Town of Ridgeland

2023 Regional Water and Sewer Master Plan

December 2023

Prepared by: FOUR WATERS ENGINEERING

Resolution # 01-2024

A RESOLUTION OF THE RIDGELAND TOWN COUNTIL APPROVING THE 2023 REGIONAL WATER AND SEWER MASTER PLAN FOR THE TOWN OF RIDGELAND WATER AND SEWER UTILITY

WHEREAS, Town staff, in conjunction with 4Waters Engineering and Raftelis Rate Consultants, have prepared a Regional Water and Sewer System Master Plan ("RWSMP") which was partially funded by a grant from the South Carolina Rural Infrastructure Authority ("SCRIA"); and

WHEREAS, the Town's water system consists of approximately 39.5 miles of distribution piping, one Water Reclamation Facility ("WRF"), five elevated storage tanks, three wells and sixteen pump stations and related facilities needed to deliver potable water to the Town's water customers; and

WHEREAS, the Town's RWSMP is the Town's primary tool for evaluating the capacity of the existing system and identifying capital improvements needed to meet demands of current and future water customers and fire fighting capacity; and

WHEREAS, the Town's RWSMP identifies potential service areas and regional partnership opportunities with the Beaufort Jasper Water/Sewer Authority ("BJWSA") as desired by the SCRIA; and

WHEREAS, periodic updates to the RWSMP may be required to account for changes to the water system, existing customer demand and new development; and

NOW, THEREFORE, BE IT RESOLVED as follows:

1) All of the above recitals are true and correct and incorporated herein by reference
2) The Town Council hereby approves the Scope of Work provided by 4Waters Engineering for the Town's Regional Water and Sewer Master Plan in substantially the form attached hereto as "Exhibit A", and incorporated herein by reference.
3) This Resolution shall take effect on the date it is approved.

BE IT FURTHER RESOLVED that the Town will support compliance with all Federal and State water quality regulations; provide and require the use of personal protective equipment by all employees; and ensure that all employees are advised of and understand their loss control responsibilities in the performance of their work.

Approved and Adopted by the Ridgeland Town Council this 1st day of February, 2024.

Joseph N. Malphrus, Jr., Mayor

Attest:

Penelope B. Daley, Town Clerk/Treasurer

EXECUTIVE SUMMARY

The Town of Ridgeland (Town) is located approximately 31 miles north of Savannah, GA, in Jasper and Beaufort Counties. The Town is roughly bounded by I-95 to the east and SR-27 to the south with Captain Bill Creek running through the Town from south to north and the Great Swamp to the west. This area has a combined land area, including marshes and wetlands, of approximately 28,608 acres, or 44.7 square miles. The Town is the highest point between Charleston, SC and Savannah, GA. Portions of the Town's utility infrastructure dates back to the 1940s with clay pipes and brick manholes located throughout the system. The overall service area of the Town's water and sewer systems include the existing Town infrastructure limits and unserved areas within the Town boundary or within the annexation process. These areas have been delineated with this Master Plan into three core development areas: the Central, West, and East regions.

The Town is adjacent to Beaufort-Jasper Water Sewer Authority (BJWSA) water and sewer service areas. The BJWSA provides water and sewer services to the unincorporated areas of Beaufort and Jasper Counties and to certain municipal areas, by contract. The BJWSA is included as a part of this Regional Water and Sewer Master Plan as there are several large, planned developments within the Town's limits where a partnership approach to water and sewer infrastructure may allow for more timely service to these areas which are remote from the Town's existing water and sewer assets.

Four Waters Engineering (4Waters) prepared a Capital Improvement Plan in 2019 for the Town, which focused on all aspects of the Town's existing water and sewer utility components and recently completed an overall assessment of vulnerability, condition, and operational efficiency of each major component of the water and sewer system as well as supporting facilities. The study allowed for prioritization of projects as different funding options became available. Additionally, BJWSA who serves the adjacent parts of Jasper County commissioned a Water and Wastewater Master Plan Update in 2022 to plan capital improvement projects required to provide water and wastewater service in accordance with their adopted level-of-service goals, for planned growth and development in the BJWSA service area.

