age. Steady-State Simulations were utilized at each time step to analyze fire flow availability during peak hour demands. Extended Period Simulations (EPS) were performed using projected average day demands and maximum day demands. The results of these EPS simulations identified areas with low or high pressure and extended water ages.

7.2.1 Goochland Courthouse Service Area

The water model was utilized to evaluate existing system conditions and to develop proposed improvements to address identified system deficiencies.

7.2.1.1 Goochland Courthouse Existing Water System Conditions

For the maximum day scenario, the operation of the VDOC booster pump station was simulated based on a timer filling the elevated storage tank at 7:00 am and 3:00 pm daily. The minimum tank level observed during maximum day demands with these simulated controls was 23 feet above the bottom of the bowl or approximately 75% full. As shown on **Figure 7-1**, minimum domestic pressures under these conditions were estimated to be approximately 45 psi, which is above the minimum County standard of 35 psi.

A 2 hour, 1,500 gpm fire event was simulated in the Courthouse pressure zone at nodes nearest each fire hydrant location, based on GIS data provided by the County. The VDOC booster pump station was as-

sumed to be off during a fire event because there is no emergency generator to provide power in an emergency situation. As indicated on **Figure 7-2**, the results of the analysis indicate that a significant portion of the Goochland Courthouse Water System meets the minimum fire flow standard of 500 gpm; however, the existing system does not meet the County's fire flow goal of 1,500 gpm for 2 hours.

In order to evaluate water age within the water distribution system, an extended period simulation was performed under average day demand condition. The results of this analysis, shown on **Figure 7-3**, indicate that the water age in the system is within a reasonable range with the exception of the waterline along Hidden Rock Lane and the fire line at J. Sergeant Reynolds campus.

As discussed in **Chapter 3**, based on a comparison of the County's billing data, approximately 8% of the water supplied by VDOC is unaccounted for in the County's water metering system. Differences in metered demands on an average basis were assumed to be a result of unmetered water usage such as manual flushing by the County to maintain adequate water quality and/or water loss within the system. It will be important for Goochland County determine the source of unaccounted for water and minimize non-revenue water usage because this will extend the capacity of the existing water supply. Consequently, it is recommended that the County conduct a water system audit to identify the sources of unaccounted for water in the distribution system.

7.2.1.2 Goochland Courthouse Existing Water System Improvements

The water model was utilized to simulate proposed improvements to address the identified issues. In order to supply the existing distribution system with County's fire flow goals, a significant portion of the water lines would require upsizing along with the addition of new water lines to create more looping within the system. The following improvements were identified in order to increase available fire flow in areas where the County's goal of 1,500 gpm for 2 hours are currently not met. The upsizing will need to be accompanied by improvements including:

1. Installing an 8-inch waterline to complete a loop at the Goochland High School and Goochland Middle School campus.
2. Upsizing the existing waterline serving the J. Sergeant Reynolds campus from a 4-inch line to a 10-inch line.
3. Installing a 12-inch waterline to close the loop between the Goochland High School and Goochland Middle School campus and the Holland Hills subdivision.
4. Installing an 8-inch waterline to close the loop in the Holland Hills subdivision along Thoroughbred Parkway and Incline Court.

With these improvements incorporated into the model, it was projected that the existing water distribution system would be able to provide the County's fire flow goal of 1,500 gpm for 2 hours at all existing hydrants with the exception of the hydrant located near the Goochland County Fairgrounds. It is estimated

that the proposed improvements would increase available fire flow at that hydrant from approximately 1,000 gpm to 1,300 gpm, but that construction of a new 12-inch waterline or loop of approximately 1 ½ miles in length would be required to increase fire flow capacity to 1,500 gpm.

In order to address water age issues, the following improvements are recommended:

1. Modify VDOC booster station controls to automatically cycle based on the Goochland Courthouse Elevated Tank level. This would allow for the optimal cycling of the tank level to minimize water age.
2. Install a mixer in the existing Courthouse elevated tank to minimize stratification.
3. Install an auto-flusher at the Goochland County Fairgrounds.
4. Install a back flow preventer on the fire suppression line at J. Sergeant Reynolds campus

It is likely that tank mixing is poor based on the inlet and outlet piping configuration of the existing elevated water tank. It is recommended that the County conduct a tank mixing evaluation prior to installing an automated mixing system in the elevated storage tank. If stratification is confirmed, a mixer should be installed to ensure complete mixing which will reduce water age within the tank; thereby, reducing flushing requirements.

Refer to **Figure 7-7** for an exhibit showing the recommended improvements to the existing Goochland Courthouse Water System.

7.2.2 Eastern Goochland Service Area

The EGWS water model was utilized to evaluate existing system conditions and proposed improvements to address identified system deficiencies. The following water system discussion is divided by pressure zone. Refer to **Figures 7-4 through 7-6** for additional information on estimates for the existing system domestic pressures, fire flow availability, and water age.

7.2.2.1 Eastern Goochland Existing Water System Conditions

The existing system was analyzed for minimum domestic pressures, fire flow availability, and water age. Minimum domestic pressures and fire flow availability were evaluated under a maximum day demand scenario and water age was evaluated using an extended period simulation and an average day demand scenario.

Centerville Pressure Zone

The Centerville Pressure Zone is supplied with water through the Centerville Booster Pump Station located at the Broad Street connection. The Centerville Booster Pump Station is currently controlled by water level relative to the bottom of the bowl in the Centerville Elevated Storage tank. The lead pump is initial-

ized when the water level drops to 10-feet. The lag pump is activated if the water level continues to fall below 8-feet. The operation of both lead and lag pumps is terminated when the water level exceeds 20-feet.

Based on existing operation, minimum domestic pressures during maximum day demand conditions is 30 psi which is below the County standard of 35 psi. The existing hydrants within the pressure zone were simulated to exceed the County fire flow requirements with the exception of hydrants at Lanier Industrial Park and north along Ashland Road towards Aw Shucks Country Store and Parkside Village.

Areas most susceptible to extended water ages were predicted to occur at Aw Shucks, Parkside Village, and Manakin Road near the Parke at Saddlecreek. This location corresponds to known water odor complaints that the County has received. To improve water quality, the County constructed a Chloramine Booster Station at the Centerville Booster Pump Station in order to maintain an influent total chlorine concentration of 3.5 ppm. Additionally, the county implemented a rigorous water quality and sampling plan in 2018, which monitors total chlorine, monochloramine, total ammonia, free ammonia, nitrate, and nitrite levels throughout the water distribution system.

West Creek Pressure Zone

The West Creek Pressure Zone is supplied by the Centerville Pressure Zone through the Route 288 pressure reducing valve (PRV) and the Ridgefield Parkway and Patterson Avenue interconnections to Henrico County's water distribution system. Control valve operations are based on timers to ensure each supply is exercised on a daily basis. Additional capacity from the interconnection to the Centerville pressure zone is available to supplement flow and pressure during high demand events through the operation of a 16-inch fire valve at the Route 288 PRV, which opens when pressures in the West Creek Pressure Zone drop below 50 psi.

Based on existing operation, minimum domestic pressures during maximum day demand conditions is 45 psi. Fire flow capacity below the County goal was identified in Kinloch, Rivergate and west of West Creek Parkway towards the Richmond Country Club. Extended water ages were also observed within the West Creek pressure zone along the Tuckahoe Creek Parkway and West Creek Parkway.

River Road Low Pressure Zone

The River Road Low Pressure Zone is served by an interconnection to Henrico County along River Road. There are no storage facilities owned by the County in this pressure zone. Therefore, all fire protection is currently provided via the Henrico County water system. Based on existing operation, minimum domestic pressures during maximum day demand conditions are estimated at 45 psi. Due to a single supply source and small pipe diameters, the pressure zone cannot provide the County's target minimum fire flow. However, there were no areas within the pressure zone that were found to have extended water ages.

Improvements are to increase fire flow availability were identified and are summarized in a later section.

River Road High Pressure Zone

The River Road High Pressure Zone is supplied with water through the River Road Booster Pump Station which pumps from the West Creek Pressure Zone. The River Road Booster Pump station consists of three booster pumps and a 10,000 gallon hydro-pneumatic tank. Based on existing operation, minimum domestic pressures during maximum day demand conditions are approximately 40 psi. Therefore, no improvements are required to improve domestic pressures.

Based on the results of the analysis, due to limited capacity of the River Road Booster Pump Station, none of the hydrants within the pressure zone could supply the County required fire flow.

Extended water ages exceeding 14 days were simulated near the Benedictine College Preparatory. This is a result of long dead-end waterlines with minimal demand.

7.2.2.2 Eastern Goochland Existing Water System Improvements

The water model was utilized to simulate proposed improvements to address identified issues within the EGWS. Where practical, and before recommending capital improvements, water system operational optimization was evaluated first to potentially minimize the need for infrastructure upgrades. The recommended improvements to the existing water distribution system are listed by pressure zone as follows:

Centerville Pressure Zone Improvements

In order to increase domestic pressures to meet the County's minimum goal of 35 psi, the Centerville Tank and Booster Pump Station operation will need to be modified to maintain a minimum tank water level of 18-feet. Increasing the minimum water level of this pressure zone to maintain a minimum domestic pressure of 35 psi would also improve fire flow availability and would exceed the County's minimum requirement for fire flow storage.

To improve available fire flow in the Lanier Industrial Park to above 1,500 gpm, it is recommended that two dead end lines in the industrial park be closed with a loop. This would require the construction of a 12-inch water line linking the existing waterlines on Lanier Road and Commerce Center Drive. This project should be considered in conjunction with future development of the industrial park.

The continuation of the County's rigorous water quality monitoring and flushing programs is recommended to maintain reasonable water ages at both Parke at Saddle Creek Development and Aw Shucks Country Store.

West Creek Pressure Zone Improvements

Due to a few higher elevation areas being served by smaller diameter lines, two water line upgrades will be required to achieve the minimum fire flow of 1,500 gpm within the West Creek Pressure Zone. These improvements are listed below:

1. Upsize existing waterline service to the Richmond Country Club from 8-inch to 12-inch.
2. Install 8-inch waterline from Barwick Lane in Rivergate to Patterson Avenue for an additional loop.

With the implementation of the improvements discussed in this section, it is anticipated that the system operation will meet the minimum fire flow goals of the County.

River Road Low Pressure Zone Improvements

As discussed in the previous section, the River Road Low Pressure Zone has sufficient domestic pressures and low water age; however, due to older and smaller diameter piping, the system does not meet the County's 1,500 gpm minimum fire flow goal. The water model was utilized to identify improvements to increase fire flow capacity. These improvements included a combination of upsizing existing water lines, adding additional looping, and adding an emergency connection to the West Creek Pressure Zone. The improvements identified are summarized below:

1. Open the interconnection between West Creek and River Road Low Pressure Zone and install a control valve to ensure adequate flow from West Creek to River Road Low in order to maintain adequate turnover of the interconnection piping and to provide additional fire flow capacity
2. Upgrade the existing water main along River Road from 8-inch to 12-inch.

With the implementation of the improvements discussed in this section, it is anticipated that the system operation will meet the minimum requirements of the County.

River Road High Pressure Zone Improvements

Since each existing booster pump at the River Road Booster Pump Station has a maximum capacity of approximately 600 GPM, the system is incapable of providing the 1,500 gpm fire flow goal plus maximum day demand with two pumps running (firm capacity). Therefore, it is recommended that two of the pumps be replaced with higher flow pumps (~2,000 gpm each) to meet the fire flow requirement. This would also require some pipe and valve upgrades at the booster station, new VFDs, larger generator, elec-

trical improvements, and a ground storage tank. The new pumps should be sized to allow them to be used in the future when additional water transfer capacity will be needed through the River Road Booster Pump Station. Alternatively, the addition of a fire pump coupled with modifications to the West Creek and River Road Low Pressure Zones may be considered to provide additional redundancy and increased capacity. The completion of a Preliminary Engineering Report (PER) is recommended to determine the feasibility of this project.

To reduce water age at Benedictine College Preparatory, it is recommended that an auto-flusher be installed at this location.

7.3 Water Supply

An evaluation of the planning period from 2020 to 2045 indicates that as the population grows within the water service areas, the County's available water supply will be sufficient to meet maximum day demands through the end of the planning period. **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

Service Area	Supply Source	Maximum Day Capacity
Courthouse	Virginia Department of Corrections	1 MGD
Eastern Goochland	Henrico County	25 MGD[1]

1. The current allocation is 5.25 MGD

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

Service Area	2020	2025	2030	2035	2045
Goochland Courthouse Service Area (MGD)	0.15	0.29	0.31	0.43	0.43
Eastern Goochland Service Area (MGD)	1.74	4.57	6.15	8.98	12.47

7.3.1 Goochland Courthouse Service Area

The Virginia Department of Corrections (VDOC) currently has an agreement with Goochland County to supply up to 1,000,000 GPD of treated water. The James River Correctional Facility WTP currently holds a withdrawal permit for 2 MGD. In 2013, the WTP produced on average of 0.66 MGD and a maximum day of 0.89 MGD. Although the withdrawal permit limits the withdrawal at 2 MGD, the WTP and intake is designed to withdraw and treat up to 3 MGD.

With the current water usage patterns and projected demands, it is anticipated that the maximum day water demand will not exceed the VDOC water allocation through the end of the planning period in 2045.

7.3.2 Eastern Goochland Service Area

Through a water agreement dated June 11, 2002, Goochland County is supplied with up to 5.25 MGD of treated water from Henrico County. This agreement also includes additional future supply capacities of 11.54 MGD and 25 MGD with a water treatment plant upgrade required for each tier. As such, it is anticipated that additional payment of capacity charges will be required to increase the amount in treated water supplied by Henrico County to Goochland County. These treatment plant upgrades are contingent upon the construction of the Cobbs Creek Reservoir, located in Cumberland County. Henrico County is the permit holder and has a signed MOU with Cumberland County. The reservoir will augment the James River during periods of low flows, discharging water back into the river from the reservoir. During times of higher flows, water will be pumped out of the James River and into the Cobbs Creek Reservoir for storage. The permit for the reservoir accounts for future water needs of Henrico and Cumberland Counties. Goochland County will indirectly benefit as it purchases water from Henrico County for use in the EGSA.

With the current water usage patterns and projected demands, it is anticipated that the maximum day water demand will not exceed the anticipated Henrico water allocations through the end of the planning period in 2045.

7.4 Water Storage and Booster Pump Station Capacity

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 the storage requirement over time is a direct result of the increased equalization requirement due to the increase in system demand. Based on direction provided by the County, system storage required for fire flow is equal to 180,000 gallons, which is the volume of water needed for the County's design standard of a 1,500 gpm, 2-hour duration fire event. The minimum recommended storage is anticipated to be much higher in the Eastern Goochland System as compared to the Goochland Courthouse system simply because of the higher anticipated demands. The storage required through the end of the planning period in both systems is summarized in **Table 7-3**.

Table 7-3: Water Storage Requirements

Service Area	2020	2025	2030	2035	2045
Goochland Courthouse Service Area (MG)	0.21	0.24	0.24	0.27	0.27
Eastern Goochland Service Area (MGl)	0.53	1.09	1.41	1.98	2.67

7.4.1 Goochland Courthouse Service Area

Based on the storage tank evaluation, the existing 300,000 gallon tank is sufficient to provide the required storage through 2045. No additional storage is required based on future demand projections.

The existing VDOC River Road West Booster Station will need to be improved before 2025 to meet the fire flow goal as well as anticipated future demand. It is recommended that the County fund the improvements to the booster station. These improvements may include the installation of a pressure reducing valve (PRV) and parallel fire valve, upgrade the VDOC booster station or construct a new booster station by 2025 in order to meet capacity needs through the end of the planning period. This will likely include a new booster station to replace the existing vault, outfitted with new pumps, piping, and updated controls.

A preliminary engineering report (PER) is recommended to determine the feasibility of replacing the existing VDOC booster station with a PRV vault and parallel emergency interconnection in lieu of a new booster station or upgrades to the existing facility.

7.4.2 Eastern Goochland Service Area

Based on the storage tank evaluation, the existing 1 million gallon Centerville Tank is sufficient to provide the required storage through 2025. In order to provide the Eastern Goochland Service Area with the future required storage, additional storage volume is required to meet the recommended storage through the end of planning period.

Significant industrial demand is anticipated in the Lanier Industrial Park and Rockville Commerce area through the planning period. The development of a new pressure zone in the Rockville area is recommended through a phased approach by 2030 to provide redundancy and operational flexibility. This will include a new interconnection to Henrico's water distribution system and a booster station along Quarry Hill Road. Based on existing and anticipated future demands, the booster station will be initially sized to provide the existing system demand and provide 1,500 gpm fire flow. Additionally, a ground storage tank is recommended to provide the required 180,000 gallons of fire storage, plus domestic storage. A pressure reducing valve is also recommended near the Interstate 64/Ashland Road interchange to separate the Rockville and Centerville pressure zones.

Construction of elevated water storage tanks are recommended at two locations starting with a 1,000,000 gallon tank at Lanier Industrial Park by 2035 and a 1,500,000 gallon storage tank at the intersection of Hockett Road and Patterson Avenue by 2035. The locations of the proposed tanks were selected based on ground elevation, centrality to future demands, and as needed to provide adequate pressures and fire flow availability.

The addition of these tanks will satisfy the future domestic and fire storage requirements within the Eastern Goochland Service Area.

Water booster pump station improvements and upgrades will be required to provide the required water supply through the planning period. A new booster pump station will be needed by 2030 at the Ridgefield water supply connection to provide required capacity. A ground storage tank is recommended at this station to provide additional storage and flow equalization, based on hydraulic limitations on maximum flow at the existing connection point.

Also by 2035, the pumps at the Centerville Booster Pump Station will have to be upsized to meet maximum day demands. Additionally, a water main will be constructed connecting the River Road High Pressure Zone to the Centerville Zone by 2035 to allow the River Road Booster Pump Station to supply water to the West Creek zone to help fill the new elevated storage tank for redundancy and improved water age.

The above described booster pump station upgrades will allow for sufficient pumping capacity for the Eastern Goochland Service Area through the end of the planning period in 2045.

7.5 Water Distribution System

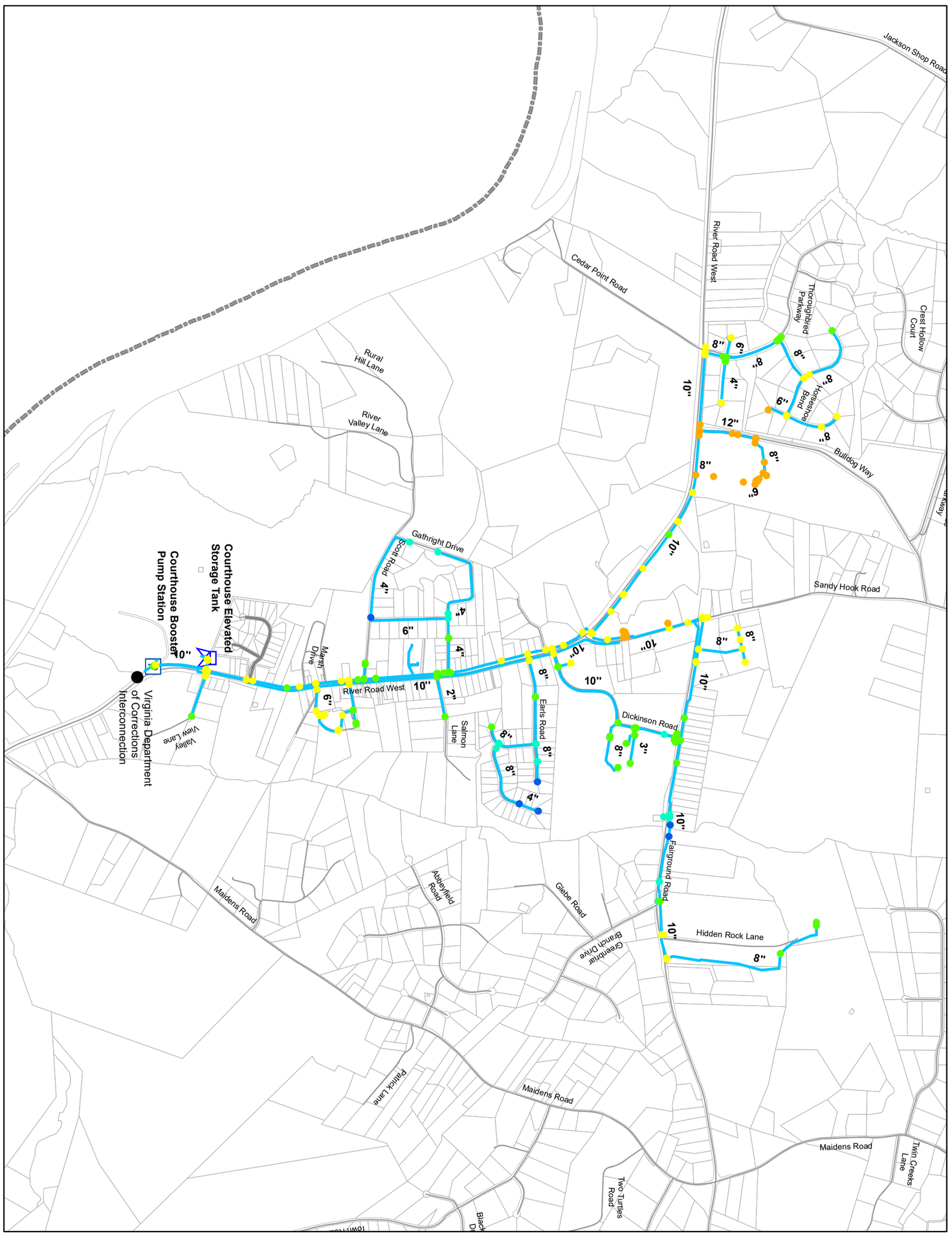
The improvements recommended to serve future development within the water distribution system are generally required to address one or more of the following issues:

- Improvements needed 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 or existing subdivisions within the Water Service Area(s).

7.6 Water Improvement Program

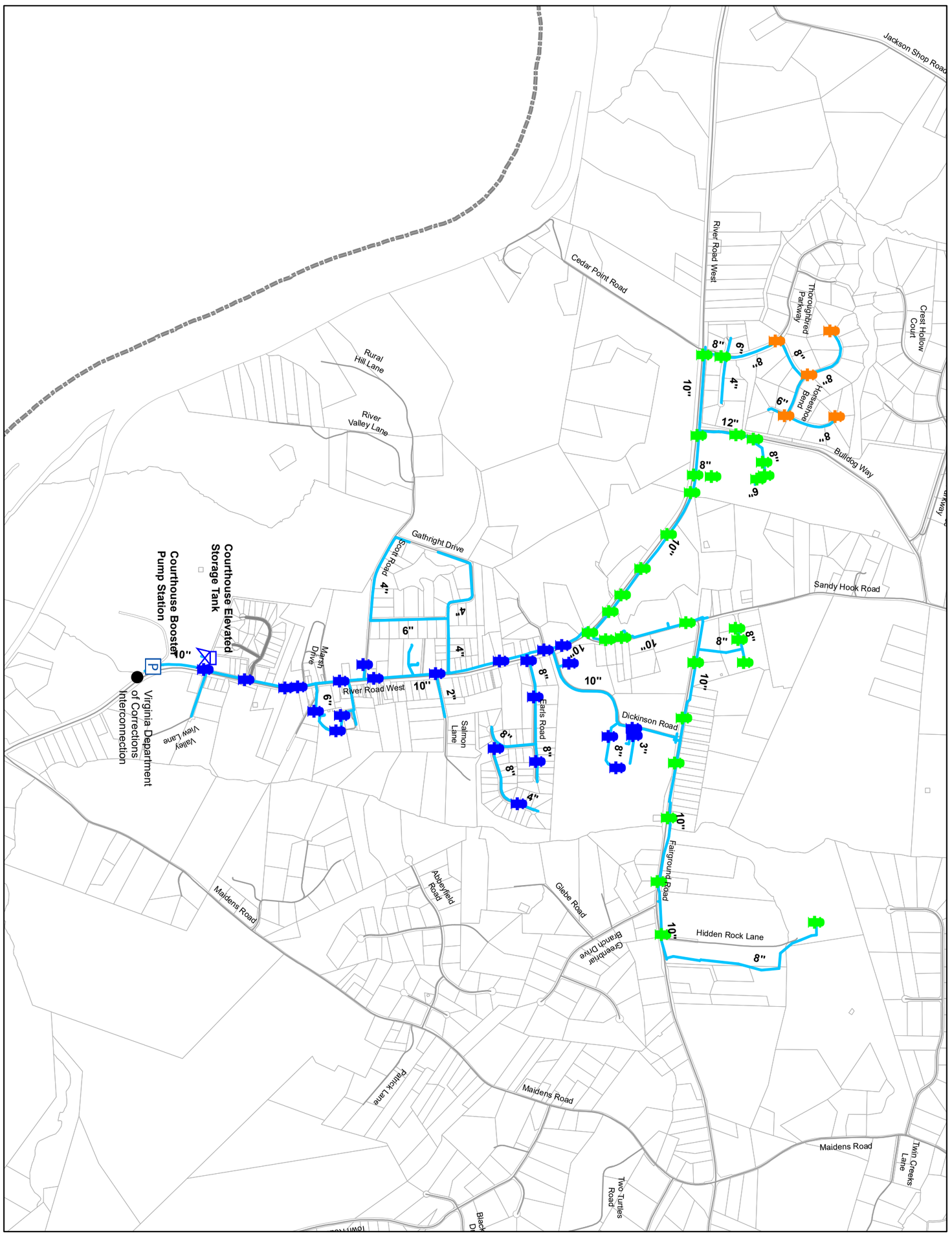
A summary of the recommended water system improvements required for future development is provided on the following pages. The improvements are separated between the Goochland Courthouse and Eastern Goochland service areas. Refer to **Figures 7-7 through 7-18** for the location of each proposed improvement.

Descriptions of the proposed water system improvements, organized by area plan, are provided on the following pages. The description lists the requirement for the improvement, 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 Chapter 9 of this Master Plan.



Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

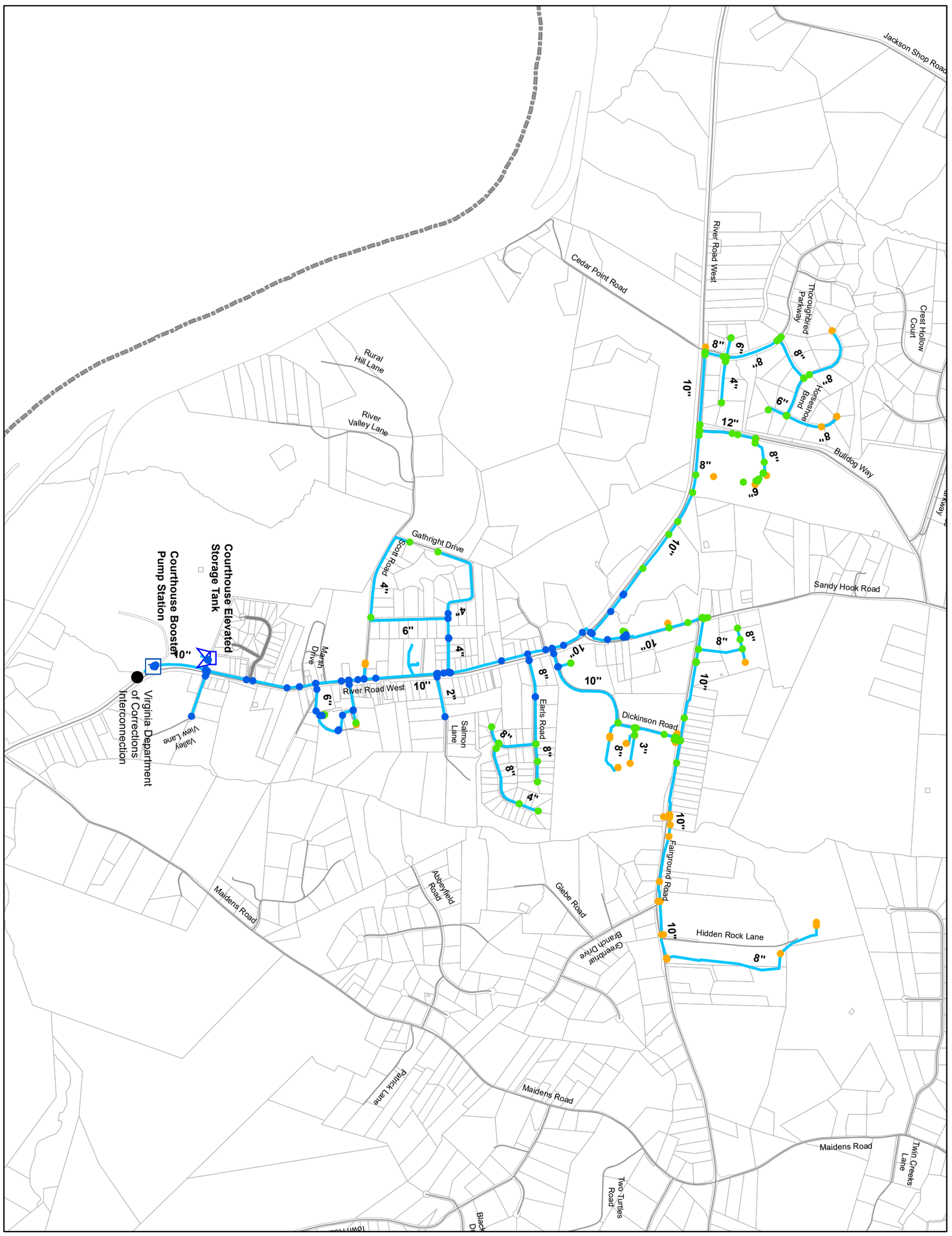
DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 1,500 feet	COURTHOUSE AREA EXISTING MINIMUM PRESSURE	7-1
PROJ. NO. 50109629	PROJECT UTILITY MASTER PLAN UPDATE GOOCHLAND COUNTY, VA		



Key Plan

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 1,500 feet	COURTHOUSE AREA EXISTING AVAILABLE FIREFLOW	7-2
PROJ. NO. 50109629	PROJECT UTILITY MASTER PLAN UPDATE GOOCHLAND COUNTY, VA		



Key Plan

Legend

- Pump Station
- Elevated Storage Tank
- Courthouse Waterline
- County Boundaries
- Under Construction

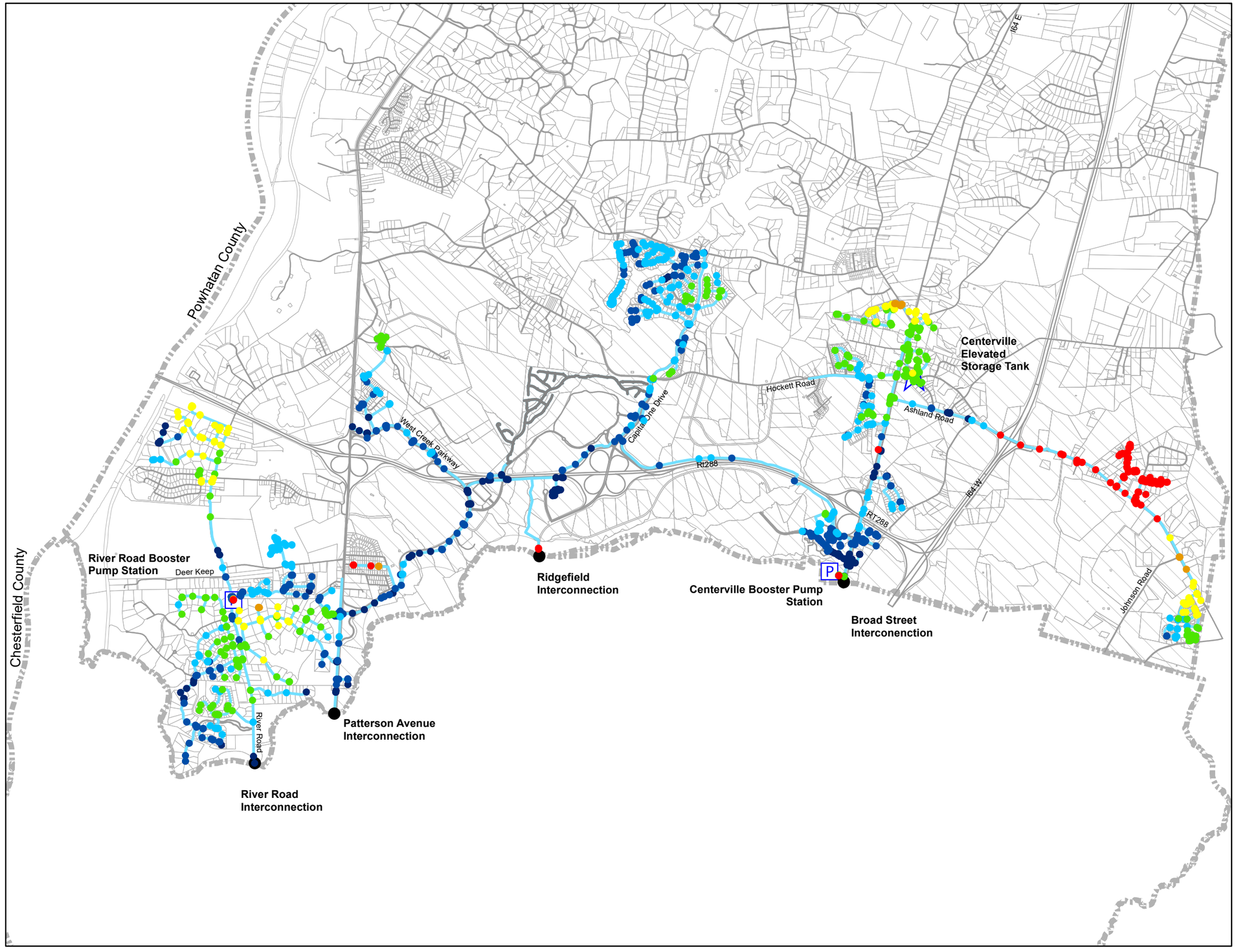
Existing Water Age

- Less Than 3 Days
- 3 - 5 Days
- 5 - 7 Days

N W E S

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 1,500 feet	COURTHOUSE AREA EXISTING WATER AGE	7-3
PROJ. NO. 50109629	PROJECT UTILITY MASTER PLAN UPDATE GOOCHLAND COUNTY, VA		



Legend

- System Interconnection
- County Boundary
- Elevated Storage Tank
- Booster Pump Station
- Under Construction

Minimum Pressure

- Less than 35 psi
- 35 to 45 psi
- 45 to 55 psi
- 55 to 65 psi
- 65 to 75 psi
- 75 to 85 psi
- Greater than 85 psi

Key Plan

FIGURE NO. 7-4

TITLE EASTERN GOOCHLAND AREA
EXISTING MINIMUM PRESSURE

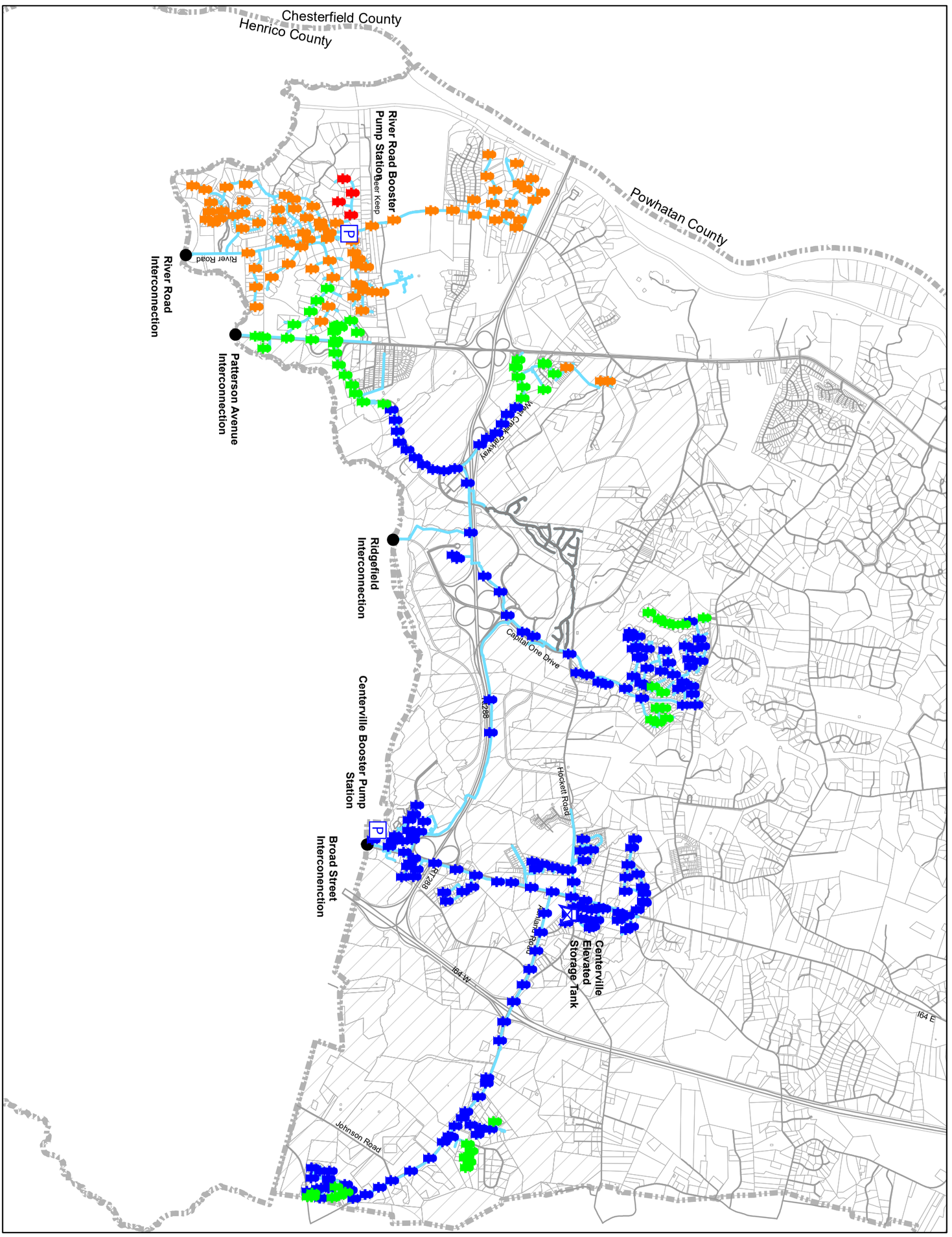
SCALE 1 inch = 4,500 feet

PROJECT UTILITY MASTER PLAN UPDATE
GOOCHLAND COUNTY, VA

DATE 05/2020

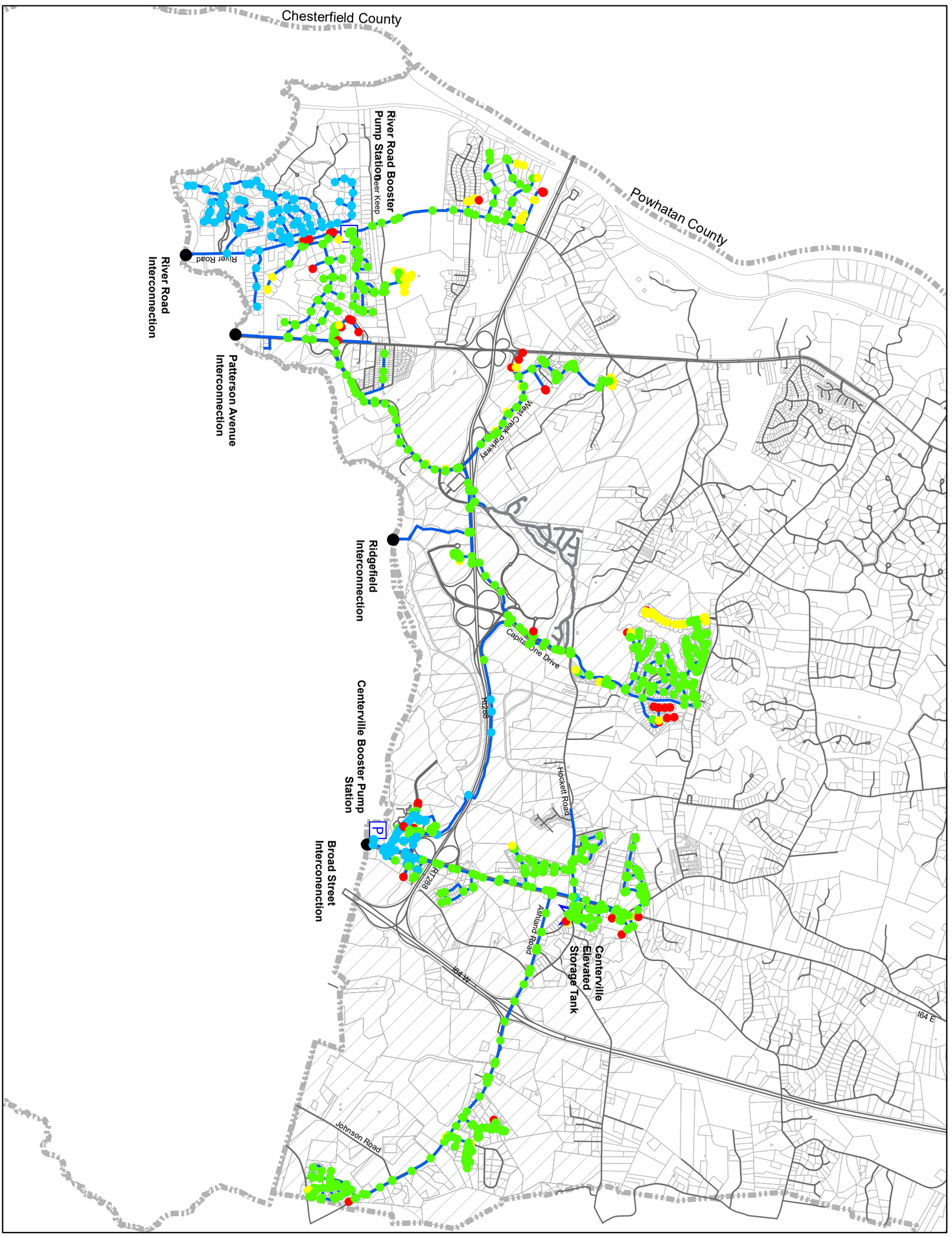
PROJ. NO. 50109629

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928



Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 4,500 feet	EASTERN GOOCHLAND AREA EXISTING FIRE FLOW	7-5
PROJ. NO. 50109629	PROJECT UTILITY MASTER PLAN UPDATE GOOCHLAND COUNTY, VA		



Key Plan

Legend

- System Interconnection
- County Boundary
- Elevated Storage Tank
- Booster Pump Station
- Under Construction

Existing Water Age

- Less Than 3 Days
- 3 - 7 Days
- 7 - 10 Days
- 10 - 14 Days

S E W N

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 4,500 feet	EASTERN GOOCHLAND AREA EXISTING WATER AGE	7-6
PROJ. NO. 50109629	PROJECT UTILITY MASTER PLAN UPDATE GOOCHLAND COUNTY, VA		

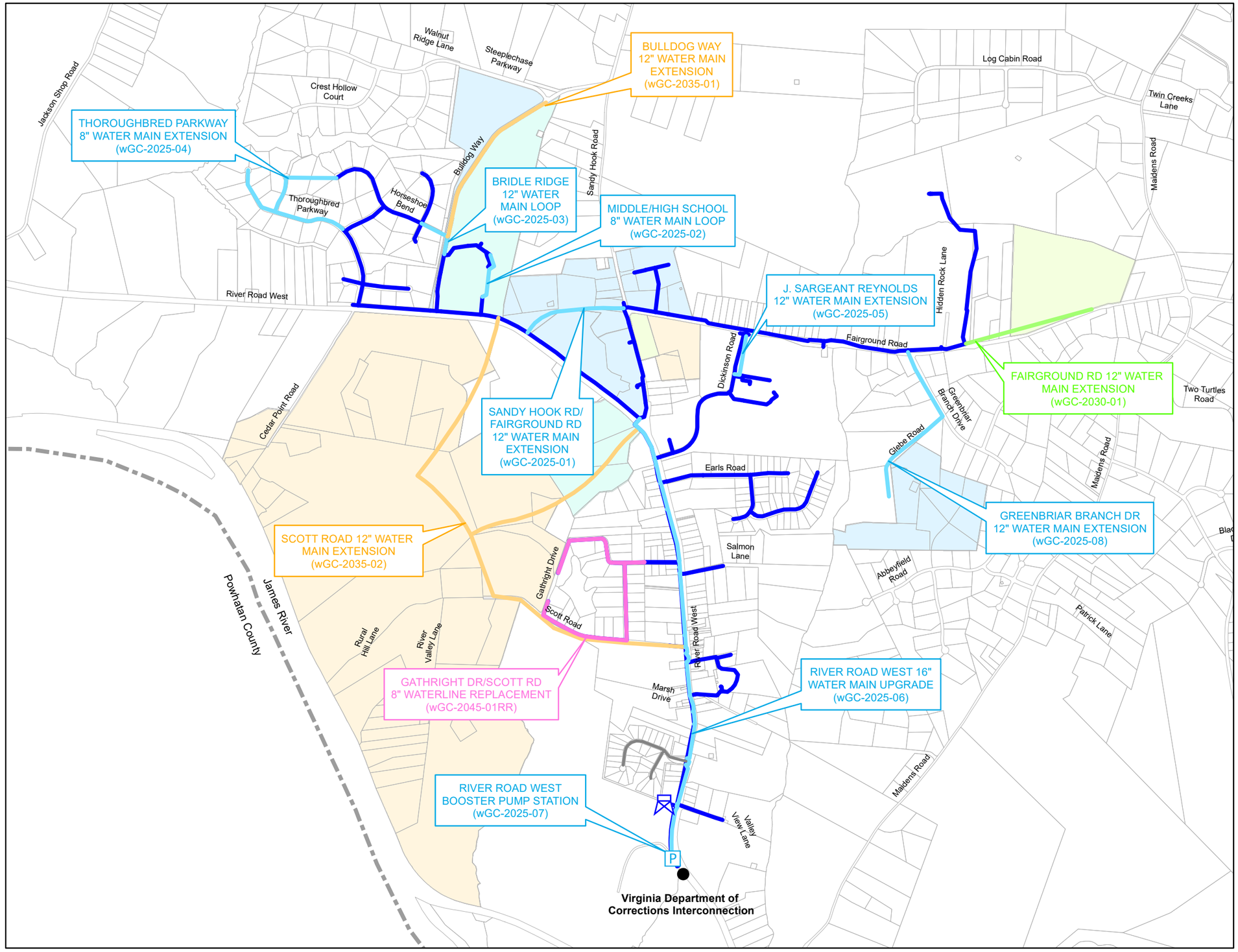


FIGURE NO. 7-7

TITLE COURTHOUSE AREA
FUTURE WATER IMPROVEMENTS

UTILITY MASTER PLAN
GOOCHLAND COUNTY, VA

SCALE 1 inch = 1,500 feet

PROJECT

DATE 05/2020

PROJ. NO. 50061868

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

Hanover County

Henrico County

LANIER INDUSTRIAL PARK IMPROVEMENTS (wEG-2025-01)

LANIER INDUSTRIAL PARK 16" WATER MAIN EXTENSION (wEG-2035-03)

ROCKVILLE RD CONTROL VALVE (wEG-2035-04)

ROCKVILLE RD 16" WATER MAIN EXTENSION (wEG-2025-02)

MANAKIN RD 16" WATER MAIN EXTENSION (wEG-2025-03)

MANAKIN RD 12" WATER MAIN EXTENSION (wEG-2025-03)

ASHLAND RD 16" WATER MAIN (wEG-2035-02)

LANIER INDUSTRIAL PARK ELEVATED TANK (wEG-2035-01)

QUARRY HILL RD 16" WATER MAIN (wEG-2030-02)

ROCKVILLE BOOSTER PUMP STATION (wEG-2030-01)

ASHVILLE RD CONTROL VALVE (wEG-2030-03)

THREE CHOPT ROAD 12" MAIN EXTENSION (wEG-2035-05)

Sylvan Lane
Lanier Road
Rockville Road
Childress Road
Junie Buck Drive
Ashland Road
Johnson Road
Pouncey Tract Road
Quarry Hill Road
I-64
Benington Road
Three Chopt Road
St. Matthews Lane

N
W
E
S

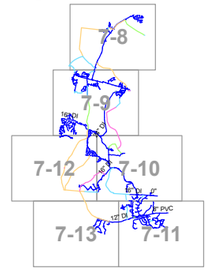
Legend

- System Interconnection
- Existing Elevated Tank
- Existing Pump Station
- County Boundaries
- Under Construction
- Existing TSCD
- 2020 Waterline
- 2025 Waterline
- 2030 Waterline
- 2035 Waterline
- 2045 Waterline

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan



SEE FIGURE 7-9 FOR CONTINUATION

FIGURE NO. 7-8

TITLE EASTERN GOOCHLAND AREA FUTURE WATER IMPROVEMENTS

PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA

SCALE 1 inch = 1,500 feet

DATE 05/2020

PROJ. NO. 50061868

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

SEE FIGURE 7-8 FOR CONTINUATION

PLAZA DRIVE WATER INSTALLATION (wEG-2025-06)

THREE CHOPT ROAD 12" MAIN EXTENSION (wEG-2035-05)

DECOMISSION ROUTE 288 PRV (wEG-2030-07)

SADDLE CREEK 12" WATER MAIN LOOP (wEG-2025-04)

HOCKETT ROAD 16" WATER MAIN EXTENSION (wEG-2030-07)

CENTERVILLE BOOSTER PUMP STATION UPGRADE (wEG-2035-06)

WILKES RIDGE PARKWAY 12" WATER MAIN EXTENSION (wEG-2025-05)

WEST CREEK BUSINESS PARK 12" WATER MAIN EXTENSION (sEG-2045-01)

Broad Street Interconnection

Henrico County

Broad Street Road
Plaza Drive
Forrest Meadow Lane
Oak Grove Drive
Whippoorwill Road
Centerville Parke Lane
Hockett Road
Pond View Lane
Gaines Thrifty Lane
Hermitage Road
Lucille Lane
Rt288
WILKES RIDGE PKWY
Hamlet Road
Tuckahoe Creek Parkway
Wellfield Road
Kimlock Road

N
W
E
S

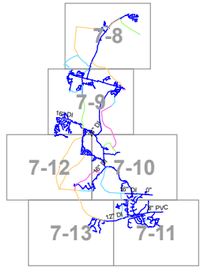
Legend

- System Interconnection
- Existing Elevated Tank
- Existing Pump Station
- County Boundaries
- Under Construction
- Existing TSCD
- 2020 Waterline
- 2025 Waterline
- 2030 Waterline
- 2035 Waterline
- 2045 Waterline