Due to the condition of the Town's existing water and sewer infrastructure and anticipated rapid growth over the next 20 years, the Town authorized 4Waters to develop a 20-year water and sewer master plan to determine the most efficient and cost-effective manner to improve the reliability and performance of the Town's existing water and sewer infrastructure and to identify possible partnerships with BJWSA for the 20 year planning period from 2023 – 2042.

The overall service area of the Town's water and sewer system serves portions of the Town of Ridgeland and the Ridgeland Prison. The facilities are owned and operated by the Town. These areas are served by one water reclamation facility (WRF) for sewage collection and treatment – the Jimmy Mixon WRF; and three well sites. The BJWSA water service area is served by two surface water treatment plants, three aquifer-storage recovery wells, nine groundwater supply wells, 18 water pumping stations, and 22 finished water storage facilities. The BJWSA sewer service area is served by eight water reclamation facilities, and 515 pump stations.

The culmination of the Regional Water and Sewer Master Plan is to provide a plan of implementation for the identified deficiencies and the proposed recommendations listed throughout the report. The Implementation Plan in Section 7 will address both the Rehabilitation needs of the water and sewer systems to maintain and/or provide a desirable level of service for the current customer population and also for the Expansion needs of the systems to service growth and development in the service areas. The Town has initiated discussions with the BJWSA to develop an understanding of regional cooperation opportunities and an approach to meet the anticipated significant water and sewer needs of the Town's East area. Based on the financial and rate evaluation of the necessary Expansion Capital Improvement Plans (CIPs) for the East area, it was determined that it would not be feasible for the Town to undertake these projects while maintaining reasonable water and sewer rates for the customer base. Accordingly, the West and Central areas Expansion CIPs are presented as a part of the Town's Implementation Plan while the East area Expansion CIPs are presented as representative projects, costs, and timelines to provide water production and sewer treatment facilities for the anticipated East area developments. The East area Expansion CIPs can be utilized during the ongoing regional partnership discussions with the BJWSA.

In summary, for all the water and sewer systems, Rehabilitation Capital Improvement Projects (CIP) totaling $16.3 million and $15.5 million, respectively, have been identified for completion over the 20-year study period, although the majority are recommended for completion within the next ten years.

Year	Sewer System Rehabilitation Capital Needs	Water System Rehabilitation Capital Needs
2023 - 2027	$10,224,000	$3,356,000
2028 - 2032	$2,746,000	$5,937,000
2033 - 2037	$1,874,000	$3,699,000
2038 - 2042	$1,424,000	$2,503,000
Total	**$16,268,000**	**$15,495,000**

The results of the facility inspections and the hydraulic models indicate that all of the water systems are effectively well operated and are in relatively good condition. Limited issues of concern were identified such as EST turnover and inconsistency of pressure along Greys Highway and Bees Creek Road between Captain Bills Road and south of Grahamville Road. While water quality modeling was beyond the scope of this report, long dead-end transmission mains could experience low disinfection residual and other water quality issues during periods of low demands. The Town is currently in the process of installing a Supervisory Control and Data Acquisition (SCADA) system for the monitoring and control of the water distribution and pumping facilities. Improvements of the existing watermain between Captain Bill Road and Bees Creek Road and improvements to Well Site No. 3 and Cypress Ridge Well are anticipated in the near future.

The pumping and transmission systems all generally function properly but there were several pump stations, such as PS3, PS4, PS 6, PS8, PS9, PS11, PS12, and PS13 are at elevated risk of failure. Many of these pump stations are a part of the 2023 Water and Sewer Resiliency Improvements project that is funded in part by the EDA grant and the RIA grant. It is not currently known at this time the extent of cast or ductile iron forcemains within the system. These pipes can deteriorate quickly when exposed to hydrogen sulfide which develops from sewage if the pipes do not remain full. The plan if the cast or ductile iron forcemains are able to be identified or are encountered as a part of other work in the Town is for them to be systematically replaced.

The hydraulic sewer models and operational data provided by the Town indicate that portions of the pumping and piping systems in the WRF system are not capable of handling the base sewer flows with sufficient backup capacity. In particular, five pump stations were identified as having insufficient pumping capacity for the current base flow condition.

The occurrence of Inflow & Infiltration (I&I) has a significant impact on the Jimmy Mixon WRF collection system and leads to loss of system and treatment capacity, additional operation costs to transfer and treat I&I and can cause structural damage and loss of integrity in the system. The I&I analysis determined that approximately 53% of the sewer sub-basins served by the Jimmy Mixon WRF experienced Medium to High I&I. The Town has also performed the *Inflow and Infiltration Abatement Analysis* to identify and prioritize sewer projects. This study utilized smoke testing and CCTV inspection as well as flow monitoring. The Town is utilizing this comprehensive information to ensure that funding for I&I reduction is effective.

The Town is anticipating significant growth and development within the Town boundaries over the 20-year period of this study. Considering the extensive development projected in the eastern portion of the Town in relation to the current sewer and water systems' infrastructure, the Town is open to partnering with BJWSA in order to meet the projected demands in a cost-effective manner. While development of the eastern portion of the service area is expected to take place over the next 40 years while the central and western portions of the service areas are expected to develop over the next 20 years, development of the eastern portion of the service area is expected to add nearly eight times as many residences as

the other two areas combined. Based on the available data and the population projections generated for the Master Plan, the Town's population is expected to grow over 14 times the current population over the 20-year study period. These new developments will need water and sewer infrastructure and will be looking to the Town and BJWSA for supply and collection services. Completion of the Rehabilitation CIP projects listed in Section 7.0 will successfully bring the existing water and sewer infrastructure to an acceptable and reliable level of service which can then be extended or expanded as necessary to serve future growth. The Expansion CIP developed for projected water and sewer population growth throughout the 20-year study period includes approximately $135.5 million for sewer system expansions and approximately $41.0 million for water system expansions.

Year	Sewer System Expansion Capital Needs	Water System Expansion Capital Needs
2023 - 2027	$51,163,400	$10,465,100
2028 - 2032	$27,041,000	$16,113,500
2033 - 2037	$49,637,500	$6,402,500
2038 - 2042	$7,637,500	$8,073,000
Total	**$135,479,400**	**$41,054,100**

The projected growth and development in the central and western portions of the Town is anticipated to require the construction of an additional WRF or expanding the capacity of the WRF in the next 5 years due to the sewer demands exceeding the WRF's capacity. When the eastern system separated out, the central and western system is expected to exceed the WRF's capacity in the next 10 years. It is anticipated to meet the needs of the central and western system will result in the construction of additional pump stations and upgrading existing pump stations as well as construction of a new WRF facility.

The need for additional water production and/or storage facilities is also anticipated for the Town's water system. Based on the projected rate of development, the Town's water system will exceed the permitted groundwater withdrawal rates and storage capacity within the next 5 years. When the eastern area is separated out, the Town will exceed the permitted groundwater withdrawal rates and storage capacity in the next 10 years. It is anticipated that to meet the needs of the central and western areas the Town will need to construct an additional well and elevated storage tank.

To serve the eastern portion of the system, the Town and the BJWSA met in March 2023 to discuss a potential regional solution to serve the anticipated development. A rate study was also undertaken for the financial feasibility and revenue sufficiency for the proposed rehabilitation and expansion projects. Based on the expenses and the timeframe, it was determined that it would not be feasible for the Town to undertake the expansion projects. As such, partnership with BJWSA is necessary to serve the anticipated eastern developments.