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan



SEE FIGURE 7-10 FOR CONTINUATION

FIGURE NO. 7-9

TITLE EASTERN GOOCHLAND AREA FUTURE WATER IMPROVEMENTS

UTILITY MASTER PLAN GOOCHLAND COUNTY, VA

SCALE 1 inch = 1,500 feet

PROJECT

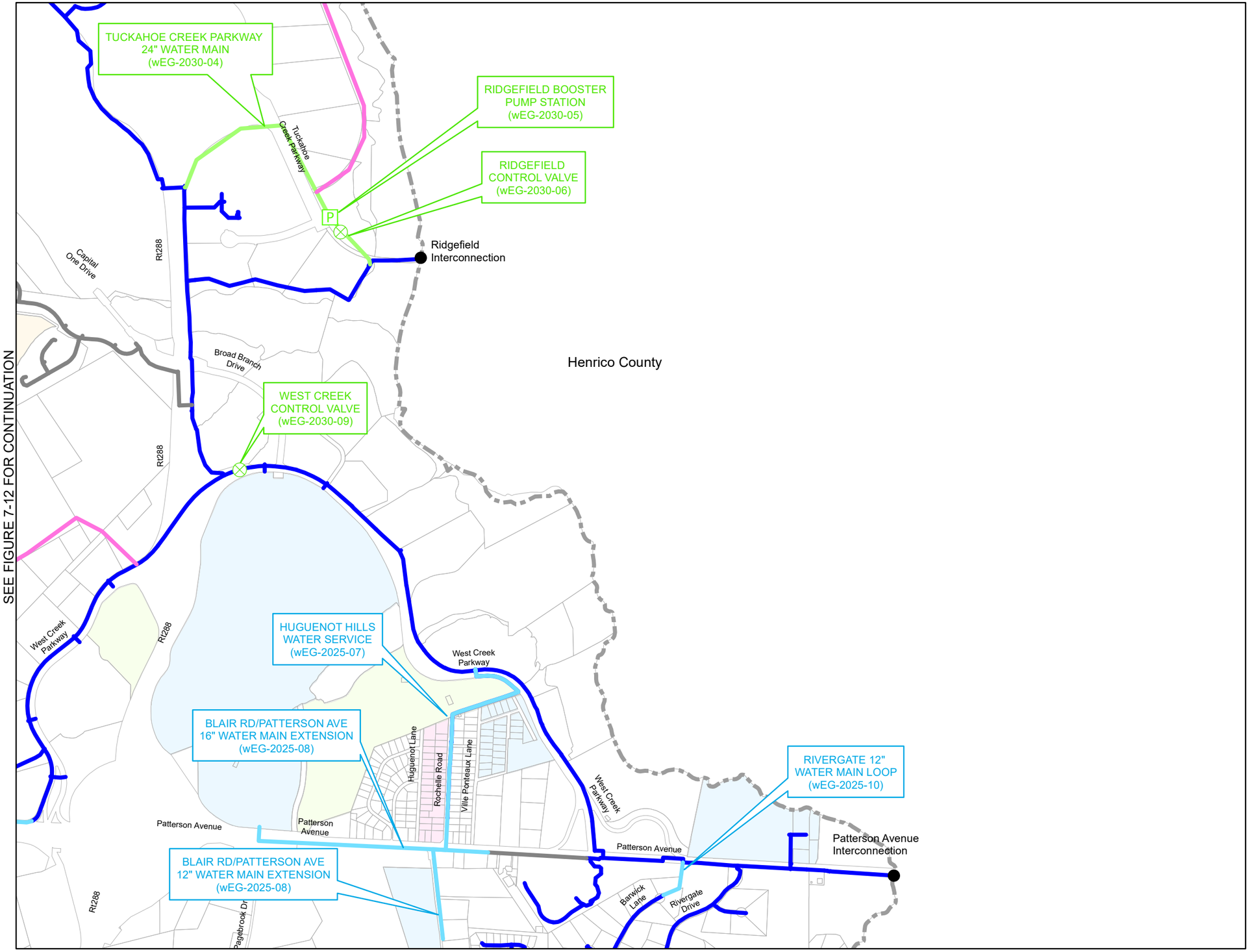
DATE 05/2020

PROJ. NO. 50061868

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

SEE FIGURE 7-9 FOR CONTINUATION

SEE FIGURE 7-12 FOR CONTINUATION



SEE FIGURE 7-11 FOR CONTINUATION

N
W E
S

Legend

- System Interconnection
- Existing Elevated Tank
- Existing Pump Station
- County Boundaries
- Under Construction
- Existing TSCD
- 2020 Waterline
- 2025 Waterline
- 2030 Waterline
- 2035 Waterline
- 2045 Waterline

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan

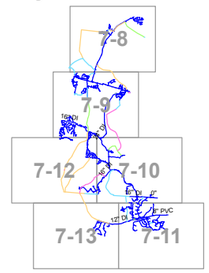


FIGURE NO. 7-10

TITLE EASTERN GOOCHLAND AREA
FUTURE WATER IMPROVEMENTS

UTILITY MASTER PLAN
GOOCHLAND COUNTY, VA

SCALE 1 inch = 1,500 feet

PROJECT

DATE 05/2020

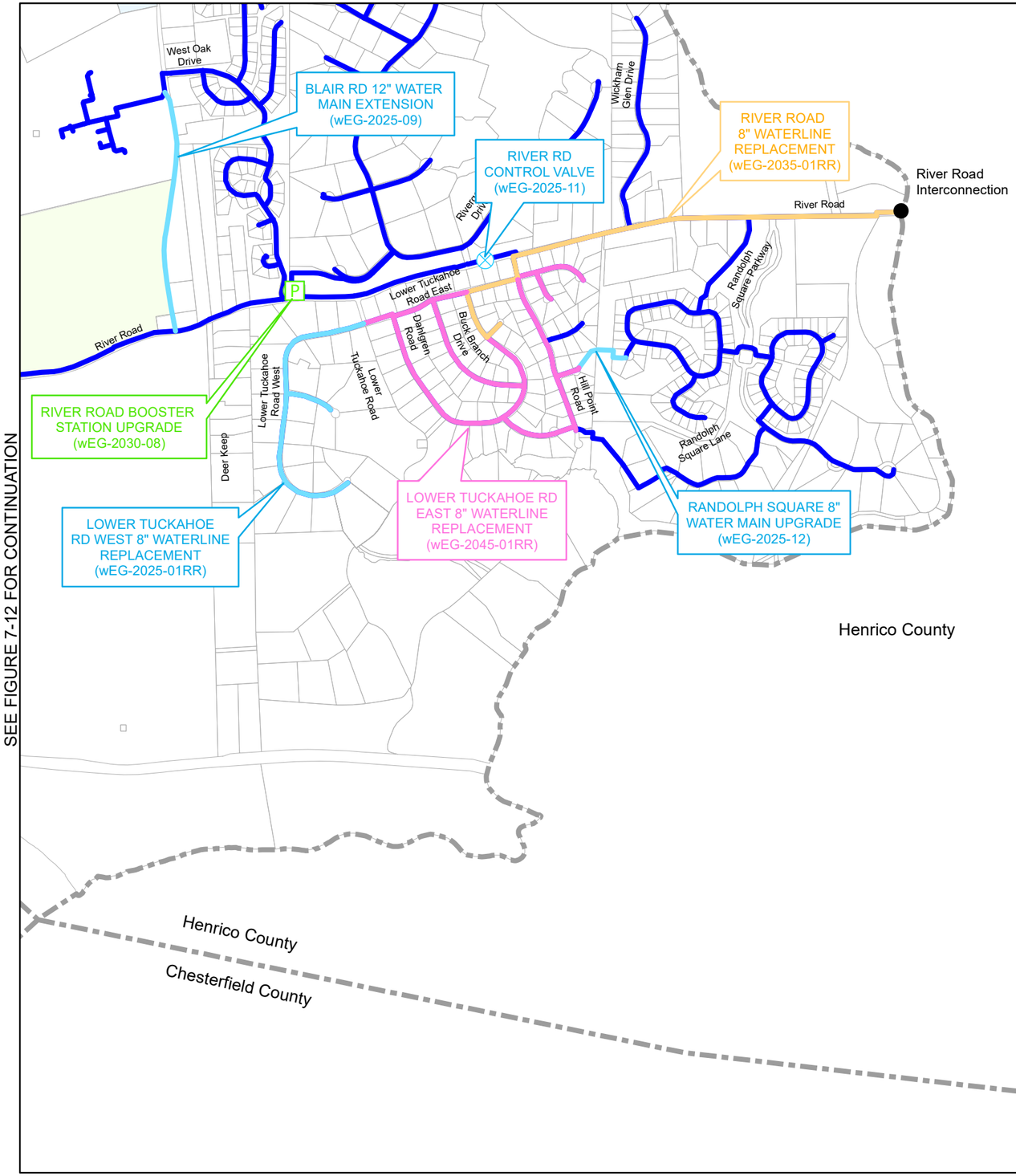
PROJ. NO. 50061868

Dewberry

Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

SEE FIGURE 7-9 FOR CONTINUATION

SEE FIGURE 7-12 FOR CONTINUATION



N

W E

S

Legend

- System Interconnection
- Existing Elevated Tank
- Existing Pump Station
- County Boundaries
- Under Construction
- Existing TSCD
- 2020 Waterline
- 2025 Waterline
- 2030 Waterline
- 2035 Waterline
- 2045 Waterline

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan

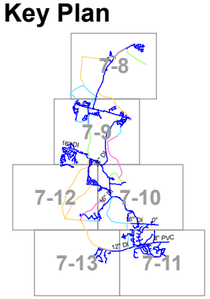


FIGURE NO. 7-11

TITLE EASTERN GOOCHLAND AREA FUTURE WATER IMPROVEMENTS

SCALE 1 inch = 1,500 feet

PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA

DATE 05/2020

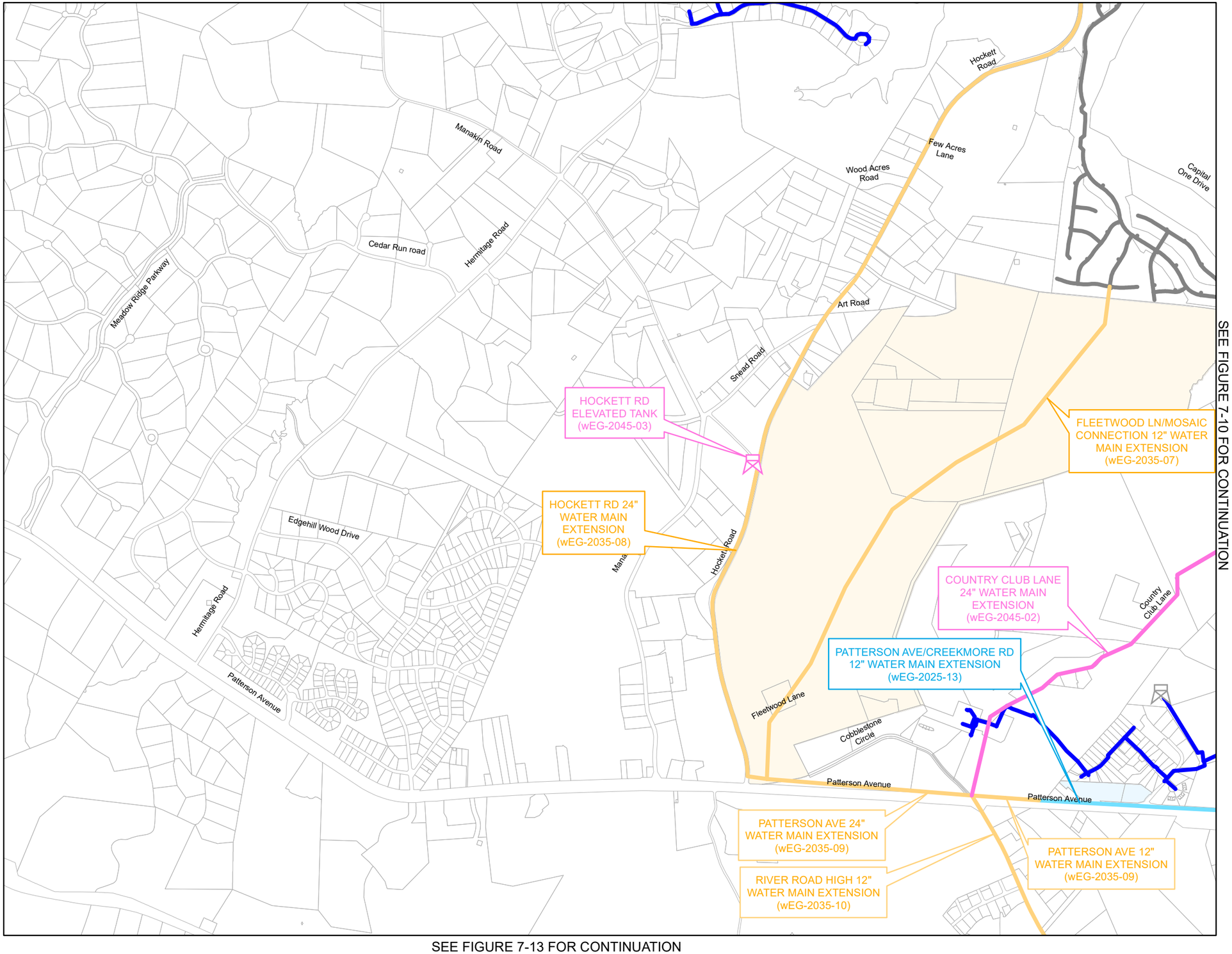
PROJ. NO. 50061868

Dewberry

Dewberry Engineers Inc.

4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

SEE FIGURE 7-9 FOR CONTINUATION



SEE FIGURE 7-10 FOR CONTINUATION

N
W E
S

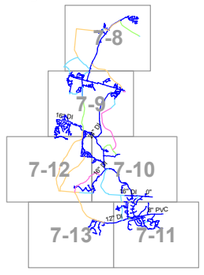
Legend

- System Interconnection
- Existing Elevated Tank
- Existing Pump Station
- County Boundaries
- Under Construction
- Existing TSCD
- 2020 Waterline
- 2025 Waterline
- 2030 Waterline
- 2035 Waterline
- 2045 Waterline

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan



SEE FIGURE 7-13 FOR CONTINUATION

FIGURE NO. 7-12

TITLE EASTERN GOOCHLAND AREA FUTURE WATER IMPROVEMENTS

PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA

SCALE 1 inch = 1,500 feet

DATE 05/2020

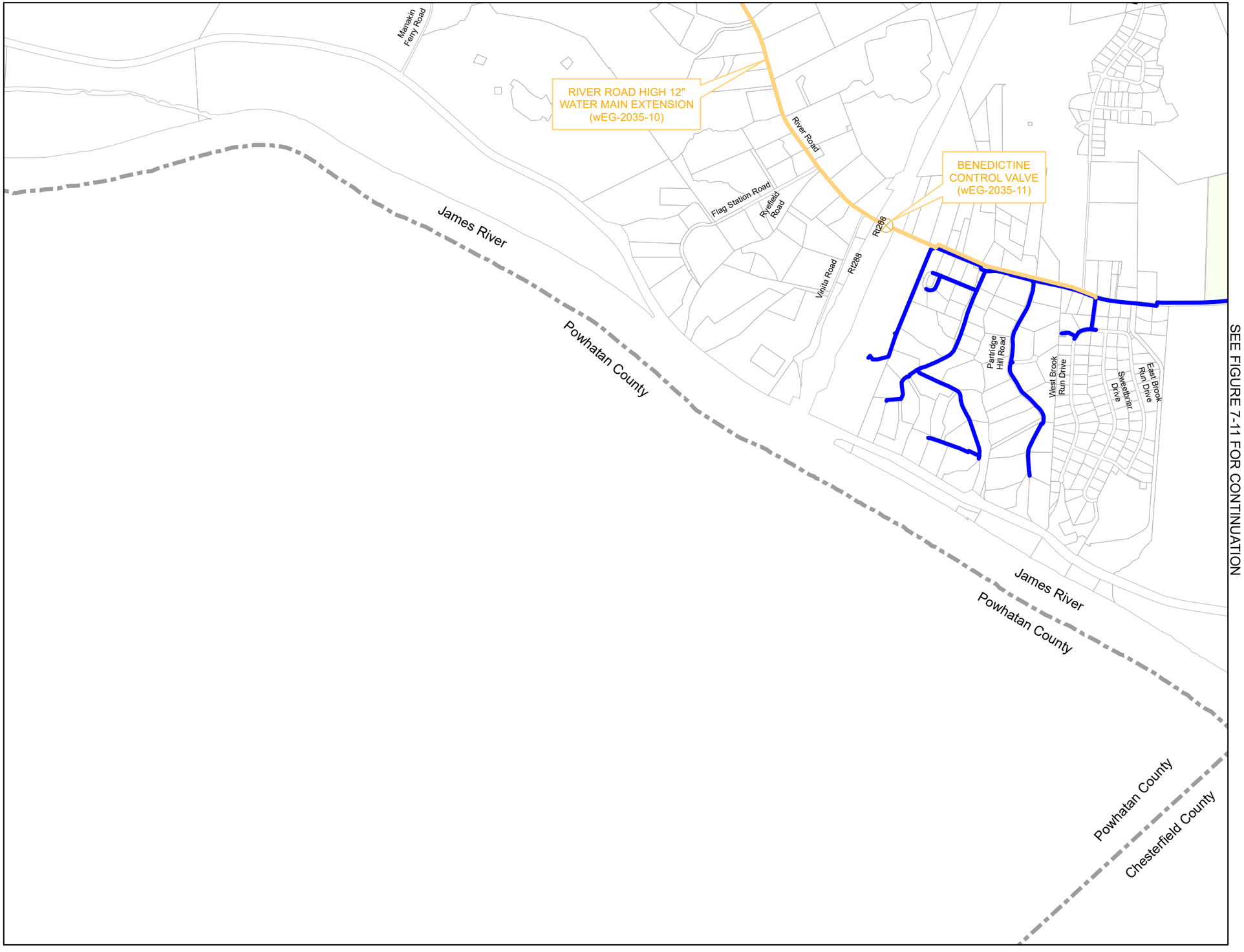
PROJ. NO. 50061868

Dewberry

Dewberry Engineers Inc.

4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

SEE FIGURE 7-12 FOR CONTINUATION



SEE FIGURE 7-11 FOR CONTINUATION

N

W E

S

Legend

- System Interconnection
- Existing Elevated Tank
- Existing Pump Station
- County Boundaries
- Under Construction
- Existing TSCD
- 2020 Waterline
- 2025 Waterline
- 2030 Waterline
- 2035 Waterline
- 2045 Waterline

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan

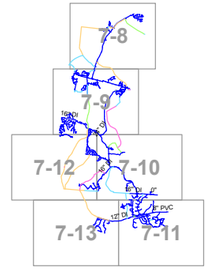


FIGURE NO. 7-13

TITLE EASTERN GOOCHLAND AREA FUTURE WATER IMPROVEMENTS

SCALE 1 inch = 1,500 feet

PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA

DATE 05/2020

PROJ. NO. 50061868

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

Goochland Courthouse Service Area
See Figure 7-7

wGC-2025-01: Sandy Hook Rd/Fairground Rd Water Main Extension
This project would consist of the following improvements:

1. Construction of a new 12" waterline extending west from the existing 10" waterline at the intersection of Fairground Road/Sandy Hook Lane to the existing 10" waterline on River Road West – approximately 1,600 LF.

Project is planned for completion in 2025.

wGC-2025-02: Middle/High School Water Main Loop
This project would consist of the following improvements:

1. Construction of a new 8" waterline from the existing waterline on River Road West, extending north to the existing waterline on Bulldog Way in order to create a loop – approximately 800 LF.

Project is planned for completion in 2025.

wGC-2025-03: Bridle Ridge Water Main Loop
This project would consist of the following improvements:

1. Construction of a new 12" waterline from the existing waterline at the intersection of Horseshoe Bend/Bridle Road extending southwest to the existing waterline on Bulldog Way – approximately 800 LF.

Project is planned for completion in 2025.

wGC-2025-04: Thoroughbred Pkwy Water Main Extension
This project would consist of the following improvements:

1. Construction of a new 8" waterline from the existing waterline on Horseshoe Parkway extending to out and south to form a loop with the existing waterline on Thoroughbred Parkway – 3,300 LF.

Project is planned for completion in 2025.

wGC-2025-05: J. Sargent Reynolds Water Main Extension
This project would consist of the following improvements:

1. Upsize existing waterline at J. Sergeant Reynolds campus from 4-inch to 12-inch – approximately 700 LF.

Project is planned for completion in 2025.

wGC-2025-06: River Road West Water Main Upgrade
This project would consist of the following improvements:

1. Upsize existing water main running along River Road West from the VDOC interconnection to the intersection of Sandy Hook/River Road West to 16" – approximately 7,300 LF.

Project is planned for completion in 2025.

wGC-2025-07: River Road West Water Booster Station

This project would consist of the following improvements:

1. Complete preliminary engineering report (PER) to determine the feasibility of replacing the existing VDOC booster station with a PRV vault and parallel emergency interconnection.
2. Construction of a 1 MGD booster pump station to convey water from the VDOC interconnection to the Courthouse system.

Project is planned for completion in 2025.

wGC-2025-08: Greenbriar Branch Drive Water Main Extension

This project would consist of the following improvements:

1. Install new 12" waterline extending down along Greenbriar Branch Drive and Glebe Road – approximately 2,800 LF.

Project is planned for completion in 2025.

wGC-2030-01: Fairground Road Water Main Extension

This project would consist of the following improvements:

1. Install new 12" waterline extending east along Fairground Road directly east of Hidden Rock Lane from the existing 8" Fairground Road waterline – approximately 2,000 LF.

Project is planned for completion in 2030.

wGC-2035-01: Bulldog Way Water Main Extension

This project would consist of the following improvements:

1. Install new 12" waterline extending north along Bulldog Way to the intersection of Steeplechase Parkway and Bulldog Way – approximately 2,700 LF.

Project is planned for completion in 2035.

wGC-2035-02: Scott Road Water Main

This project would consist of the following improvements:

1. Install a new 12" waterline along Scott Road extending northwest, then forming into a loop following the proposed 2035 Comprehensive Plan roads, connecting to the existing 10" waterline on River Road West – approximately 11,200 LF.

Project is planned for completion in 2035.

Eastern Goochland Service Area
See Figures 7-8 through 7-13

wEG-2025-01: Lanier Industrial Park Improvements
This project would consist of the following improvements:

1. Construction of a 16" waterline extending from Lanier Lane down to Commerce Center Drive – approximately 700 LF.

Project is planned for completion in 2025.

wEG-2025-02: Rockville Road Water Main Extension
This project would consist of the following improvements:

1. Construction of a 16" waterline starting at the intersection of Ashland/Rockville Road extending north up Rockville Road – approximately 6,300 LF.

Project is planned for completion in 2025.

wEG-2025-03: Manakin Road Water Main Extension
This project would consist of the following improvements:

1. Construction of approximately 4,300 LF of 12" waterline and approximately 2,000 LF of 16" waterline northeast along Manakin Road from the existing 16" waterline at Manakin Towne Boulevard, extending northeast to reach Tuckahoe Creek Parkway.

Project is planned for completion in 2025.

wEG-2025-04: Saddle Creek Water Main Loop
This project would consist of the following improvements:

1. Construction of a new 12" waterline connecting from Pond View Lane to Hounslow Drive – approximately 2,700 LF.

Project is planned for completion in 2025.

wEG-2025-05: Wilkes Ridge Parkway Water Main Extension
This project would consist of the following improvements:

1. Construction of a new 12" waterline extending directly south of the end of Wilkes Ridge Parkway towards Tuckahoe Creek – approximately 2,400 LF.

Project is planned for completion in 2025.

wEG-2025-06: Plaza Drive Water Installation
This project would consist of the following improvements:

1. Construction of a new 16" waterline from the Plaza Drive intersection with Ashland Road extending west on Plaza Drive to the St Matthews Lane intersection – approximately 1,400 LF.

Project is planned for completion in 2025.

wEG-2025-07: Huguenot Hills Water Service

This project would consist of the following improvements:

1. Installation of approximately 4,200 LF of 12" waterline along Rochelle Road, serving customers between West Creek Parkway and Patterson Avenue.

Project is planned for completion in 2025.

wEG-2025-08: Blair Road/Patterson Ave Water Main Extension

This project would consist of the following improvements:

1. Construction of a new 16" water main from the RT. 288/Patterson Avenue interchange east to the Patterson Avenue/Blair Road intersection – approximately 3,800 LF.
2. Construction of a new 12" water main from the Patterson Avenue/Blair Road intersection, extending south down Blair Road – approximately 1,400 LF.

Project is planned for completion in 2025.

wEG-2025-09: Blair Road Water Main Extension

This project would consist of the following improvements:

1. Construction of a new 12-inch waterline extending south along Blair Road to River Road – approximately 3,000 LF.

Project is planned for completion in 2025.

wEG-2025-10: Rivergate Water Main Loop

This project would consist of the following improvements:

1. Construction of a new 12-inch waterline from Barwick Lane to the existing 16-inch waterline along Patterson Avenue, creating a hydraulic loop – approximately 700 LF.

Project is planned for completion in 2025.

wEG-2025-11: River Rd Control Valve

This project would consist of the following improvements:

1. Construction of a new pressure reducing valve facility along River Road between the River Road booster pump station and the River Road Interconnection.

Project is planned for completion in 2025.

wEG-2025-12: Randolph Square Water Main Upgrade

This project would consist of the following improvements:

1. Upgrade approximately 1,400 LF of existing 6-inch waterline to 8-inch waterline.

Project is planned for completion in 2025.

wEG-2025-13: Patterson Avenue/Creekmore Road Water Main Extension

This project would consist of the following improvements:

1. Construction of a new 12" waterline from West Creek Parkway/Patterson Avenue intersection extending west on Patterson Avenue – approximately 3,000 LF.

Project is planned for completion in 2025.

wEG-2030-01: Rockville Booster Pump Station

This project would consist of the following improvements:

1. Installation of a 3 MGD booster pump station and chloramine station, ground storage tank, and new interconnection with Henrico County located off of Quarry Hill Road.

Project is planned for completion in 2030.

wEG-2030-02: Quarry Hill Road Water Main

This project would consist of the following improvements:

1. Construction of a new 16" waterline extending east along Quarry Hill Road from Ashland Road to the proposed Rockville Booster Pump Station – approximately 5,500 LF.

Project is planned for completion in 2030.

wEG-2030-03: Ashland Rd Control Valve

This project would consist of the following improvements:

1. Construction of a new pressure reducing valve facility along Ashland Rd, separating the Rockville and Centerville pressure zones.

Project is planned for completion in 2030.

wEG-2030-04: Tuckahoe Creek Parkway Water Main

This project would consist of the following improvements:

1. Construction of a new 24" waterline extending down Tuckahoe Creek Parkway from the existing 24" West Creek water main – approximately 4,500 LF.

Project is planned for completion in 2030.

wEG-2030-05: Ridgefield Booster Pump Station

This project would consist of the following improvements:

1. Construction of a 7 MGD booster pump station and chloramine booster station to convey flow from the Ridgefield connection north into the Centerville pressure zone.

Project is planned for completion in 2030.

wEG-2030-06: Ridgefield Control Valve

This project would consist of the following improvements:

1. Construction of a new pressure reducing valve facility along Tuckahoe Creek Parkway upstream of the Ridgefield booster pump station.

Project is planned for completion in 2030.

wEG-2030-07: Hockett Road Water Main Extension

This project would consist of the following improvements:

1. Construction of a new 16" waterline from Goins Road extending south down Hockett Rd – approximately 6,500 LF.
2. Decommission Route 288 PRV.

Project is planned for completion in 2030.

wEG-2030-08: River Road Booster Pump Station Upgrade

This project would consist of the following improvements:

1. Upgrade the capacity of the existing River Road booster pump station to 1.5 MGD to meet projected future demands.

Project is planned for completion in 2030.

wEG-2030-09: West Creek Control Valve

This project would consist of the following improvements:

1. Installation of a PRV Facility on the existing 12" waterline on West Creek Parkway, directly west of the West Creek Parkway/Capital One Drive intersection.

Project is planned for completion in 2030.

wEG-2035-01: Lanier Industrial Park Elevated Tank

This project would consist of the following improvements:

1. Construction of a new 1.1 MGD elevated storage in Lanier Industrial Park.

Project is planned for completion in 2035.

wEG-2035-02: Ashland Road Water Main Extension

This project would consist of the following improvements:

1. Construction of a new 16" waterline extending south down Ashland Road from Quarry Hill Road to Lanier Industrial Park – approximately 4,600 LF.

Project is planned for completion in 2035.

wEG-2035-03: Lanier Industrial Park Water Main

This project would consist of the following improvements:

2. Construction of a new 16" waterline connecting Lanier Industrial Park and the Manakin Road waterline – approximately 13,600 LF.

Project is planned for completion in 2035.

wEG-2035-04: Rockville Rd Control Valve

This project would consist of the following improvements:

1. Installation of a PRV Facility on the proposed 16" River Road waterline, below the I-64 crossing.

Project is planned for completion in 2035.

wEG-2035-05: Three Chopt Road Water Main Extension

This project would consist of the following improvements:

1. Construction of a new 12" waterline connecting the Ashland Road water main to the Little Tuckahoe Ct water main – approximately 9,100 LF.

Project is planned for completion in 2035.

wEG-2035-06: Centerville Booster Pump Station Upgrade

This project would consist of the following improvements:

1. Upgrade the existing Centerville booster pump station to a capacity of 8 MGD.

Project is planned for completion in 2035.

wEG-2035-07: Fleetwood Lane/Mosaic Connection Water Main Extension

This project would consist of the following improvements:

1. Construction of a new 12" waterline connecting Fleetwood Lane to the Mosaic residential area – approximately 9,700 LF.

Project is planned for completion in 2035.

wEG-2035-08: Hockett Road Water Main Extension

This project would consist of the following improvements:

1. Construction of a new 24" waterline connecting River Road West to Tuckahoe Creek Parkway – approximately 15,800 LF.

Project is planned for completion in 2035.

wEG-2035-09: Patterson Ave Water Main Extension

This project would consist of the following improvements:

1. Construction of approximately 1,100 LF of 12" waterline and approximately 3,200 LF of 24" waterline along Patterson Ave directly south of Richmond Country Club.

Project is planned for completion in 2035.

wEG-2035-10: River Road High Water Main Extension

This project would consist of the following improvements:

1. Construction of a 12" waterline extending southwest from the Mosaic residential area, connecting Mosaic to the River Road West waterline – approximately 10,100 LF.

Project is planned for completion in 2035.

wEG-2035-11: Benedictine Control Valve

This project would consist of the following improvements:

1. Installation of a PRV Facility on the proposed 12" River Road waterline, directly adjacent to the RT. 288 crossing.

Project is planned for completion in 2035.

wEG-2045-01: West Creek Business Park Water Main Extension

This project would consist of the following improvements:

1. Construction of a 12" waterline extending south along the Rt. 288 corridor, paralleling the existing 24" – approximately 11,700 LF.

Project is planned for completion in 2045.

wEG-2045-02: Country Club Lane Water Main Extension

This project would consist of the following improvements:

1. Extend a new 24" water main from West Creek Parkway south to Patterson Ave to improve conveyance to the western portion of the system.

Project is planned for completion in 2045.

wEG-2045-03: Hockett Road Elevated Water Storage Tank

This project would consist of the following improvements:

1. New 1,500,000 gallon elevated water storage tank constructed north of Tuckahoe Creek Parkway, along Hockett Road.
2. New water main with valves and appurtenances to connect new tank to the existing water system

Project is planned for completion in 2045.

Chapter 8 Wastewater System Improvements

8.1 General

This chapter of the Master Plan presents an overview of system improvements that are proposed to provide wastewater service within the County's Water and Sewer Service Areas through the Year 2045.

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 chapter.

8.2 Wastewater Discharge Capacity

An evaluation of the planning period from 2020 to 2045 indicates that as the population grows within the water service areas, the County will be need to obtain additional wastewater treatment and discharge allocations to meet peak system demands through the end of the planning period. **Table 8-1** provides a summary of the existing wastewater treatment and discharge capacity by location for the County's wastewater service areas and **Table 8-2** shows the projected maximum month average wastewater loadings through the end of the planning period in 2045. **Table 8-3** shows the existing and projected sewer pump station influent flow rates and required capacities.

Table 8-1: Existing Wastewater Discharge Capacity by Location

Discharge Location	Service Area	Maximum Month Average Capacity
Virginia Department of Corrections	Courthouse	0.136 MGD
City of Richmond	Eastern Goochland	15 MGD
Henrico County	Eastern Goochland Lower Tuckahoe	0.69 MGD

Table 8-2: Wastewater Loading Projections (Maximum Day Average)[1]

Discharge Location	Service Area	2020	2025	2030	2035	2045
Virginia Department of Corrections	Courthouse	0.10	0.25	0.27	0.39	0.39
City of Richmond	Eastern Goochland	0.84	2.95	4.00	6.23	9.04
Henrico County	Lower Tuckahoe	0.12	0.12	0.12	0.12	0.12

1. Loading projections in MGD.

Table 8-3: Sewer Pump Station Existing and Projected Capacities

Sewer Pump Station	Design Capacity (gpm)	Modeled Capacity (gpm) - 2020	Modeled Capacity (gpm) - 2045	Peak Hour Influent Flow Rate (gpm)				
				2020	2025	2030	2035	2045
Lanier Industrial PS	1,500	-	1,500	-	-	-	1,378	1,378
Reverse C PS	710	-	710	-	-	701	701	701
James River PS	300	-	300	-	-	-	144	144
Kinloch PS	317	300	300	14	14	14	14	14
Swann's Inn PS	120	120	120	11	26	26	26	26
Reed Marsh PS	120	0	120	0	34	34	34	34
Eastern Goochland Pump Station	9,310	20,470	20,470	3,661	5,328	6,429	7,933	10,328
Lower Tuckahoe PS	250	350	350	221	221	221	221	221
Valley View PS	145	150	210	137	309	326	343	343
West Oak PS	250	360	360	53	100	330	330	330

8.2.1 Goochland Courthouse Service Area

The County currently has an agreement in place with VDOC to discharge a maximum month average flow rate of 136,000 GPD to the wastewater treatment facilities located at the Virginia Correctional Center for Women (VCCW) on River Road West. Based on future demand projections and current WWTP capacity, the VCCW WWTP will require an expansion to provide treatment and disposal of wastewater through the end of the planning period in 2045. VDOC has completed a study that estimates the WWTP improvements totaling approximately $3 million will be required to provide the County with a 330,000 GPD allocation. It is anticipated the WWTP expansion will be phased. This increase in treatment capacity will be adequate for the anticipated flows through at least the 2030 planning period.

8.2.2 Eastern Goochland Service Area

There are currently two agreements active in the Eastern Goochland Service Area concerning wastewater discharge: one with Henrico County (Henrico) and one with the City of Richmond (Richmond).

Through an agreement dated June 1, 2002, Goochland County may convey up to the initial contracted wastewater treatment maximum month average capacity of 5 MGD with an allowable peak hour conveyance capacity of 1.33 times the maximum month average capacity (6.65 MGD). Goochland County has the option of purchasing additional wastewater treatment capacity up to a maximum month average of 8 MGD without upgrading the existing WWTP. As part of the agreement, additional wastewater treatment capacity up to a maximum month average of 15 MGD is available but will require upgrades to the Richmond's wastewater treatment plant and the renegotiation of capacity charges. The existing agreement does not allow for Goochland to exceed a maximum month average of 15 MGD and a peak hour flow of 20 MGD. Based on the loading projections, the County will need to obtain additional wastewater treat-

ment capacity by 2045; this will require additional negotiation with the City of Richmond and Henrico County.

Henrico County is currently under contract to provide Goochland County with a maximum month average wastewater treatment capacity of up to 0.69 MGD. Based on the future wastewater loading projections, this capacity is adequate to meet the County's need through the end of the planning period in 2045.

8.3 Wastewater Collection and Conveyance

This chapter provides a summary of the recommended wastewater collection system improvements in a similar format to the water system improvements discussed in **Chapter 7**. Wastewater system improvements for each service area are presented in separate sections that are used in the water system improvement program.

8.3.1 Goochland Courthouse Service Area

The sewer model was utilized to evaluate the capacity of the existing sewer collection system. As shown in **Figure 8-1**, the system has adequate capacity for the current wastewater flows. To keep up with influent flow during high flow periods at Valley View Pump Station, both pumps are required to operate which exceeds the firm capacity of the pump station. If one of the pumps were out of service, the pump station could not keep up with existing peak hour flows. Based on this, it is recommended that the pumps be replaced with higher capacity pumps or improvements should be considered to increase the capacity of the station. It should be noted that until the pumps are upsized, the County has an adequate contingency plan in the event a pump fails. The contingency plan includes the ownership of a spare pump and a diesel backup pump to allow for bypass pumping which reduces the priority of upsizing the pumps.

Based on daily flow SCADA data provided by Goochland County, the maximum day flow rate through the Valley View Pump Station was approximately 230,000 GPD (~160 gpm). Peak hour flow data was not available but for planning purposes it is assumed that the peak hour flow rate is approximately 240 gpm. It is recommended that the peak hour flow rate be verified prior to replacing the pumps.

A developer-funded project is currently underway to increase the forcemain size from 4-inch to 6-inch. This will increase the capacity of Valley View PS from approximately 145 gpm to 210 gpm.

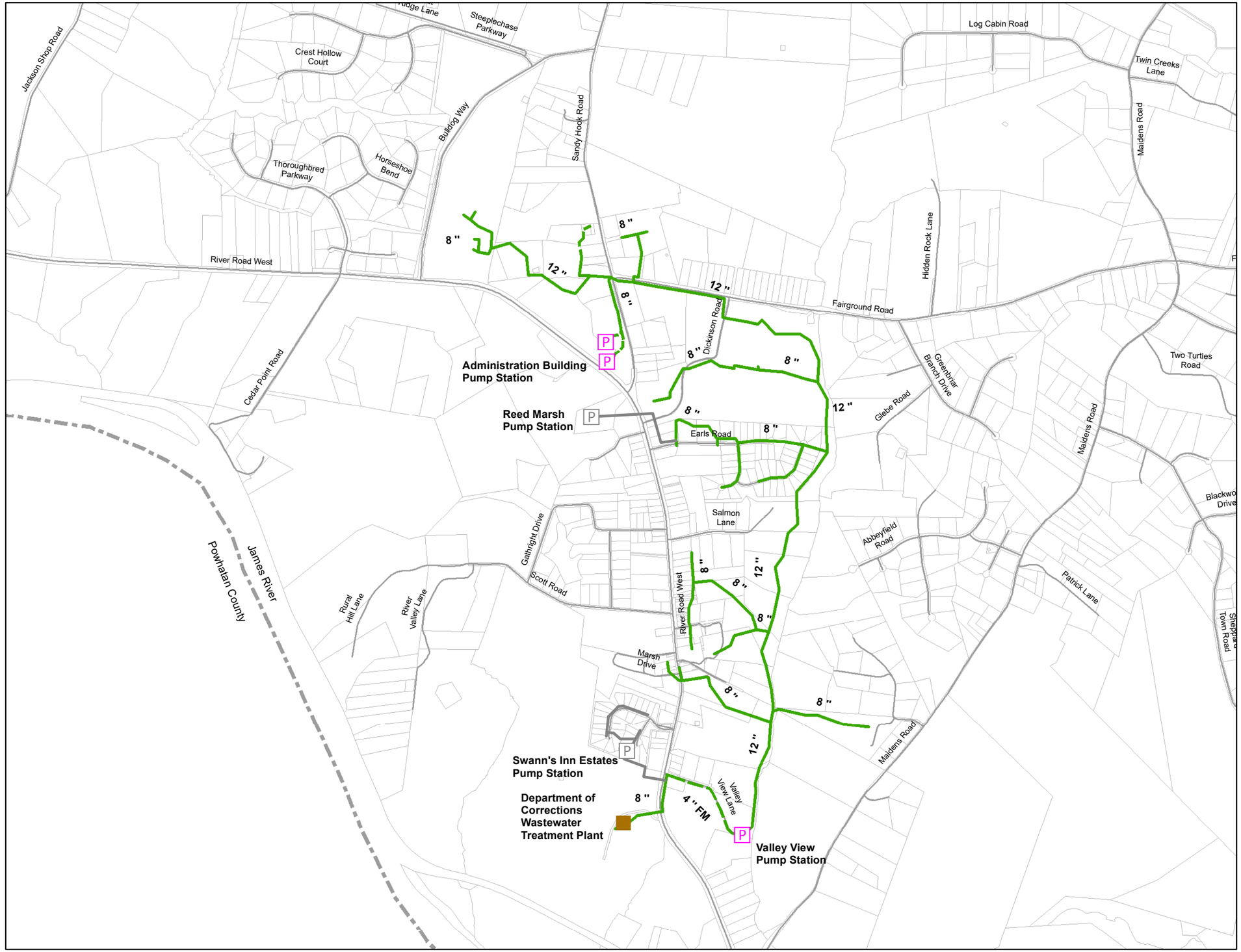
By 2025, a third pump will have to be installed at the Valley View Pump Station to meet projected flows. Assuming that Goochland County continues to send wastewater to VDOC, it is anticipated that the main interceptor along River Road West leading to the VCCW WWTP should be upsized to 18-inch diameter piping by 2025.

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

8.3.2 Eastern Goochland Service Area

As shown on **Figure 8-2**, the existing system currently has adequate capacity. Based on the analysis of the existing wastewater collection system, the existing system has capacity for projected sewer flow rates until about 2035. Anticipated upgrades include installing parallel interceptors along the tuckahoe creek interceptor.

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



N
W E
S

Legend

- Gravity Main
- Force Main
- Under Construction
- Pump Station
- Discharge Location

d/D Ratio

- Less than 50%
- 50 to 80%
- Greater than 80%

Key Plan

FIGURE NO. 8-1

TITLE COURTHOUSE AREA EXISTING WASTEWATER SYSTEM

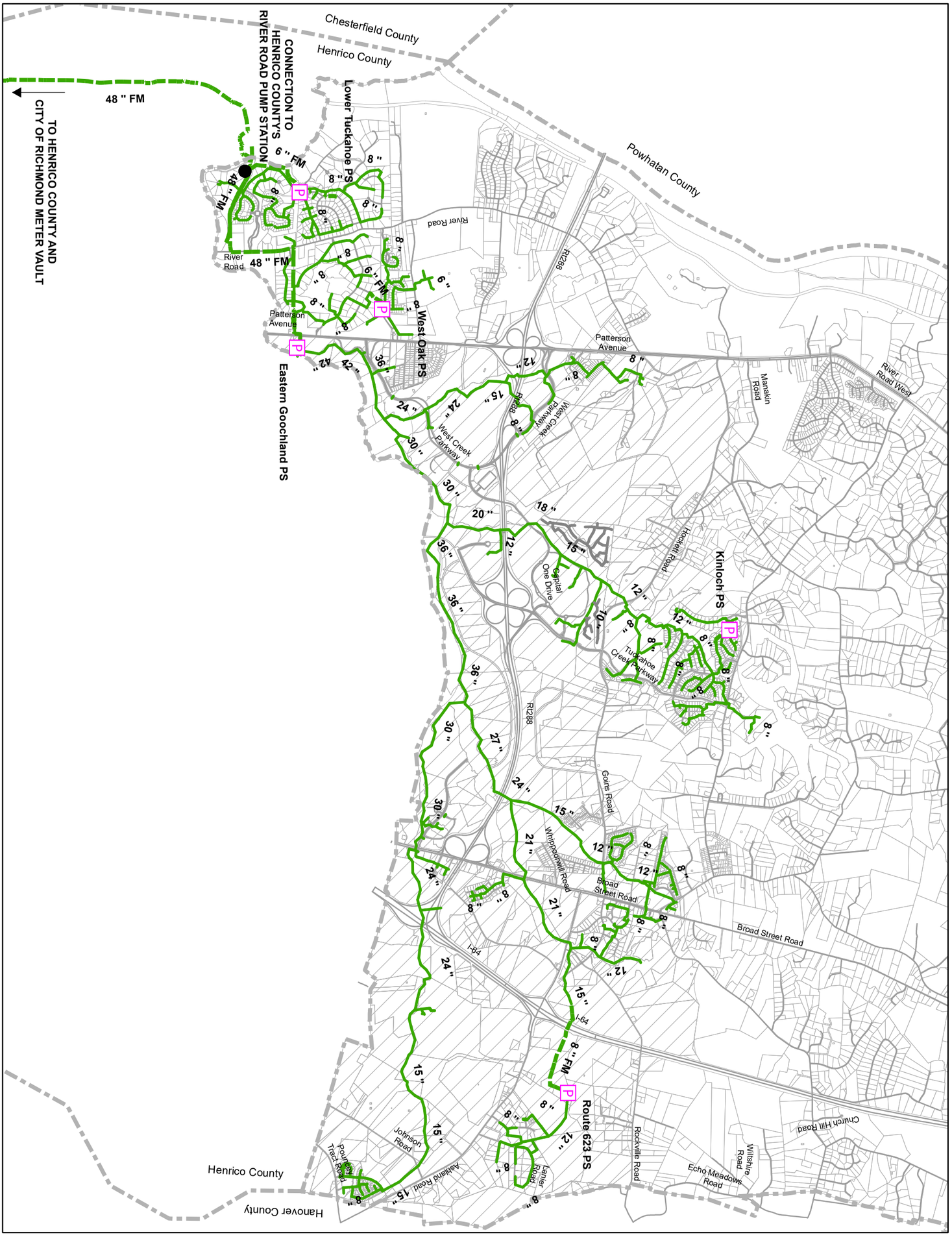
SCALE 1 inch = 1,500 feet

PROJECT UTILITY MASTER PLAN UPDATE GOOCHLAND COUNTY, VA

DATE 05/2020

PROJ. NO. 50109629

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928



Key Plan

Legend

- P Pump Station
- Gravity Main
- Under Construction
- Existing TCSD

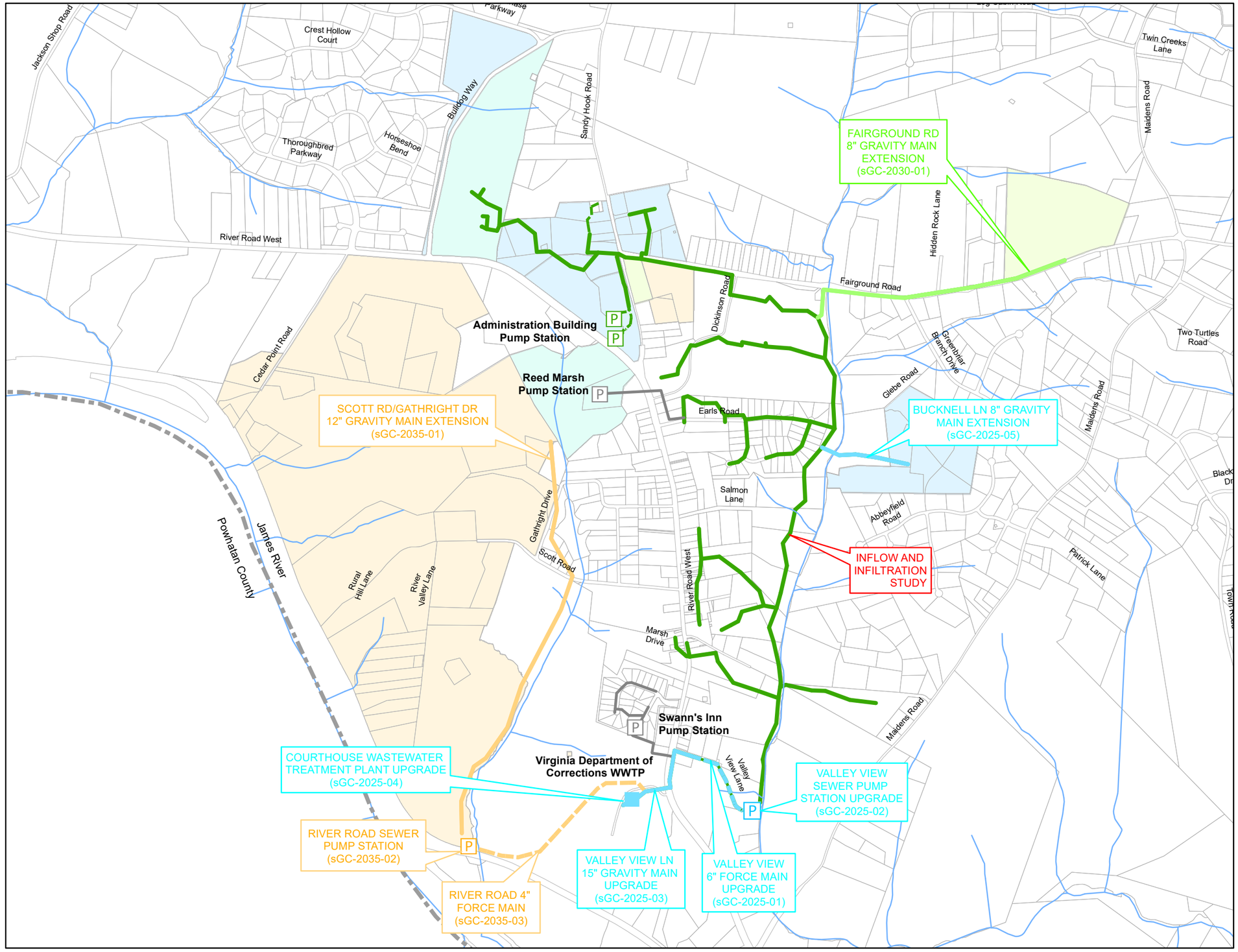
d/D Ratio

- Less than 50%
- 50 to 80%
- Greater than 80%

S E W N

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 4,500 feet	EASTERN GOOCHLAND AREA EXISTING WASTEWATER SYSTEM	8-2
PROJ. NO. 50109629	PROJECT	UTILITY MASTER PLAN UPDATE GOOCHLAND COUNTY, VA	



N

W E

S

Legend

- Existing Pump Station
- County Boundaries
- Under Construction
- Existing TSCD
- Streams
- 2020 Gravity Main
- 2025 Gravity Main
- 2030 Gravity Main
- 2035 Gravity Main
- 2045 Gravity Main

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan

FIGURE NO. 8-3

TITLE COURTHOUSE AREA FUTURE SEWER IMPROVEMENTS

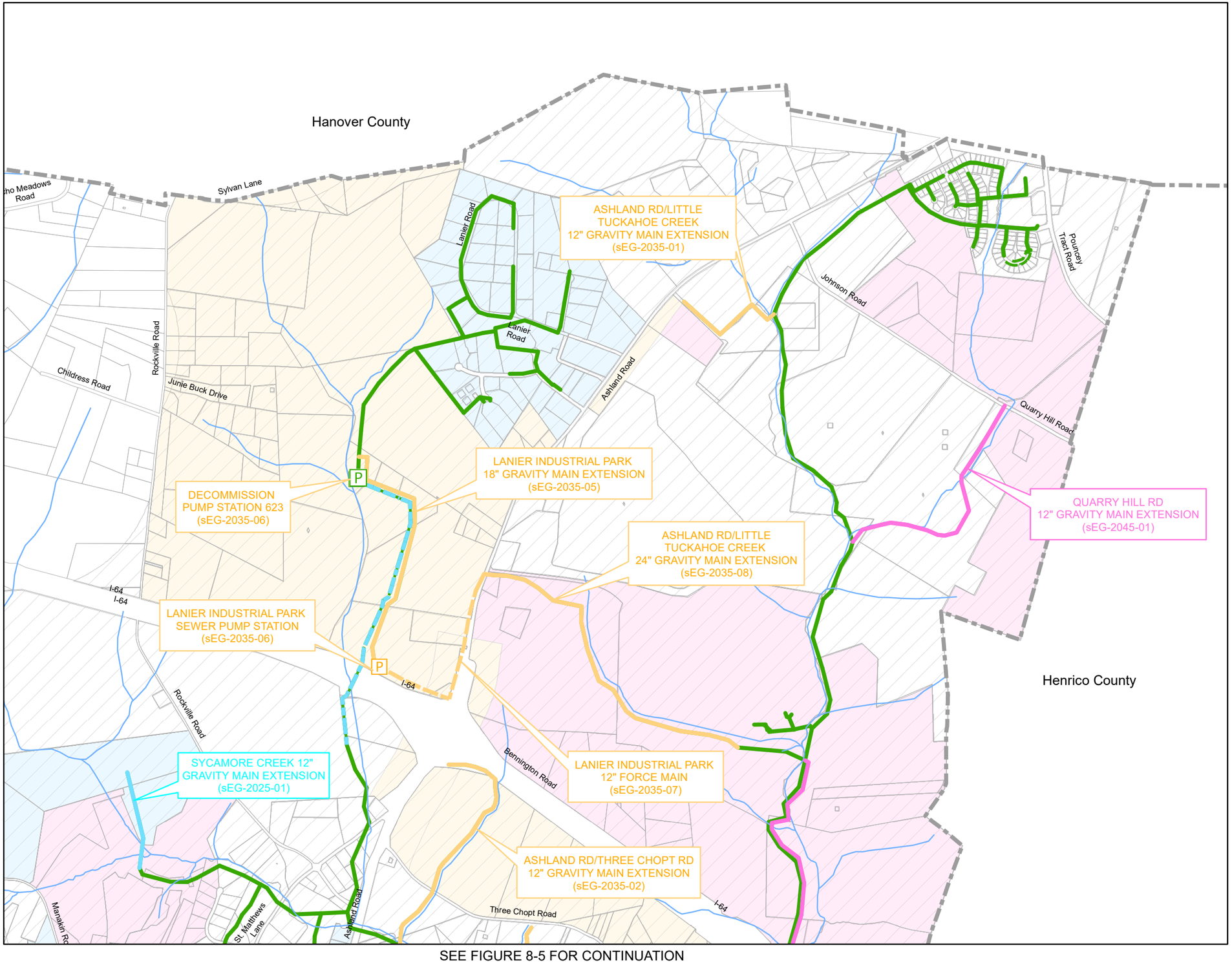
SCALE 1 inch = 1,500 feet

PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA

DATE 05/2020

PROJ. NO. 50109629

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928



SEE FIGURE 8-5 FOR CONTINUATION

N
W E
S

Legend

- Existing Pump Station
- County Boundaries
- Under Construction
- Existing TSCD
- Streams
- 2020 Gravity Main
- 2025 Gravity Main
- 2030 Gravity Main
- 2035 Gravity Main
- 2045 Gravity Main

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan

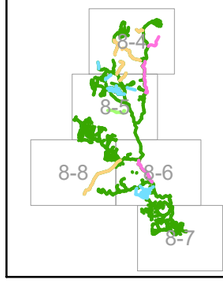


FIGURE NO. 8-4

TITLE EASTERN GOOCHLAND AREA FUTURE SEWER IMPROVEMENTS

SCALE 1 inch = 1,500 feet

PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA

DATE 05/2020

PROJ. NO. 50109629

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

SEE FIGURE 8-4 FOR CONTINUATION

PLAZA DRIVE SEWER SERVICE (sEG-2025-05)

BIGGS DRIVE SEWER SERVICE (sEG-2025-07)

THREE CHOPT RD 12" GRAVITY MAIN EXTENSION (sEG-2035-03)

TUCKAHOE CREEK/ I-64 PARALLEL 24" GRAVITY INTERCEPTOR (sEG-2045-03)

BROAD STREET/RT 288 SEWER SERVICE (sEG-2025-07)

RT. 288 8" FORCE MAIN (sEG-2030-02)

PAULA LN GRAVITY SEWER EXTENSION (sEG-2030-03)

HOCKETT RD SEWER PUMP STATION (sEG-2030-01)

Broad Street Road
Plaza Drive
Forrest Meadow Lane
Oak Grove Drive
Whippoorwill Road
Centerville Parke Lane
Pond View Lane
Hocket Road
Rt288
WILKES RIDGE PKWY
Gaines Thrifty Lane
Hermitage Road
Lucille Lane
Hockett Road
Hamlet Road
Tuckahoe Creek Parkway
Wellfield Road
Knitoch Road
P

Henrico County

N
W E
S

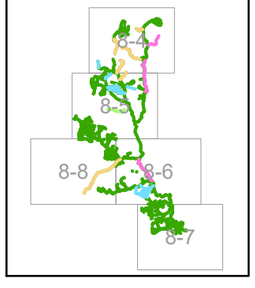
Legend

- P Existing Pump Station
- County Boundaries
- Under Construction
- Existing TSCD
- Streams
- 2020 Gravity Main
- 2025 Gravity Main
- 2030 Gravity Main
- 2035 Gravity Main
- 2045 Gravity Main

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan



SEE FIGURE 8-6 FOR CONTINUATION

FIGURE NO. 8-5

TITLE EASTERN GOOCHLAND AREA FUTURE SEWER IMPROVEMENTS

PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA

SCALE 1 inch = 1,500 feet

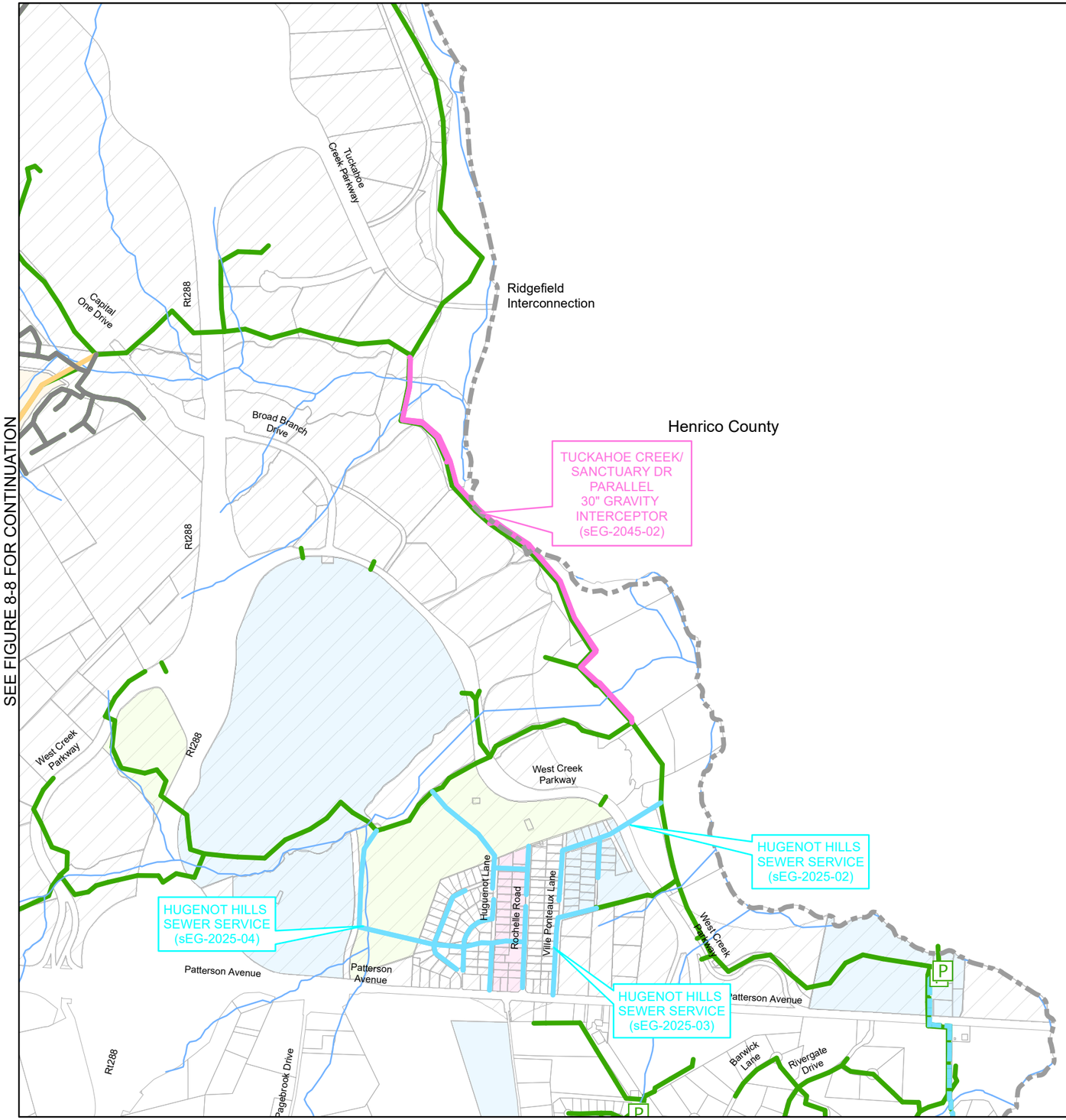
DATE 05/2020

PROJ. NO. 50109629

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

SEE FIGURE 8-5 FOR CONTINUATION

SEE FIGURE 8-8 FOR CONTINUATION



SEE FIGURE 8-7 FOR CONTINUATION

N
W E
S

Legend

- P Existing Pump Station
- County Boundaries
- Under Construction
- Existing TSCD
- Streams
- 2020 Gravity Main
- 2025 Gravity Main
- 2030 Gravity Main
- 2035 Gravity Main
- 2045 Gravity Main

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan

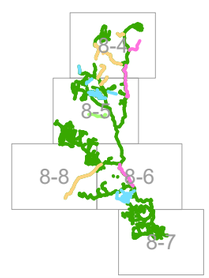


FIGURE NO. 8-6

TITLE EASTERN GOOCHLAND AREA FUTURE SEWER IMPROVEMENTS

SCALE 1 inch = 1,500 feet

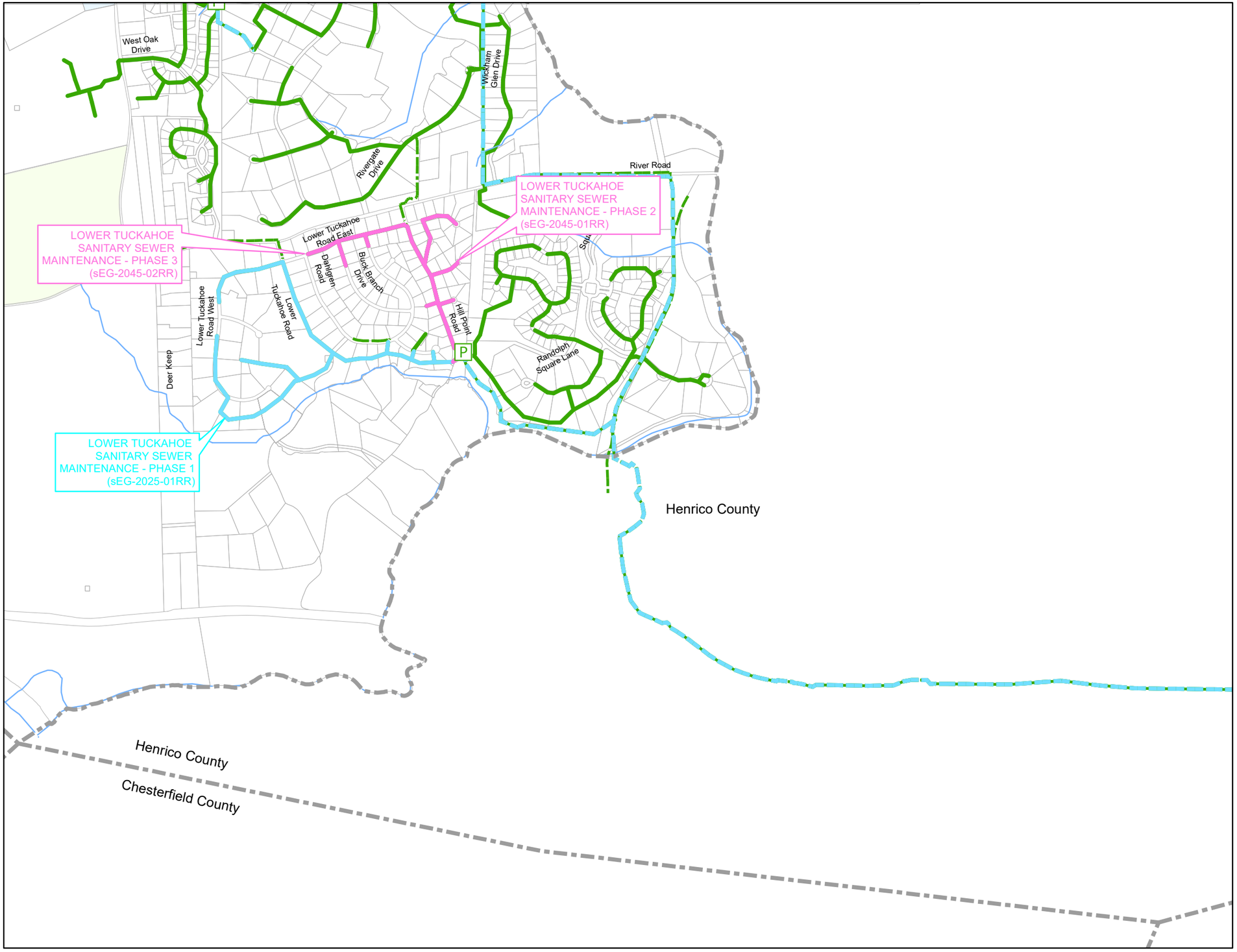
PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA

DATE 05/2020

PROJ. NO. 50109629

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

SEE FIGURE 8-6 FOR CONTINUATION



N
W E
S

Legend

- Existing Pump Station
- County Boundaries
- Under Construction
- Existing TSCD
- Streams
- 2020 Gravity Main
- 2025 Gravity Main
- 2030 Gravity Main
- 2035 Gravity Main
- 2045 Gravity Main

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan

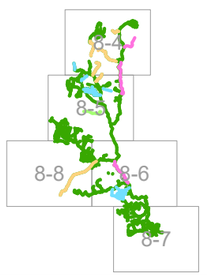


FIGURE NO. 8-7

TITLE EASTERN GOOCHLAND AREA FUTURE SEWER IMPROVEMENTS

UTILITY MASTER PLAN
GOOCHLAND COUNTY, VA

SCALE 1 inch = 1,500 feet

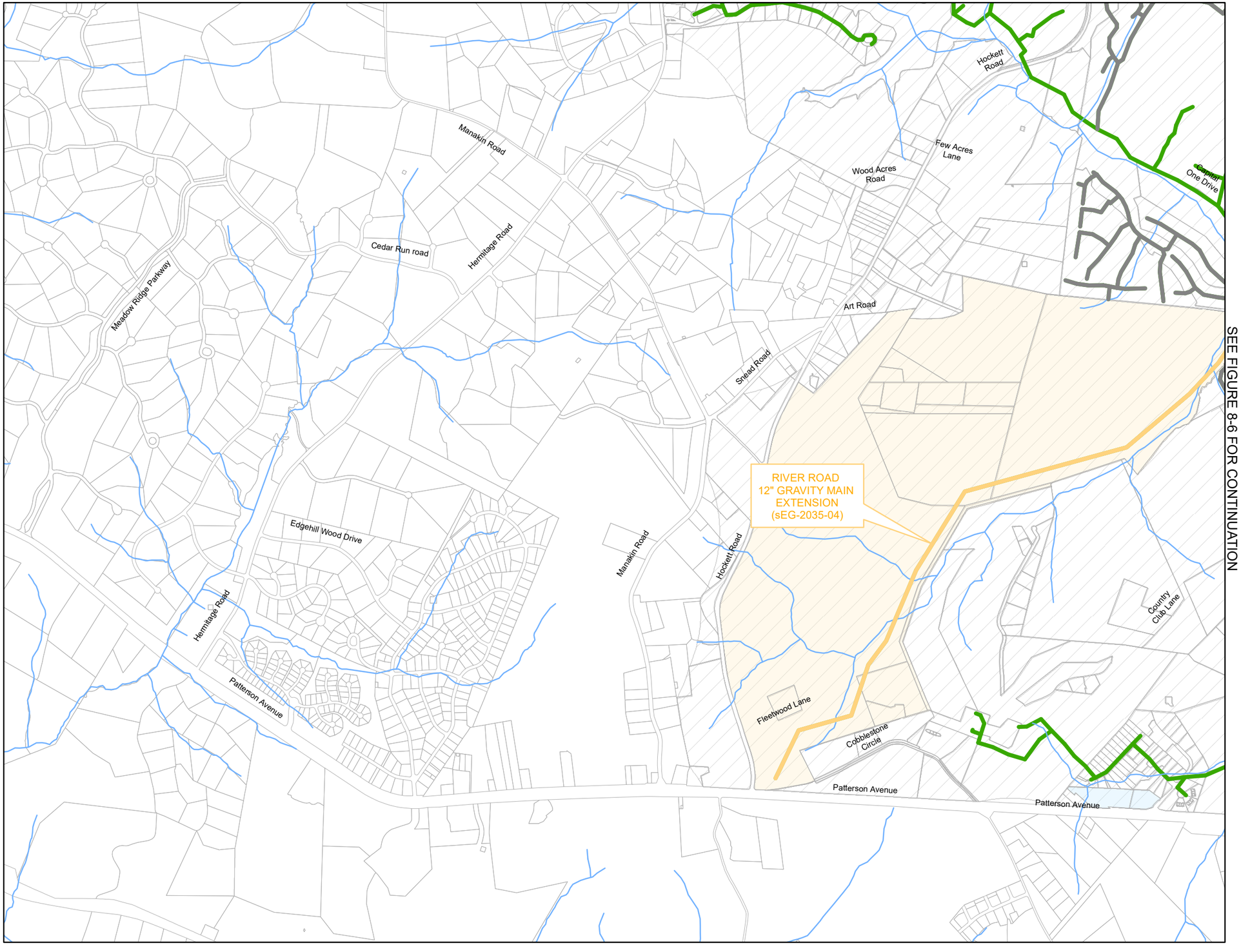
PROJECT

DATE 05/2020

PROJ. NO. 50109629

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

SEE FIGURE 8-5 FOR CONTINUATION



SEE FIGURE 8-6 FOR CONTINUATION

N
W E
S

Legend

- Existing Pump Station
- County Boundaries
- Under Construction
- Existing TSCD
- Streams
- 2020 Gravity Main
- 2025 Gravity Main
- 2030 Gravity Main
- 2035 Gravity Main
- 2045 Gravity Main

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan

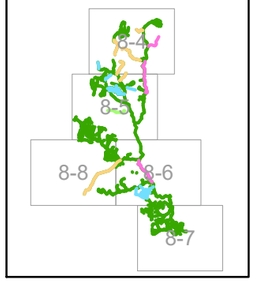


FIGURE NO. 8-8

TITLE EASTERN GOOCHLAND AREA FUTURE SEWER IMPROVEMENTS

UTILITY MASTER PLAN
GOOCHLAND COUNTY, VA

SCALE 1 inch = 1,500 feet

PROJECT

DATE 05/2020

PROJ. NO. 50109629

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

Goochland Courthouse Service Area
See Figure 8-3

sGC-2025-001: Valley View Force Main Upgrade
This project would consist of the following improvements:
1. Replace approximately 1,400 LF of 4-inch existing force main with 6-inch diameter piping.

Project is planned for completion by 2025.

sGC-2025-002: Valley View Pump Station – Pump Station Upgrade
This project would consist of the following improvements:
1. Construct new wetwell and valve vault sized for 0.5 MGD
2. Upsize pumps for 0.5 MGD
3. Ensure there is enough room to add a third pump in the future

Project is planned for completion by 2025.

sGC-2025-003: Valley View Ln Gravity Main Upgrade
This project would consist of the following improvements:
1. Upsize approximately 1,500 LF of 6-inch existing gravity main to 15-inch gravity main.

Project is planned for completion by 2025.

sGC-2025-004: Courthouse Wastewater Treatment Plant Upgrade
This project would consist of the following improvements:
1. Upgrade the existing Courthouse WWTP to a capacity of 4 MGD to accommodate the projected flows for the area.

Project is planned for completion by 2025.

sGC-2025-005: Bucknell Lane Gravity Main Extension
This project would consist of the following improvements:
1. Construction of approximately 1,400 LF of 8-inch gravity main west towards Bucknell Lane from the main Courthouse gravity interceptor.

Project is planned for completion by 2025.

sGC-2030-01: Fairground Road Gravity Main Extension
This project would consist of the following improvements:
1. Construction of approximately 4,300 LF of 8-inch gravity sewer east along Fairground Road.

Project is planned for completion by 2030.

sGC-2035-01: Scott Road/Gathright Dr Gravity Main Extension
This project would consist of the following improvements:
1. Construction of approximately 6,600 LF of 12-inch gravity sewer from the intersection of Gathright Drive and Scott Road down to River Road in order to serve the western area of Courthouse.

Project is planned for completion by 2035.

sGC-2035-02: River Road Sewer Pump Station:

This project would consist of the following improvements:

1. Construction of a 0.3 MGD pump station to serve the western Courthouse service area. This pump station would collect wastewater from the proposed Scott Road/Gathright Drive gravity main and transport it via the proposed River Road force main to the VDOC Wastewater Treatment Plant.

Project is planned for completion by 2035.

sGC-2035-03: River Road Force Main:

This project would consist of the following improvements:

1. Construction of a 4" force main from the proposed River Road pump station connecting to the 12" gravity main that outfalls in the VDOC Wastewater Treatment Plant – approximately 3,300 LF.

Project is planned for completion by 2035.

Eastern Goochland Service Area
See Figures 8-4 through 8-8

sEG-2025-01: Sycamore Creek Gravity Main Extension

This project would consist of the following improvements:

1. Construction of approximately 1,500 LF of 12-inch gravity sewer extending north from the existing St. Matthew's Lane gravity main.

Project is planned for completion by 2025.

sEG-2025-02: Huguenot Hills Sewer Service

This project would consist of the following improvements:

1. Construction of approximately 12,100 LF of 8-inch gravity sewer within the existing Huguenot Hills neighborhood.

Project is planned for completion by 2025.

sEG-2025-03: Huguenot Hills Sewer Service

This project would consist of the following improvements:

1. Construction of approximately 2,300 LF of 12-inch gravity sewer within the existing Huguenot Hills neighborhood.

Project is planned for completion by 2025.

sEG-2025-04: Huguenot Hills Sewer Service

This project would consist of the following improvements:

1. Construction of approximately 6,400 LF of 15-inch gravity sewer within the existing Huguenot Hills neighborhood.

Project is planned for completion by 2025.

sEG-2025-05: Plaza Drive Sewer Service

This project would consist of the following improvements:

1. Construction of approximately 1,400 LF of 8-inch gravity sewer extending southwest along Plaza Drive.

Project is planned for completion by 2025.

sEG-2025-06: Biggs Drive Sewer Service

This project would consist of the following improvements:

1. Construction of approximately 600 LF of 8-inch gravity sewer extending north along Biggs Drive.

Project is planned for completion by 2025.

sEG-2025-07: Broad Street/Rt. 288 Sewer Service

This project would consist of the following improvements:

1. Construction of approximately 1,800 LF of 8-inch gravity sewer extending east along Broad Street Road.

Project is planned for completion by 2025.

sEG-2030-01: Hockett Road Pump Station

This project would consist of the following improvements: Construction of a 1 MGD sewer pump station serving the region between Hockett Road and Route 288. This sewer pump station will convey flow to the 24-inch gravity sewer just north of Route 288.

Project is planned for completion by 2030.

sEG-2030-02: Route 288 Force Main

This project would consist of the following improvements:

1. Construction of an 8" force main from the proposed Hockett Road Pump Station, north along the Rt. 288 corridor to outfall in the existing 24" gravity sewer before it crosses Rt. 288 – approximately 1,700 LF.

Project is planned for completion by 2030.

sEG-2030-03: Paula Lane Gravity Sewer Extension

This project would consist of the following improvements:

1. Construction of a 12" gravity main from Hockett Road east to the Rt. 288 corridor, terminating at the proposed Hockett Road Pump Station – approximately 4,100 LF.

Project is planned for completion by 2030.

sEG-2035-01: Ashland Road/Little Tuckahoe Creek Gravity Main Extension

This project would consist of the following improvements:

1. Construction of 12-inch gravity sewer from Ashland Road to the existing 15-inch gravity main south of Parkside – approximately 1,900 LF.

Project is planned for completion by 2035.

sEG-2035-02: Ashland/Three Chopt Road Gravity Sewer Extension

This project would consist of the following improvements:

1. Construction of a 12-inch gravity sewer running parallel to Ashland Road, directly south of Interstate 64 and tying in to the existing 21" Tuckahoe Creek gravity sewer – approximately 3,900 linear feet

Project is planned for completion by 2035.

sEG-2035-03: Three Chopt Road Gravity Main Extension

This project would consist of the following improvements

1. Construction of 12-inch gravity sewer running south from Three Chopt Road, parallel to Ashland Road– approximately 2,400 LF.

Project is planned for completion by 2035.

sEG-2035-04: River Road Gravity Main Extension (Sewer Service to Mosaic)
This project would consist of the following improvements:

1. Construction of 12-inch gravity sewer extending from the Mosaic residential area down southeast to River Road West – approximately 11,300 linear feet

Project is planned for completion by 2035.

sEG-2035-05: Lanier Industrial Park Gravity Main Extension
This project would consist of the following improvements:

1. Construction of 18-inch gravity sewer extending from Lanier Industrial Park down to Interstate 64 – approximately 4,000 linear feet.

Project is planned for completion by 2035.

sEG-2035-06: Lanier Industrial Park Pump Station
This project would consist of the following improvements:

1. Construction of a 2 MGD sewer pump station, located directly northwest of the Ashland Road/Interstate 64 interchange.
2. Decommission pump station 623.

Project is planned for completion by 2035.

sEG-2035-07: Lanier Industrial Park Force Main
This project would consist of the following improvements:

1. Construction of 12-inch force main extending from the proposed Lanier Industrial Park pump station north along the Ashland Road corridor – approximately 3,300 linear feet.

Project is planned for completion by 2035.

sEG-2035-08: Ashland Road/Little Tuckahoe Creek Gravity Main Extension
This project would consist of the following improvements:

1. Construction of 24-inch gravity main extending from the proposed Lanier Industrial Park force main east across the TCSD to the existing 24" gravity sewer along Little Tuckahoe Creek – approximately 11,400 LF.

Project is planned for completion by 2035.

sEG-2045-01: Quarry Hill Gravity Main Extension
This project would consist of the following improvements:

1. Construction of 12-inch gravity main running from Quarry Hill Road south to the existing 15" gravity main – approximately 4,000 LF.

Project is planned for completion by 2045.

sEG-2045-02: Tuckahoe Creek/Sanctuary Dr Parallel Gravity Interceptor

This project would consist of the following improvements:

1. Construction of a new 30" gravity main alongside the existing 24" Tuckahoe Creek/Sanctuary Dr gravity main to resolve capacity issues – approximately 6,200 LF.

Project is planned for completion by 2045.

sEG-2045-03: Tuckahoe Creek/I-64 Parallel Gravity Interceptor

This project would consist of the following improvements:

1. Construction of a new 24" gravity main alongside the existing 24" Tuckahoe Creek/I-64 gravity main to resolve capacity issues – approximately 8,300 LF.

Project is planned for completion by 2045.

Chapter 9 Implementation

The implementation plan outlined in this Chapter of the Master Plan 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 provides a summary of the total costs of the CIP projects countywide. **Tables 9-2** and **9-3** outline the projected water and wastewater system improvements by service area, summarizing the following information:

- Name of system improvement.
- Budgetary cost estimate in 2019 dollars because this is the most recent complete fiscal year.
- Year of project completion. For the purpose of this report, projects within the 1-5 year time frame are listed by individual year of completion. Past the near term of 1-5 years, projects are just listed in the range of either 5-10 years, 10-15 years, or 15-20 years. This allows the projects to remain developer driven.

Table 9-1

CIP Project Type	Fiscal Year			
	2020 - 2025	**2025 - 2030**	**2030 - 2035**	**2035 - 2045**
Water	$13,415,000	$21,011,000	$21,415,000	$7,362,000
Wastewater	$13,836,000	$3,615,000	$16,324,000	$7,784,000
Grand Total	**$27,251,000**	**$24,626,000**	**$37,739,000**	**$15,146,000**

Table 9-1 and **Table 9-2** provide a breakdown of the cost estimates per project for the Goochland Courthouse and Eastern Goochland Service Areas, respectively. **Table 9-4** provides a listing of the unit costs used as the basis for developing the construction cost estimates. Bid tab data was aggregated from projects in the Metro-Richmond area that have either been constructed, are currently under construction, or have been bid on in the past 10 years (2010-2020). This bid tab data was adjusted for inflation to 2020 dollars and categorized by project type and the size of the project. A cost per linear foot or per gallon was calculated for each project, and averaged together with other projects of the same size and type. For any unit costs that were missing historical project data, the unit cost was interpolated between available historical data.

Costs for Engineering were assumed to be 15 percent of the total estimated construction cost and no less than 75,000 per project. Additionally, a construction contingency of 35 percent was added for each project. This assumes each project is constructed in one phase, unless otherwise indicated.

Table 9-2 Courthouse Service Area Water and Wastewater CIP Projects

Water Improvement Project			Size (in)	Length (ft)	Fiscal Year							
Project ID	**CIP ID**	**Project Description**			**2021**	**2022**	**2023**	**2024**	**2025**	**2025 - 2030**	**2030 - 2035**	**2035 - 2045**
wGC-2025-01	344	Sandy Hook Rd/Fairground Rd Water Main Extension	12"	1,600					$ 240,000			
wGC-2025-02	338	Middle/High School Water Main Loop	8"	800					$ 126,000			
wGC-2025-03	338	Bridle Rdg Water Main Loop	12"	800					$ 147,000			
wGC-2025-04	338	Thoroughbred Pkwy Water Main Extension	8"	3,300					$ 347,000			
wGC-2025-05	340	J. Sargeant Reynolds Water Main Extension	12"	700				$ 145,000				
wGC-2025-06	342	River Road West Water Main Upgrade	16"	7,300					$ 1,424,000			
wGC-2025-07	346	River Road West BPS							$ 1,645,000			
wGC-2025-08	-	Greenbriar Branch Dr Water Main Extension	12"	2,800					$ 410,000			
wGC-2030-01	-	Fairground Rd Water Main Extension	12"	2,000						$ 300,000		
wGC-2035-01	-	Bulldog Way Water Main Extension	12"	2,700							$ 405,000	
wGC-2035-02	-	Scott Road Water Main Extension	12"	11,200							$ 1,680,000	
		Courthouse Service Area Water Improvements Subtotal			**$ -**	**$ -**	**$ -**	**$ 145,000**	**$ 4,339,000**	**$ 300,000**	**$ 2,085,000**	**$ -**
Wastewater Improvement Project			**Size (in)**	**Length (ft)**	**Fiscal Year**							
Project ID	**CIP ID**	**Project Description**			**2021**	**2022**	**2023**	**2024**	**2025**	**2025 - 2030**	**2030 - 2035**	**2035 - 2045**
sGC-2025-01	454	Valley View Force Main Upgrade	6"	1,400				$ 173,000				
sGC-2025-02	454	Valley View Sewer Pump Station - 0.5 MGD						$ 1,688,000				
sGC-2025-03	456	Valley View Ln Gravity Main Upgrade	15"	1,500			$ 394,000					
sGC-2025-04	458	Courthouse Wastewater Treatment Plant[1]			$ 750,000	$ 6,000,000						
sGC-2025-05	-	Bucknell Ln Gravity Main Extension	8"	1,400					$ 211,000			
sGC-2030-01	-	Fairground Rd Gravity Main Extension	8"	4,300						$ 634,000		
sGC-2035-01	-	Scott Rd/Gathright Dr Gravity Main Extension	12"	6,600							$ 1,467,000	
sGC-2035-02	-	River Road Sewer Pump Station - 0.3 MGD									$ 563,000	
sGC-2035-03	-	River Road Force Main	4"	3,300							$ 207,000	
		Courthouse Service Area Wastewater Improvements Subtotal			**$ 750,000**	**$ 6,000,000**	**$ 394,000**	**$ 1,861,000**	**$ 211,000**	**$ 634,000**	**$ 2,237,000**	**$ -**
		Courthouse Service Area Improvements Grand Total			**$ 750,000**	**$ 6,000,000**	**$ 394,000**	**$ 2,006,000**	**$ 4,550,000**	**$ 934,000**	**$ 4,322,000**	**$ -**

[1] Cost shown to reflect FY20 CIP. Project already in Progress.

Table 9-3 East End Service Area Water and Wastewater CIP Projects

Water Improvement Project			Size (in)	Length (ft)	Fiscal Year							
Project ID	CIP ID	Project Description			2021	2022	2023	2024	2025	2025 - 2030	2030 - 2035	2035 - 2045
wEG-2025-01	352	Lanier Industrial Park Improvements	16"	700					$ 166,000			
wEG-2025-02	-	Rockville Road Water Main Extension	16"	6,300					$ 1,214,000			
wEG-2025-03 (12")	-	Manakin Rd Waterline Extension	12"	4,300					$ 632,000			
wEG-2025-03 (16")	-	Manakin Rd Waterline Extension	16"	2,000					$ 375,000			
wEG-2025-04	416	Saddle Creek Water Main Loop	12"	2,700				$ 401,000				
wEG-2025-05	-	Wilkes Ridge Pkwy Water Main Extension	12"	2,400					$ 355,000			
wEG-2025-06	272	Plaza Drive Water Installation	16"	1,400					$ 254,000			
wEG-2025-07	-	Huguenot Hills Water Service	12"	4,200					$ 623,000			
wEG-2025-08 (12")	-	Blair Rd/Patterson Ave Water Main Extension	12"	1,400					$ 213,000			
wEG-2025-08 (16")	-	Blair Rd/Patterson Ave Water Main Extension	16"	3,800					$ 725,000			
wEG-2025-09	410	Blair Rd Water Main Extension	12"	3,000					$ 449,000			
wEG-2025-10	356	Rivergate Water Main Loop	12"	700					$ 142,000			
wEG-2025-11	358	River Rd Control Valve							$ 300,000			
wEG-2025-12	360	Randolph Square Water Main Upgrade	8"	1,400					$ 167,000			
wEG-2025-13	-	Patterson Ave/Creekmore Rd Water Main Extension	12"	3,000					$ 448,000			
wEG-2030-01	-	Rockville BPS - 3 MGD and Chloramine Booster Station		400						$ 4,933,000		
wEG-2030-02	-	Quarry Hill Rd Water Main	16"	5,500						$ 1,068,000		
wEG-2030-03	-	Ashland Rd Control Valve								$ 300,000		
wEG-2030-04	442	Tuckahoe Creek Pkwy Waterline	24"	4,500						$ 1,343,000		
wEG-2030-05	426	Ridgefield BPS - 7 MGD and Chloramine Booster Station								$ 11,510,000		
wEG-2030-06	-	Ridgefield Control Valve								$ 300,000		
wEG-2030-07	418	Hockett Rd Water Main Extension	16"	6,500						$ 1,257,000		
wEG-2030-08	406	River Road BPS Upgrade - 1.5 MGD							$ 2,467,000			
wEG-2035-01	414	Lanier Industrial Park Elevated Tank									$ 4,950,000	
wEG-2035-02	424	Ashland Rd Water Main Extension	16"	4,600							$ 894,000	
wEG-2035-03	-	Lanier Industrial Park Water Main Extension	16"	13,600							$ 2,635,000	
wEG-2035-04	-	Rockville Rd Control Valve									$ 300,000	
wEG-2035-05	-	Three Chopt Road Water Main Extension	12"	9,100							$ 1,362,000	
wEG-2035-06	420	Centerville BPS Upgrade									$ 75,000	
wEG-2035-07	-	Fleetwood Ln/Mosaic Connection Water Main Extension	12"	9,700							$ 1,453,000	
wEG-2035-08	-	Hockett Rd Water Main Extension	24"	15,800							$ 4,716,000	
wEG-2035-09 (12")	428	Patterson Ave Water Main Extension	12"	1,100							$ 180,000	
wEG-2035-09 (24")	428	Patterson Ave Water Main Extension	24"	3,200							$ 953,000	
wEG-2035-10	408	River Rd High Water Main Extension	12"	10,100							$ 1,512,000	
wEG-2035-11	-	Benedictine PRV									$ 300,000	

Table 9-3 East End Service Area Water and Wastewater CIP Projects

wEG-2045-01	-	West Creek Business Park Water Main Extension	12"	11,700								$ 1,748,000
wEG-2045-02	354	Country Club Lane Water Main Extension	24"	8,100								$ 2,426,000
wEG-2045-03	438	Hockett Rd Elevated Tank										$ 3,188,000
		East End Service Area Water Improvements Subtotal			**$ -**	**$ -**	**$ -**	**$ 401,000**	**$ 8,530,000**	**$ 20,711,000**	**$ 19,330,000**	**$ 7,362,000**

Table 9-3 East End Service Area Water and Wastewater CIP Projects

Wastewater Improvement Project			Size (in)	Length (ft)	Fiscal Year							
Project ID	CIP ID	Project Description			2021	2022	2023	2024	2025	2025 - 2030	2030 - 2035	2035 - 2045
sEG-2025-01	-	Sycamore Creek Gravity Main Extension	12"	1,500					$ 337,000			
sEG-2025-02	266	Hugenot Hills Sewer Service - 8"	8"	12,100		$ 1,813,000						
sEG-2025-03	266	Hugenot Hills Sewer Service - 12"	12"	2,300		$ 511,000						
sEG-2025-04	266	Hugenot Hills Sewer Service - 15"	15"	6,400		$ 2,089,000						
sEG-2025-05*	274	Plaza Drive Sewer Service	8"	1,400					$ 215,000			
sEG-2025-06*	276	Biggs Drive Sewer Service	8"	600					$ 135,000			
sEG-2025-07*	280	Broad Street/Rt. 288 Sewer Service	8"	1,800					$ 270,000			
sEG-2030-01	-	Hockett Rd Sewer Pump Station - 1 MGD								$ 1,875,000		
sEG-2030-02	-	Rt. 288 Force Main	8"	1,700						$ 188,000		
sEG-2030-03	-	Hockett Rd/Paula Ln Gravity Sewer Extension	12"	4,100						$ 918,000		
sEG-2035-01	-	Ashland Rd/Little Tuckahoe Creek Gravity Main Extension	12"	1,900							$ 422,000	
sEG-2035-02	-	Ashland Rd/Three Chopt Rd Gravity Sewer Extension	12"	3,900							$ 868,000	
sEG-2035-03	-	Three Chopt Rd Gravity Main Extension	12"	2,400							$ 528,000	
sEG-2035-04	-	River Road Gravity Main Extension (Sewer Service to Mosaic)	12"	11,300							$ 2,531,000	
sEG-2035-05	-	Lanier Industrial Park Gravity Main Extension	18"	4,000							$ 1,306,000	
sEG-2035-06	-	Lanier Industrial Park Sewer Pump Station - 2 MGD									$ 3,000,000	
sEG-2035-07	-	Lanier Industrial Park Force Main	12"	3,300							$ 495,000	
sEG-2035-08	-	Ashland Rd/Little Tuckahoe Creek Gravity Main Extension	24"	11,400							$ 4,937,000	
sEG-2045-01	-	Quarry Hill Rd Gravity Main Extension	12"	4,000								$ 882,000
sEG-2045-02	462	Tuckahoe Creek/Sanctuary Dr Interceptor Upgrade	30"	6,200								$ 3,333,000
sEG-2045-03	-	Tuckahoe Creek/I-64 Parallel Gravity Interceptor	24"	8,300								$ 3,569,000
		East End Service Area Wastewater Improvements Subtotal			**$ -**	**$ 4,413,000**	**$ -**	**$ -**	**$ 957,000**	**$ 2,981,000**	**$ 14,087,000**	**$ 7,784,000**
		East End Service Area Improvements Grand Total			**$ -**	**$ 4,413,000**	**$ -**	**$ 401,000**	**$ 9,487,000**	**$ 23,692,000**	**$ 33,417,000**	**$ 15,146,000**

Table 9-4 Units Costs

Size (in)	Water/Sewer Facility	Adjusted Unit Prices / LF	Sewer Replacement
6	6" Gravity Sewer	$ 80	$ 160
8	8" Gravity Sewer	$ 100	$ 200
10	10" Gravity Sewer	$ 120	$ 240
12	12" Gravity Sewer	$ 150	$ 300
15	15" Gravity Sewer	$ 180	$ 360
18	18" Gravity Sewer	$ 220	$ 440
24	24" Gravity Sewer	$ 290	$ 580
27	27" Gravity Sewer	$ 330	$ 660
30	30" Gravity Sewer	$ 360	$ 720
36	36" Gravity Sewer	$ 440	$ 880
42	42" Gravity Sewer	$ 510	$ 1,020
48	48" Gravity Sewer	$ 580	$ 1,160
4	4" Force Main	$ 40	-
6	6" Force Main	$ 50	-
8	8" Force Main	$ 70	-
10	10" Force Main	$ 80	-
12	12" Force Main	$ 100	-
14	14" Force Main	$ 120	-
16	16" Force Main	$ 130	-
18	18" Force Main	$ 150	-
24	24" Force Main	$ 200	-
30	30" Force Main	$ 240	-
36	36" Force Main	$ 290	-
42	42" Force Main	$ 340	-
4	4" Water Main	$ 40	-
6	6" Water Main	$ 50	-
8	8" Water Main	$ 70	-
10	10" Water Main	$ 85	-
12	12" Water Main	$ 100	-
16	16" Water Main	$ 130	-
20	20" Water Main	$ 160	-
24	24" Water Main	$ 200	-
30	30" Water Main	$ 240	-
36	36" Water Main	$ 290	-

Water/Sewer Facility	Facilties Unit Price / gal
Elevated Water Storage Tank (below 1 MG)	$ 4.25
Elevated Water Storage Tank (1 MG and above)	$ 3.00
Water Booster Station (below 1 MGD)	$ 1.20
Water Booster Station (1 MGD and above)	$ 1.10
Sewer Pump Station (2 MGD and below)	$ 1.25
Sewer Pump Station (2 MGD - 5 MGD)	$ 1.00
Sewer Pump Station (5 MGD and above)	$ 0.75
Surface Water Treatment Plant (5 MGD and above)	$ 3.10
Wastewater Treatment Plant (10 MGD - 20 MGD)	$ 2.00
PRV Facility	$200,000

Chapter 10 Renewal and Replacement Improvements

This chapter of the Master Plan provides an overview of renewal and replacement (R&R) projects that are proposed to maintain water and wastewater service within the County's Water and Sewer Service Areas through the Year 2045.

10.1 General

The projects identified in this chapter are meant to establish a proactive approach to prevent unplanned interruptions to service. Similar to capital improvements, renewal and replacement projects were identified for each time period in the planning horizon. These projects are not dependent upon development, but are recommended as part of the ongoing operation and maintenance program and to serve as a budgeting tool to continue to meet the customers' needs. The following sections describe how the projects were identified.

10.2 Project Identification

Renewal and replacement projects identified are based on a desktop review of available GIS data and record drawings. Approximate year of installation was used to forecast when rehabilitation or replacement for the identified assets should be considered. Horizontal water and wastewater assets, such as water mains, sanitary interceptors, and forcemains, were assumed to be replaced after reaching their 60-year service anniversary. The areas identified were validated through coordination with DPU and confirmed to be areas of concern with a higher number of work orders than other parts of the system. These projects are summarized below.

10.3 Water Renewal and Replacement Projects

This section provides a summary of both water systems within the County with respect to age and identifies water replacement projects through the planning period. Budgetary cost estimates are found in Table 10-1 and 10-2 and were developed assuming replacement of the existing watermains.

10.3.1 Goochland Courthouse Service Area

Based on the available data, the earliest year of install for water mains currently in service was found to be 1987. Water line material was generally found to be ductile iron and PVC. Projects were identified as potential replacement projects included portions along Scott Road, Gathright Drive, and Pitts Drive. These improvements were identified as a single project for budgeting purposes which is shown on Figure 7-7.

10.3.2 Eastern Goochland Service Area

The earliest year of installation for water mains currently in service was found to be 1960 based on the GIS data and record drawings. Water line material was generally found to be ductile iron and PVC. Projects that were identified as potential replacement projects included certain water mains in the Lower Tuckahoe subdivision. These improvements were identified as a single project per time period which is shown on Figure 7-11.

10.4 Wastewater Renewal and Replacement Projects

This section provides a summary of both wastewater systems in the County with respect to age, and identifies Wastewater renewal and replacement projects through the planning period. Budgetary cost estimates are found in Table 10-3 and 10-4 and include an anticipated range of costs intended to capture either a renewal (or rehabilitation) or replacement option, respectively.

10.4.1 Goochland Courthouse Service Area

The earliest year of installation for sewer mains currently in service was found to be 1998 based on the GIS data and record drawings. Collection system pipe material was generally found to be ductile iron and PVC. Several sections of the system consist of concrete or unspecified mains. No projects were identified as potential replacement projects during this planning period; however, it is recommended to complete an inflow and infiltration study. Section 10.5 provides an overview of how this data can be utilized to help identify future R&R projects.

10.4.2 Eastern Goochland Service Area

The earliest year of install for sewer mains currently in service was found to be 1965 based on the GIS data and record drawings. Collection system pipe material was generally found to be ductile iron and PVC. Several sections of the system consist of concrete pipe or pipe of unspecified material. Projects that were identified as potential replacement projects included portions of gravity sewer in the Lower Tuckahoe subdivision. Additionally, it is recommended to complete an inflow and infiltration study within the Lower Tuckahoe subdivision in the near term. Section 10.5 provides an overview of how this data can be utilized to help identify future R&R projects. These improvements were identified as a single project and is shown on Figure 8-7.

10.5 Asset Management Program

These improvements are intended to guide the County through the planning period with a proactive and balanced approach to combat aging infrastructure. In order to evaluate each renew and replacement project in greater detail, more data collection and analysis is needed. The County has implemented an asset management program, utilizing software by Beehive Industries, which allows the County to build an asset inventory, log work orders, identify problem areas, and improves overall data quality.

As the County continues to utilize this program, the data collected can be used to aid in the phasing and prioritization of renewal and replacement projects, and identification of additional projects. It is recommended that the County continue to populate the data base with known information and implement policies and procedures where staff routinely updates the GIS data using field observations. This data can be collected when addressing work orders, new construction, or explorative activities.

As previously mentioned, inflow and infiltration (I&I) studies are recommended for portions of the gravity sewer systems in both the Goochland Courthouse and Eastern Goochland wastewater systems. A typical I&I study includes flow monitoring, smoke testing, and closed-circuit television (CCTV) inspections of gravity sewer lines and manholes. Results from the CCTV inspections can be incorporated into the County's asset management software to assist DPU in prioritizing future R&R projects.

The National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) condition grading system should be used to standardize the coding of defects and observations identified during CCTV inspection. Prioritization methodology can then be developed to rank each sewer segment incorporating the Likelihood of Failure (LoF), Consequence of Failure (COF) and associated Risk Factors. This will provide the County with the information needed to develop a targeted and cost-effective approach to address aging infrastructure.

Collecting and utilizing this data will allow the County will be able to fully implement an Asset Management Plan and Business Risk Model to prioritize R&R projects in the near future.

Goochland Courthouse Service Area – Water Replacement Projects

See Figure 7-7

wGC-2045-01RR: Gathright Drive/Scott Road 8" Waterline Replacement
This project would consist of the following improvements:

1. Replacement of existing water main with a new 8" waterline extending along Scott Road, Gathright Drive, and Pitts Drive - approximately 4,800 LF.

Project is planned for completion in 2045.

Eastern Goochland Service Area – Water Replacement Projects
See Figure 7-11

wEG-2025-01RR: Lower Tuckahoe Road West 8" Waterline Replacement
This project would consist of the following improvements:

1. Replacement of existing water main with a new 8" waterline in the Lower Tuckahoe subdivision - approximately 4,200 LF

Project is planned for completion in 2025.

wEG-2035-01: River Road 8" Waterline Replacement
This project would consist of the following improvements:

1. Replacement of existing water main with a new 8" waterline extending along River Road from the interconnection with Henrico County to the Lower Tuckahoe subdivision - approximately 7,700 LF

Project is planned for completion in 2035.

wEG-2045-01: Lower Tuckahoe Road East Waterline Replacement
This project would consist of the following improvements:

1. Replacement of existing water main with a new 8" waterline extending in the Lower Tuckahoe subdivision - approximately 11,200 LF

Project is planned for completion in 2045.

Eastern Goochland Service Area – Wastewater Renewal and Replacement Projects
See Figure 8-7

sGC-2025-01RR: Lower Tuckahoe Sanitary Sewer Maintenance – Phase 1
This project would consist of the following improvements:

1. Rehabilitation or replacement of 8" sanitary sewer serving the Lower Tuckahoe Subdivision – approximately 9,800 LF.

Project is planned for completion in 2025.

sGC-2045-01RR: Lower Tuckahoe Sanitary Sewer Maintenance – Phase 2

This project would consist of the following improvements:

1. Rehabilitation or replacement of 8" sanitary sewer serving the Lower Tuckahoe Subdivision – approximately 4,600 LF.

Project is planned for completion in 2045.

sGC-2045-02RR: Lower Tuckahoe Sanitary Sewer Maintenance – Phase 3

This project would consist of the following improvements:

1. Rehabilitation or replacement of 8" and 10" sanitary sewer serving the Lower Tuckahoe Subdivision – approximately 2,300 LF.

Project is planned for completion in 2045.

Table 10-1 Courthouse Service Area Water R&R Projects

Water Improvement Project			Size (in)	Length (ft)	Fiscal Year			
Project ID	CIP ID	Project Description			2020 - 2025	2025 - 2030	2030 - 2035	2035 - 2045
wGC-2045-01RR	-	Garthright Rd/Scott Dr 8" Waterline Replacement	8	4,800				$ 504,000
		Courthouse Service Area Water Improvements Total			**$ -**	**$ -**	**$ -**	**$ 504,000**

Table 10-2 East End Service Area Water R&R Projects

Water Improvement Project			Size (in)	Length (ft)	Fiscal Year			
Project ID	CIP ID	Project Description			2020 - 2025	2025 - 2030	2030 - 2035	2035 - 2045
wEG-2025-01RR	360	Lower Tuckahoe Rd West 8" Waterline Replacement	8	4,200	$ 441,000			
wEG-2035-01RR	362	River Rd 8" Waterline Replacement	8	7,700			$ 809,000	
wEG-2045-01RR	360	Lower Tuckahoe Rd East 8" Waterline Replacement	8	11,200				$ 1,176,000
		East End Service Area Water Improvements Subtotal			**$ 441,000**	**$ -**	**$ 809,000**	**$ 1,176,000**

Table 10-3 East End Service Area Sewer Rehabilitation Projects

Wastewater Improvement Project			Size (in)	Length (ft)	Fiscal Year			
Project ID	**CIP ID**	**Project Description**			**2020 - 2025**	**2025 - 2030**	**2030 - 2035**	**2035 - 2045**
sEG-2025-01RR	-	Rehabilitate 8" Gravity Sewer	8	9,800	$ 2,473,000			
sEG-2045-01RR	-	Rehabilitate 8" Gravity Sewer	8	4,600				$ 1,153,000
sEG-2045-02RR	-	Rehabilitate 8" and 10" Gravity Sewer	8/10	2,176/38				$ 636,000
		East End Service Area Sewer Rehabilitation Total			**$ 2,473,000**	**$ -**	**$ -**	**$ 1,789,000**

Table 10-4 East End Service Area Sewer Replacement Projects

Wastewater Improvement Project			Size (in)	Length (ft)	Fiscal Year			
Project ID	**CIP ID**	**Project Description**			**2020 - 2025**	**2025 - 2030**	**2030 - 2035**	**2035 - 2045**
sEG-2025-01RR	-	Replace 8" Gravity Sewer	8	9,800	$ 2,918,000			
sEG-2045-01RR	-	Replace 8" Gravity Sewer	8	4,600				$ 1,361,000
sEG-2045-02RR	-	Replace 8" and 10" Gravity Sewer	8/10	2,300				$ 738,000
		East End Service Area Sewer Replacement Total			**$ 2,918,000**	**$ -**	**$ -**	**$ 2,099,000**

APPENDIX A
Future Demand Projections Details

Utility Master Plan
Goochland County, Virginia

Dewberry

Water Demand Projections - Courthouse Service Area

Proposed Residential Demand

Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Units	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1001	49.2	50%	24.6	Low	30		5,352		
1002	49.1	50%	24.6	Low	49	8,742			
1005	824.4	50%	412.2	Low	300			53,520	
1006	45.4	50%	22.7	Low	65	11,596			
1010	26.8	50%	13.4	Low		5,760			
Total Demand						26,098	5,352	53,520	0

Proposed Commercial Demand

Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1003	4.4	50%	2.2	Low		2,198		
1004	14.1	50%	7.1	Low			7,070	
1007	21.5	50%	10.8	Low	10,766			
Total Demand					10,766	2,198	7,070	0

Proposed Office Demand

Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Units	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1008	33.5	50%	16.7	Low		16,740			
1009	30.7	50%	15.4	Low		15,352			
Total Demand						32,092	0	0	0

Sewer Demand Projections - Courthouse Service Area

Proposed Residential Demand

Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Units	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1001	49.2	50%	24.6	Low	30		5,352		
1002	49.1	50%	24.6	Low	49	8,742			
1005	824.4	50%	412.2	Low	300			53,520	
1006	45.4	50%	22.7	Low	65	11,596			
1010	26.8	50%	13.4	Low		5,760			
Total Demand						26,098	5,352	53,520	0

Proposed Commercial Demand

Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1003	4.4	50%	2.2	Low		2,198		
1004	14.1	50%	7.1	Low			7,070	
1007	21.5	50%	10.8	Low	10,766			
Total Demand					10,766	2,198	7,070	0

Proposed Office Demand

Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Units	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1008	33.5	50%	16.7	Low		16,740			
1009	30.7	50%	15.4	Low		15,352			
Total Demand						32,092	0	0	0

Water Demand Projections - East End Service Area

Proposed Residential Demand

Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Units	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1101	157.8	50%	78.9	Medium	303	94,142			
1106	1.0	50%	0.5	Medium	5	1,554			
1107	96.4	50%	48.2	Medium	98	30,449			
1109	163.7	50%	81.8	Medium	1,600		497,120		
1110	76.4	50%	38.2	Medium	120		37,284		
1111	44.7	50%	22.3	Medium	130	40,391			
1113	19.7	50%	9.8	Medium	49	15,224			
1114	224.0	50%	112.0	Medium	300	93,210			
1124	139.2	50%	69.6	Medium	65				20,196
1128 - 1	656.1	50%	328.1	Medium	3,000			466,050	
1128 - 2	656.1	50%	328.1	Medium	3,000				466,050
1131	93.7	50%	46.9	Medium	1450	450,515			
1133	14.9	50%	7.4	Medium	32.0				9,678
Mosaic	-	-	-	Medium	491.0	146,171			
Total Demand						725,485	534,404	466,050	495,923

Water Demand Projections - East End Service Area

Proposed Commercial Demand

Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1102	123.7	50%	61.9	Medium	123,704			
1103	198.4	50%	99.2	Medium			198,416	
1104	17.3	50%	8.7	Medium	17,303			
1105	204.7	50%	102.4	Medium	204,734			
1108	225.9	50%	113.0	Medium				225,901
1112	17.9	50%	9.0	Medium	17,913			
1116	50.6	50%	25.3	Medium	50,615			
1117	15.5	50%	7.7	Medium				15,491
1118	24.1	50%	12.1	Medium		24,126		
1119	80.2	50%	40.1	Medium		80,232		
1120	95.3	50%	47.7	Medium		95,343		
1121	100.4	50%	50.2	Medium				100,412
1122	150.9	50%	75.4	Medium				150,863
1123	42.4	50%	21.2	Medium				42,376
1125	18.0	50%	9.0	Medium	18,007			
1126	7.4	50%	3.7	Medium	7,372			
1127	73.5	50%	36.8	Medium	73,538			
1129	41.3	50%	20.7	Medium			41,321	
1130	10.8	50%	5.4	Medium			10,839	
1135	21.7	50%	10.8	Medium				21,662
1136	10.2	50%	5.1	Medium				10,184
Total Demand					513,186	199,701	250,577	566,890

Proposed Industrial Demand

Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1134	767.5	50%	383.8	Medium			1,151,324	
1137	711.0	50%	355.5	Medium				1,066,429
Total Demand					0	0	1,151,324	1,066,429

Water Demand Projections - East End Service Area

Proposed Office Demand

Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Units	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1115	7.9	50%	3.9	Medium	32,000	6,400			
1132	2.8	50%	1.4	Medium					1,375
Total Demand						6,400	0	0	1,375

Sewer Demand Projections - East End Service Area

Proposed Residential Demand

Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Units	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1101	157.8	0.5	78.9	Medium	303	57,934			
1106	1.0	0.5	0.5	Medium	5	956			
1107	96.4	0.5	48.2	Medium	98	18,738			
1109	163.7	0.5	81.8	Medium	1,600		305,920		
1110	76.4	0.5	38.2	Medium	120		22,944		
1111	44.7	0.5	22.3	Medium	130	24,856			
1113	19.7	0.5	9.8	Medium	49	9,369			
1114	224.0	0.5	112.0	Medium	300	57,360			
1124	139.2	0.5	69.6	Medium	65				12,428
1128 - 1	656.1	0.5	328.1	Medium	3,000			286,800	
1128 - 2	656.1	0.5	328.1	Medium	3,000				286,800
1131	93.7	0.5	46.9	Medium	1450	277,240			
1133	14.9	0.5	7.4	Medium	32.0				5,956
Mosaic	-	-	-	Medium	491.0	89,951			
Total Demand						446,452	328,864	286,800	305,184

Sewer Demand Projections - East End Service Area

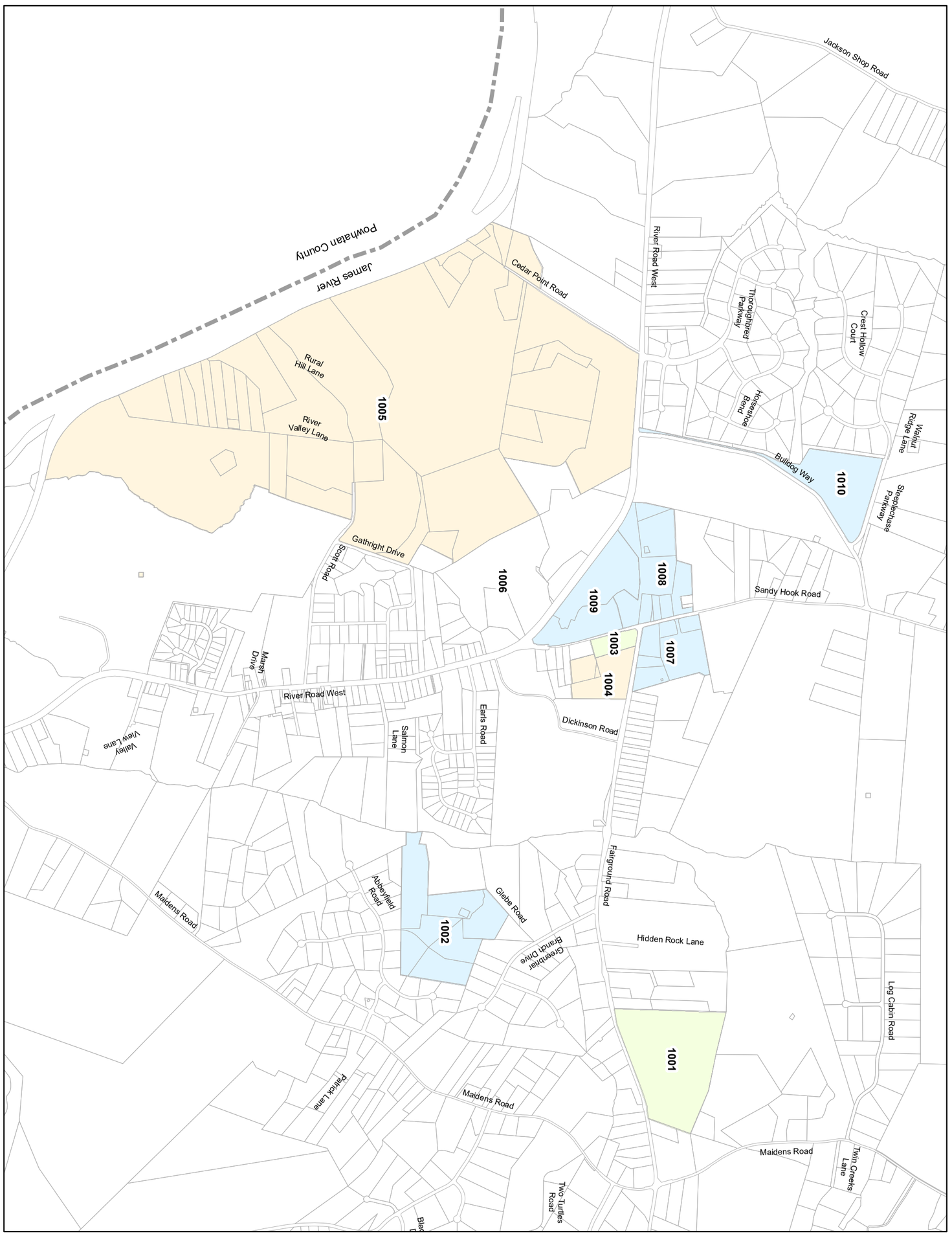
Proposed Commercial Demand

Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1102	123.7	0.5	61.9	Medium	123,704			
1103	198.4	0.5	99.2	Medium			198,416	
1104	17.3	0.5	8.7	Medium	17,303			
1105	204.7	0.5	102.4	Medium	204,734			
1108	225.9	0.5	113.0	Medium				225,901
1112	17.9	0.5	9.0	Medium	17,913			
1116	50.6	0.5	25.3	Medium	50,615			
1117	15.5	0.5	7.7	Medium				15,491
1118	24.1	0.5	12.1	Medium		24,126		
1119	80.2	0.5	40.1	Medium		80,232		
1120	95.3	0.5	47.7	Medium		95,343		
1121	100.4	0.5	50.2	Medium				100,412
1122	150.9	0.5	75.4	Medium				150,863
1123	42.4	0.5	21.2	Medium				42,376
1125	18.0	0.5	9.0	Medium	18,007			
1126	7.4	0.5	3.7	Medium	7,372			
1127	73.5	0.5	36.8	Medium	73,538			
1129	41.3	0.5	20.7	Medium			41,321	
1130	10.8	0.5	5.4	Medium			10,839	
1135	21.7	0.5	10.8	Medium				21,662
1136	10.2	0.5	5.1	Medium				10,184
Total Demand					513,186	199,701	250,577	566,890

Sewer Demand Projections - East End Service Area

Proposed Industrial Demand

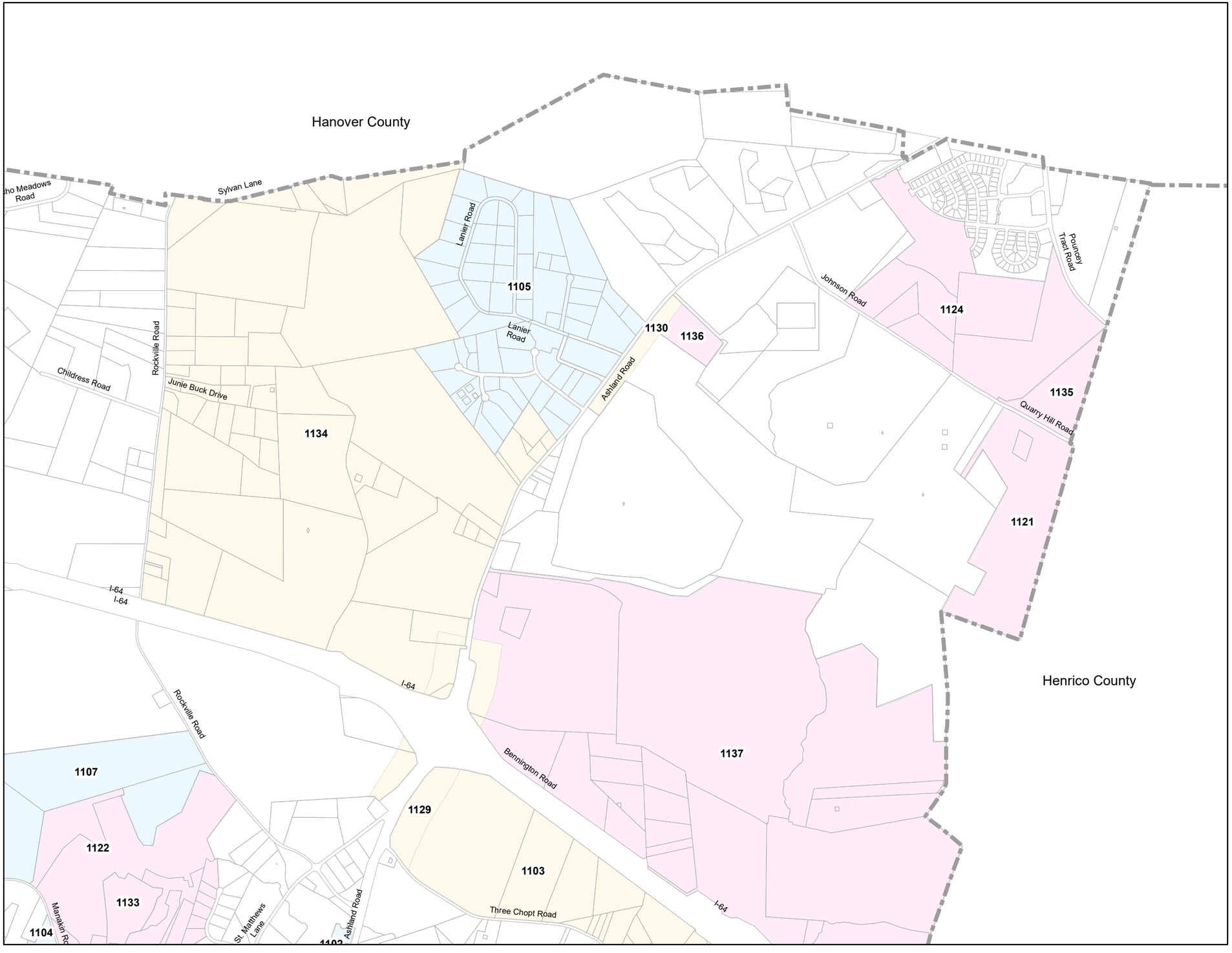
Map ID	Total Area (AC)	Percent Developable	Developable Area (AC)	Density	Demand by 2025 (gpd)	Demand by 2030 (gpd)	Demand by 2035 (gpd)	Demand by 2045 (gpd)
1134	767.5	0.5	383.8	Medium			1,151,324	
1137	711.0	0.5	355.5	Medium				1,066,429
Total Demand					0	0	1,151,324	1,066,429



Key Plan

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 1,500 feet	COURTHOUSE AREA FUTURE DEVELOPMENT PARCELS	A-1
PROJ. NO. 50061868	PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA		



N
W E
S

Legend

- County Boundaries
- Existing TSCD

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year

Key Plan

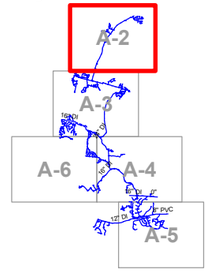


FIGURE NO. A-2

TITLE EASTERN GOOCHLAND AREA FUTURE DEVELOPMENT PARCELS

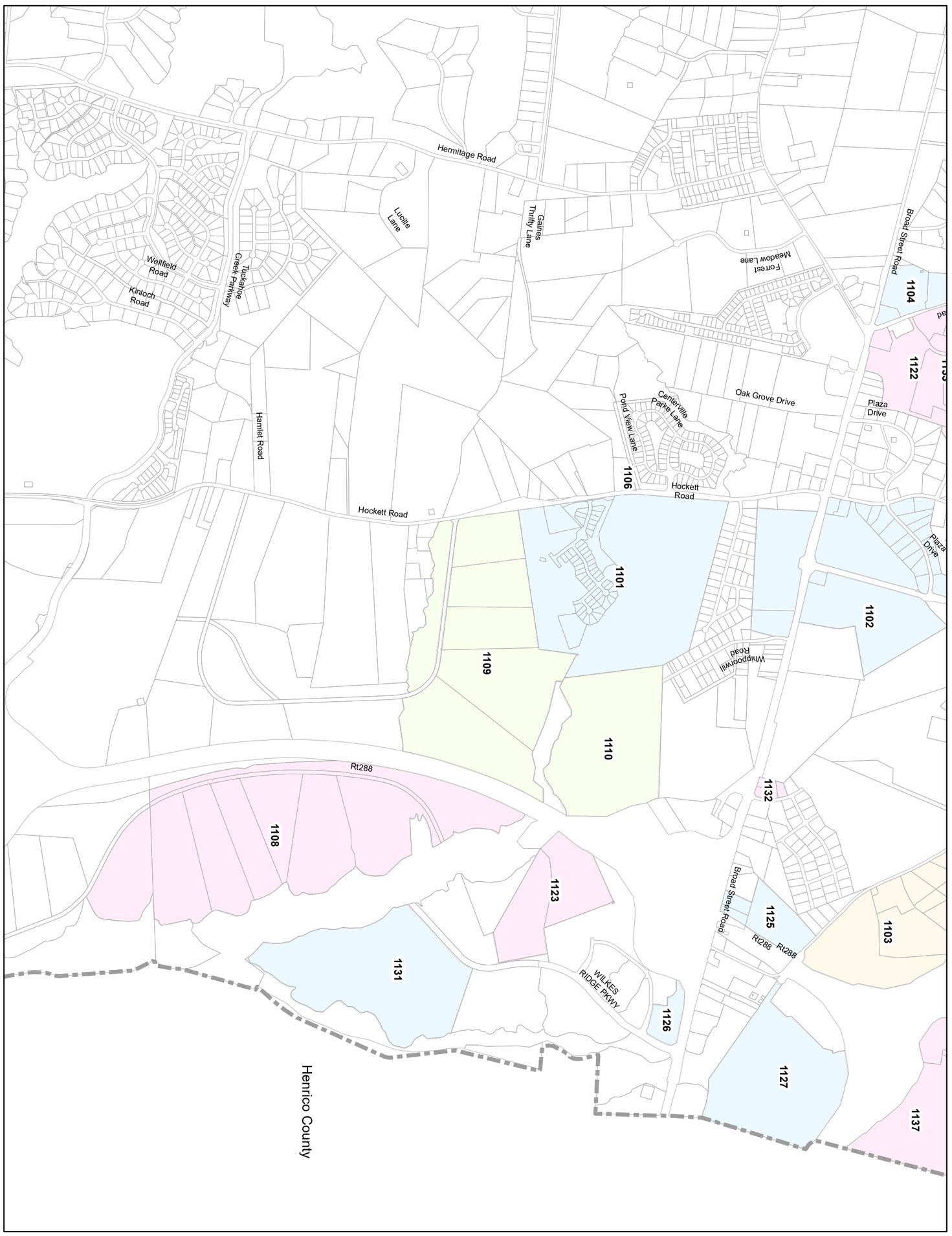
SCALE 1 inch = 1,500 feet

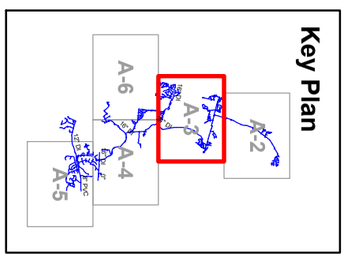
PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA

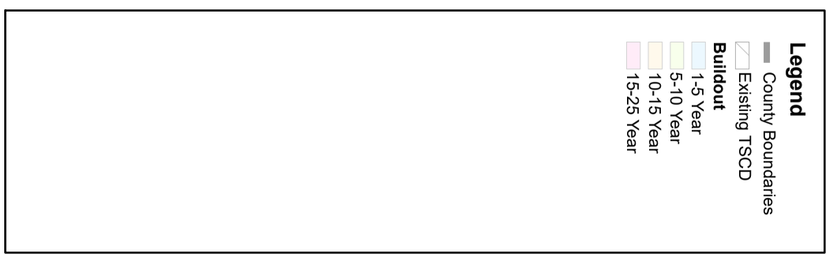
DATE 05/2020

PROJ. NO. 50061868

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

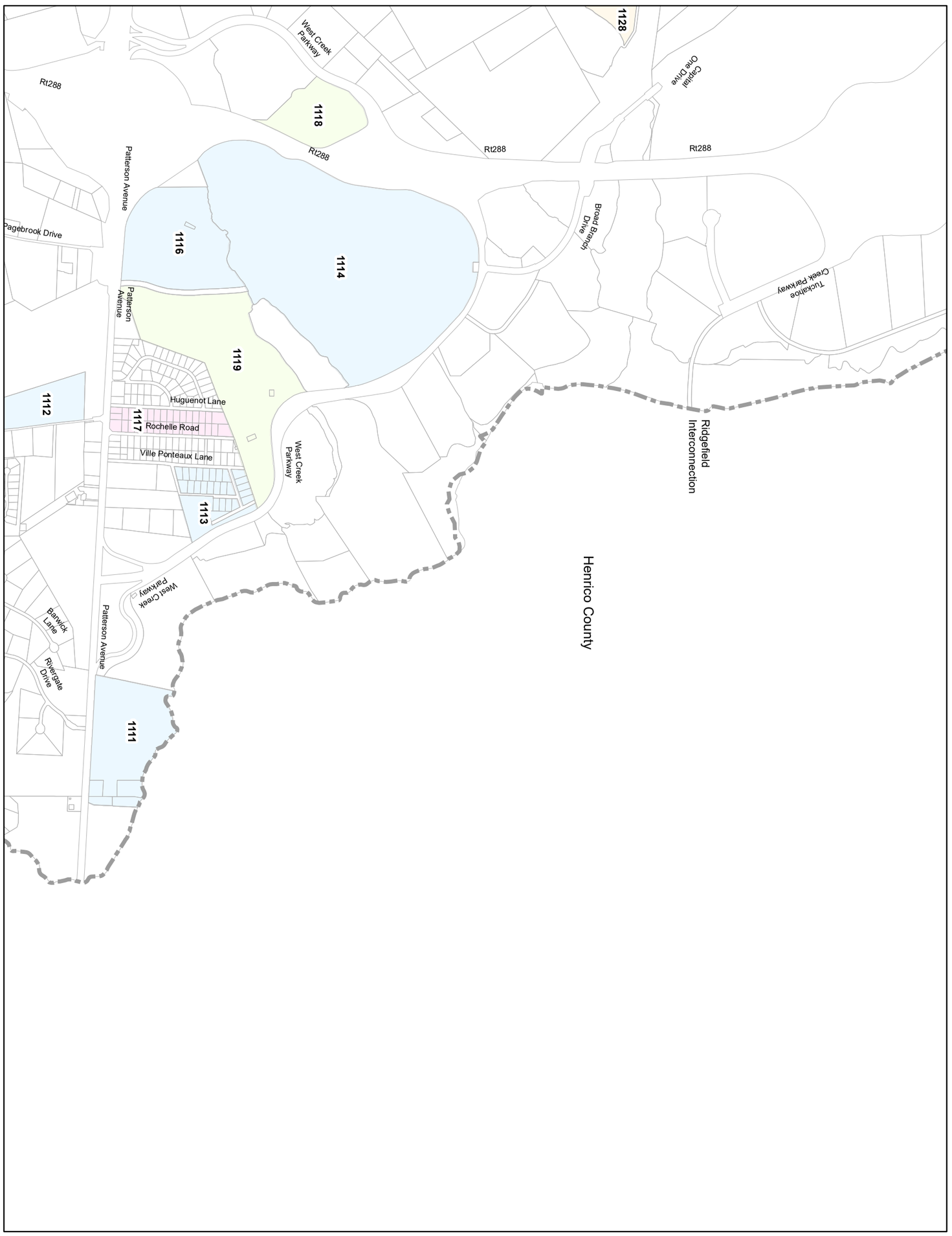


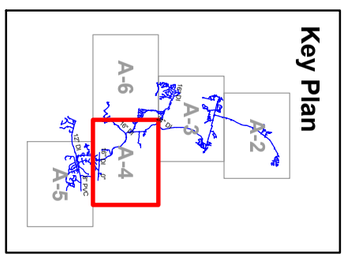


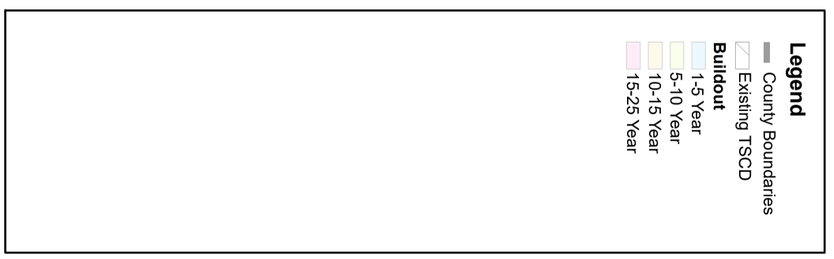


Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 1,500 feet	EASTERN GOOCHLAND AREA FUTURE DEVELOPMENT PARCELS	A-3
PROJ. NO. 50061868	PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA		

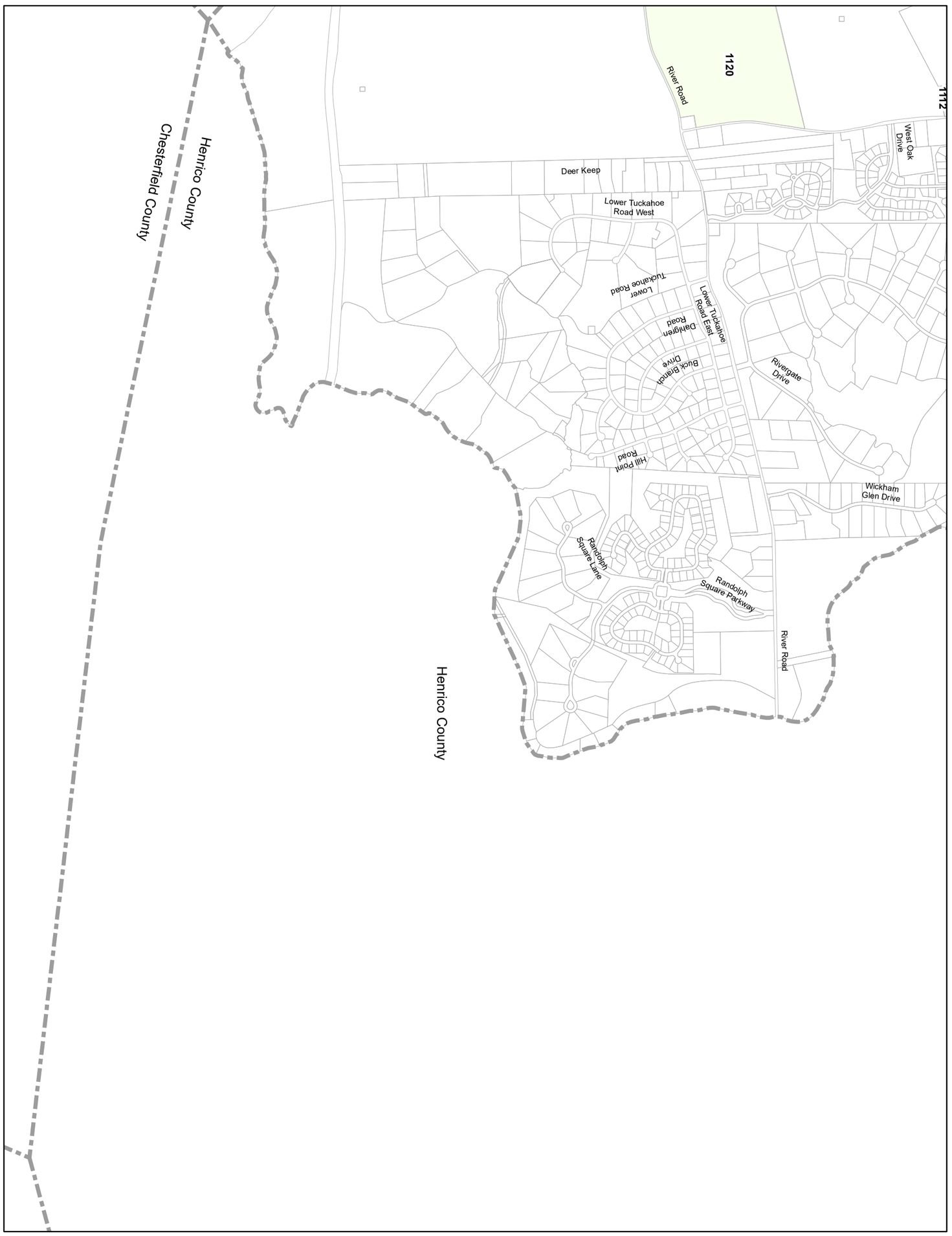


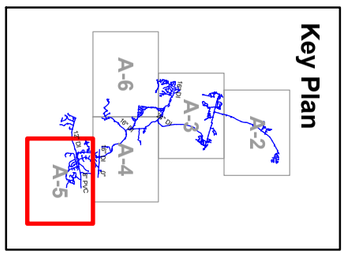


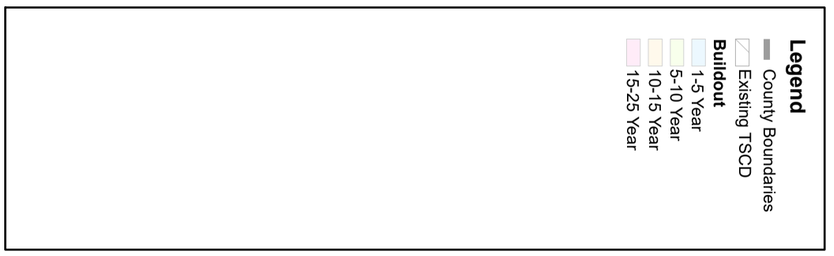


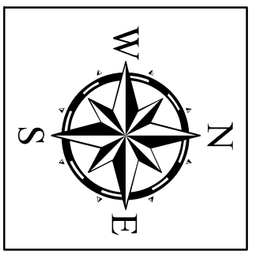
Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 1,500 feet	EASTERN GOOCHLAND AREA FUTURE DEVELOPMENT PARCELS	A-4
PROJ. NO.	PROJECT		
50061868	UTILITY MASTER PLAN GOOCHLAND COUNTY, VA		



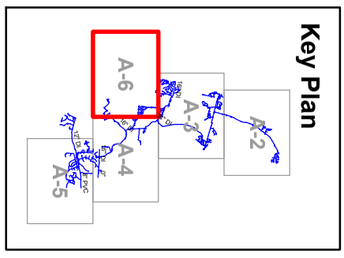






Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 1,500 feet	EASTERN GOOCHLAND AREA FUTURE DEVELOPMENT PARCELS	A-5
PROJ. NO.	PROJECT		
50061868	UTILITY MASTER PLAN GOOCHLAND COUNTY, VA		

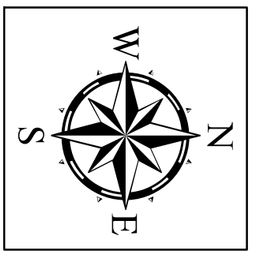


Legend

- County Boundaries
- Existing TSCD

Buildout

- 1-5 Year
- 5-10 Year
- 10-15 Year
- 15-25 Year



Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

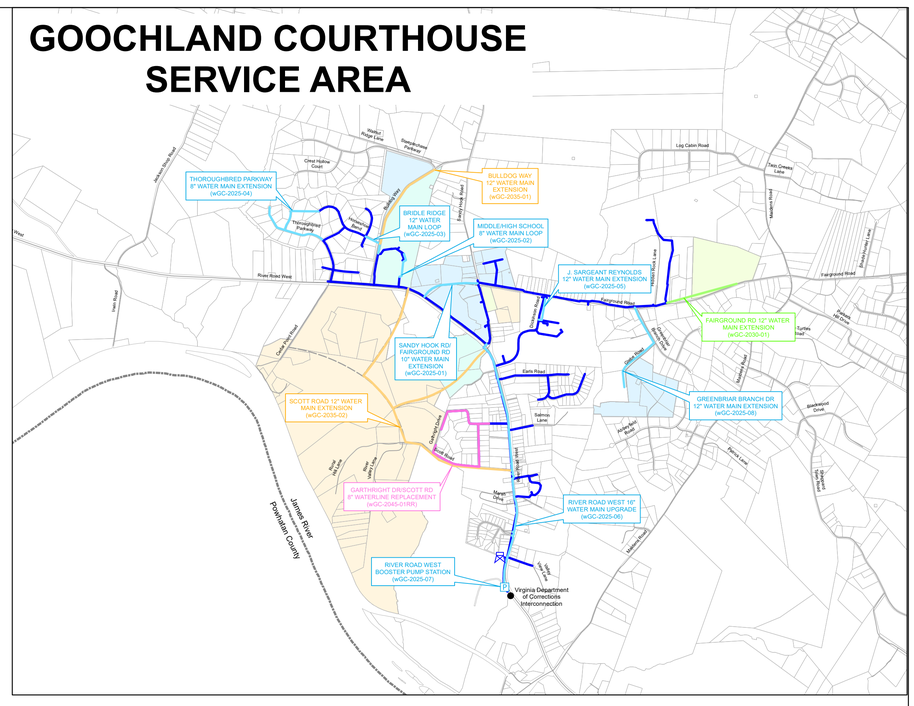
DATE	SCALE	TITLE	FIGURE NO.
05/2020	1 inch = 1,500 feet	EASTERN GOOCHLAND AREA FUTURE DEVELOPMENT PARCELS	A-6
PROJ. NO. 50061868	PROJECT UTILITY MASTER PLAN GOOCHLAND COUNTY, VA		

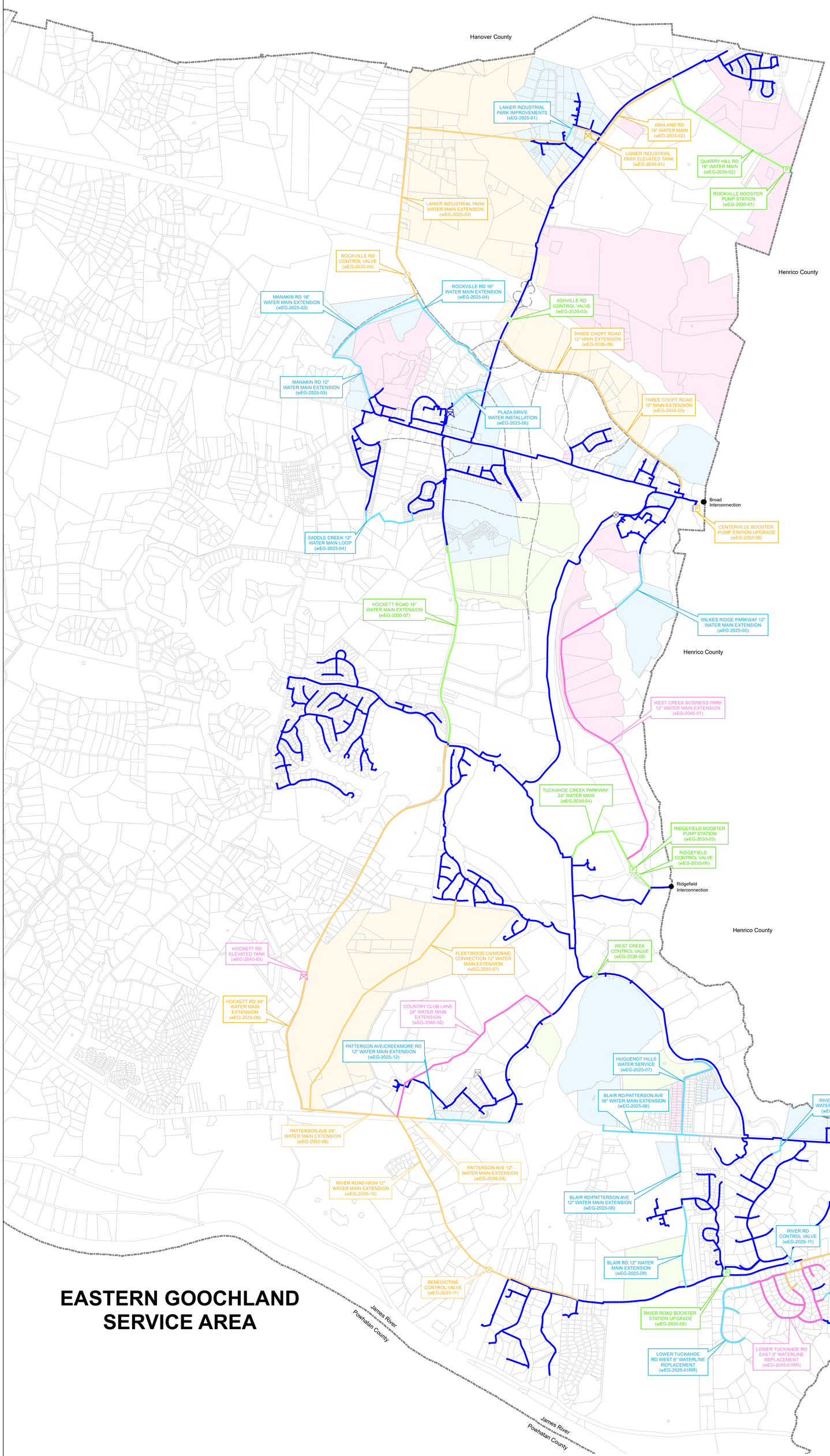
APPENDIX B
Overall Water Improvements

Utility Master Plan
Goochland County, Virginia

Dewberry

GOOCHLAND COURTHOUSE SERVICE AREA





EASTERN GOOCHLAND SERVICE AREA

N
W E
S

1 inch = 1,500 feet

UTILITY MASTER PLAN
WATER SYSTEM IMPROVEMENTS
GOOCHLAND COUNTY, VA

Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

Legend

- System Interconnection
- Existing Elevated Tank
- Existing Pump Station
- Existing TSCD
- 2035 Comp Plan Roads

Waterline Improvements
- 2025 Improvements
- 2030 Improvements
- 2035 Improvements
- 2040 Improvements
- R&R Improvements
- Fire Protection Improvements

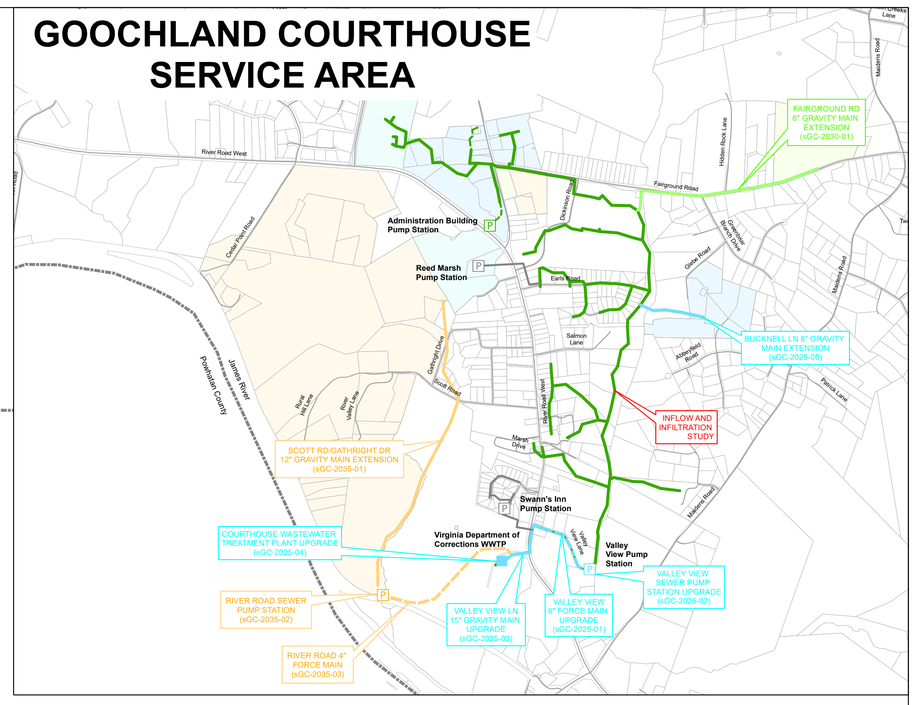
Future Development
Buildout
- 1-5
- 5-10
- 10-15
- 15-20

APPENDIX C
Overall Sewer Improvements

Utility Master Plan
Goochland County, Virginia

Dewberry

GOOCHLAND COURTHOUSE SERVICE AREA



1 inch = 1,500 feet

UTILITY MASTER PLAN
WASTEWATER SYSTEM IMPROVEMENTS
GOOCHLAND COUNTY, VA

Dewberry

Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

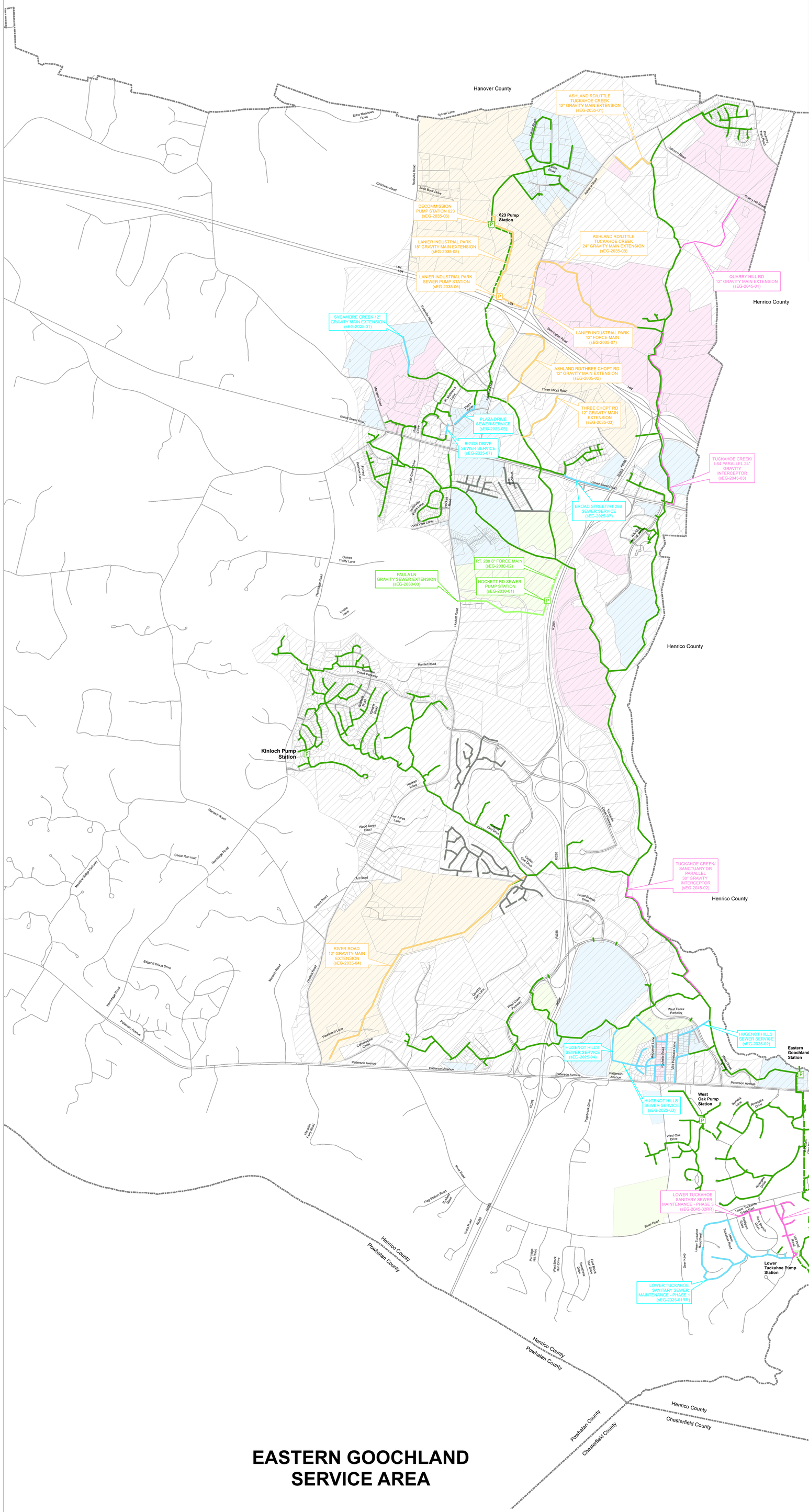
Legend

- Existing Discharge
- Existing Pump Station
- Existing TCSD
- Existing Gravity
- Existing Force Main
- 2025 Gravity Main
- 2025 Force Main
- 2030 Gravity Main
- 2030 Force Main
- 2035 Gravity Main
- 2035 Force Main
- 2045 Gravity Main
- 2045 Force Main
- Sewer R&R Improvements

Future Developments

Buildout

- 1-5
- 5-10
- 10-15
- 15-20



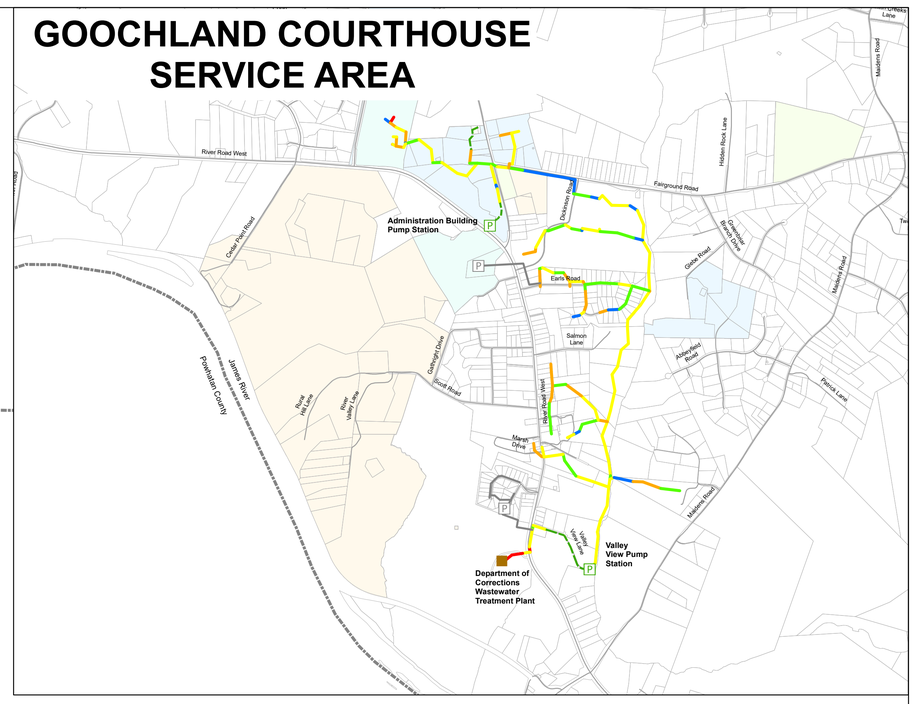
EASTERN GOOCHLAND SERVICE AREA

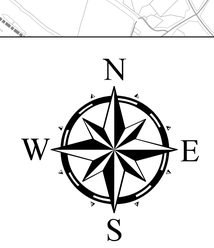
APPENDIX D
Available Sewer Capacity

Utility Master Plan
Goochland County, Virginia

Dewberry

GOOCHLAND COURTHOUSE SERVICE AREA





1 inch = 1,500 feet

UTILITY MASTER PLAN
EXISTING GRAVITY SEWER CAPACITY
GOOCHLAND COUNTY, VA

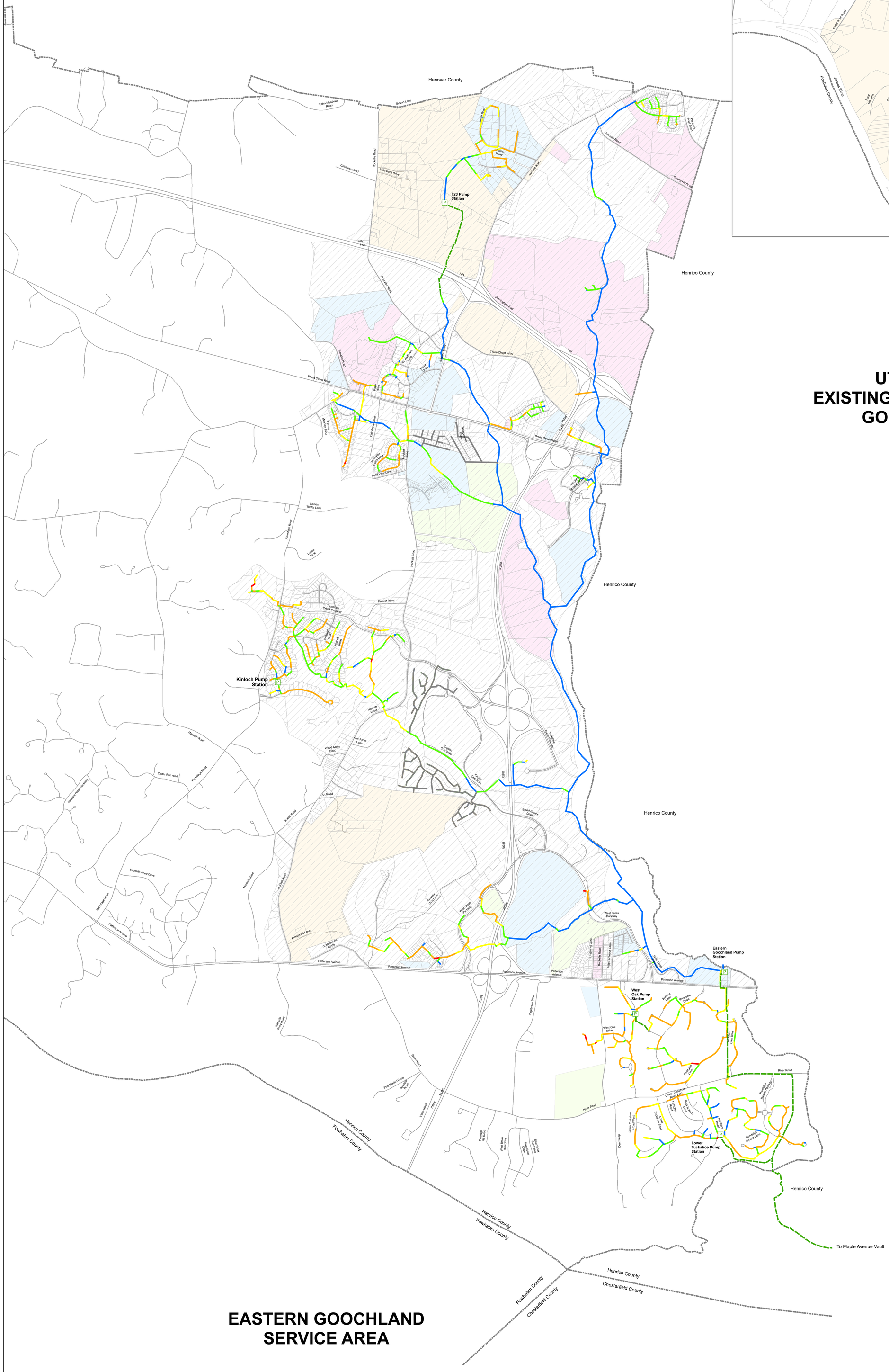
Dewberry
Dewberry Engineers Inc.
4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7907
FAX: 804.290.7928

Legend

Existing Gravity Sewer
Remaining Capacity (gpm)
- 11.4951439 - 100.000000
- 100.000001 - 200.000000
- 200.000001 - 400.000000
- 400.000001 - 800.000000
- 800.000001 - 15000.0000

Existing Discharge
Existing Pump Station
Existing TCSD
Existing Force Main

Future Developments
Buildout
- 1-5
- 5-10
- 10-15
- 15-20



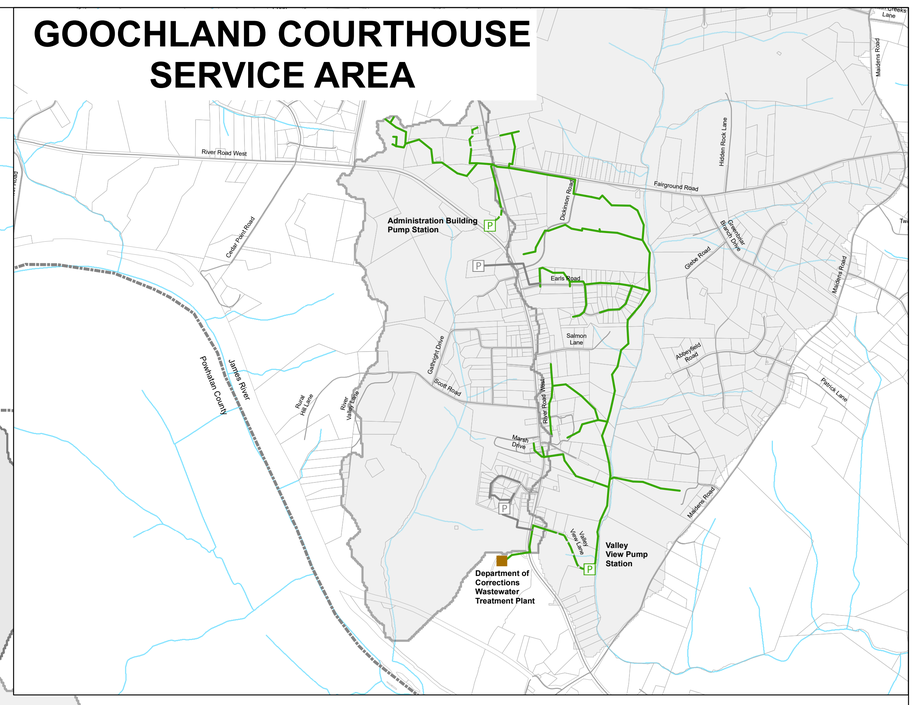
EASTERN GOOCHLAND SERVICE AREA

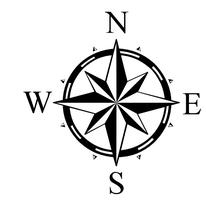
APPENDIX E
Gravity Sewer
Shed Map

Utility Master Plan
Goochland County, Virginia

Dewberry

GOOCHLAND COURTHOUSE SERVICE AREA





1 inch = 1,500 feet

UTILITY MASTER PLAN GRAVITY SEWER SHEDS GOOCHLAND COUNTY, VA

Dewberry

Dewberry Engineers Inc.

4805 LAKE BROOK DRIVE, SUITE 200
GLEN ALLEN, VIRGINIA 23060
PHONE: 804.290.7957
FAX: 804.290.7928

Legend

Existing Gravity Sewer

- Existing Gravity Sewer
- Existing Discharge
- Existing Pump Station
- Existing TCSD
- Existing Force Main