The Town established a goal to provide a unified water and sewer system which ensures the availability of suitable level of service for the existing customer base and the anticipated future growth within the Town's boundary and annexation process. The completion of the Regional Water and Sewer Master Plan, the I&I Assessment and Reduction Plan, and the general commitment of the Town Council, Administration, and staff, provide the Town Water & Sewer Department with the necessary resources, information, and guidance to achieve the goals and obligations of providing a high level of service to the customer base.

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1.0 INTRODUCTION

1.1 BACKGROUND AND PURPOSE

The Town of Ridgeland (Town) has set a goal to develop a 20-year water and sewer master plan using a regional approach to determine the most efficient and cost effective manner to improve the reliability and performance of the Town's existing water and sewer infrastructure and to identify the water and sewer system improvements and strategies needed to serve the growth projected to occur in the Town and adjacent areas of Jasper County over the planning period. To this end, the Town commissioned Four Waters Engineering, Inc. (4Waters) to prepare a Regional Water and Sewer Master Plan to assess the status of the existing Town water and sewer systems and to plan for capital improvements that meet the current and projected needs of the Town and adjacent areas of Jasper County.

4Waters prepared a Capital Improvement Plan in 2019 for the Town, which focused on all aspects of the Town's existing water and sewer utility components and recently completed an overall assessment of vulnerability, condition, and operational efficiency of each major component of the water and sewer system as well as supporting facilities. The study allowed for prioritization of projects as different funding options became available. Additionally, Beaufort-Jasper Water and Sewer Authority (BJWSA) who serves the adjacent parts of Jasper County commissioned a Water and Wastewater Master Plan Update in 2022 to plan capital improvement projects required to provide water and wastewater service in accordance with their adopted level-of-service goals for planned growth and development in the BJWSA service area.

The general scope of this project involved a thorough analysis of the Town's existing water and sewer systems and as part of the Regional Water and Sewer Master Plan, 4Waters completed the following tasks:

- Assessment of existing conditions
- Population projections and associated water and sewer generation rates
- Future Conditions
- Development of hydraulic water and sewer models
- Inflow and infiltration of the sewer system
- Assessment of septic and private well areas
- Compilation of rehabilitation and expansion capital improvement plans (CIPs) which addresses the need for renovation of existing water and sewer facilities and for expanded or upgraded water and sewer facilities for a planning period of 20 year
- Master Plan Implementation
- Funding Evaluation

The BJWSA provides water and sewer services to the unincorporated areas of Beaufort and Jasper Counties and to certain municipal areas, by contract. Within Jasper County, the area to the south of the Town is currently served by BJWSA. The BJWSA is included as a part of this Regional Water and Sewer Master Plan as there are several large, planned developments within the Town's limits where a partnership approach to water and sewer infrastructure may allow for more timely service to these areas which are remote from the Town's existing water and sewer assets.

The resulting 2023 Regional Water and Sewer Master Plan will provide a concise guide for the Town to utilize for planning near-term and long-term water and sewer system improvements. It is also intended to address future issues of service area overlap and partnership opportunities between the different utility service providers in the area while balancing serving underserved communities, in addition to environmental, public, health, and funding constraints.

1.2 SERVICE AREAS

The Town of Ridgeland is located approximately 31 miles north of Savannah, GA, in Jasper and Beaufort Counties. The Town is roughly bounded by I-95 to the east and SR-27 to the south with Captain Bill Creek running through the Town from south to north and the Great Swamp to the west. This area has a combined land area, including marshes and wetlands, of approximately 28,608 acres, or 44.7 square

miles. The Town of Ridgeland is the highest point between Charleston and Savannah, GA. The BJWSA is the regional water and sewer provider for Beaufort and Jasper Counties, providing service to approximately 1,420 square miles. This area includes the cities of Beaufort and Hardeeville and the towns of Bluffton and Port Royal as well as several wholesale customers. The Broad River divides the service area into two distinct regions, North of Broad (NOB) and South of Broad (SOB). Figure 1.1. provides a vicinity map of the Town of Ridgeland and BJWSA.

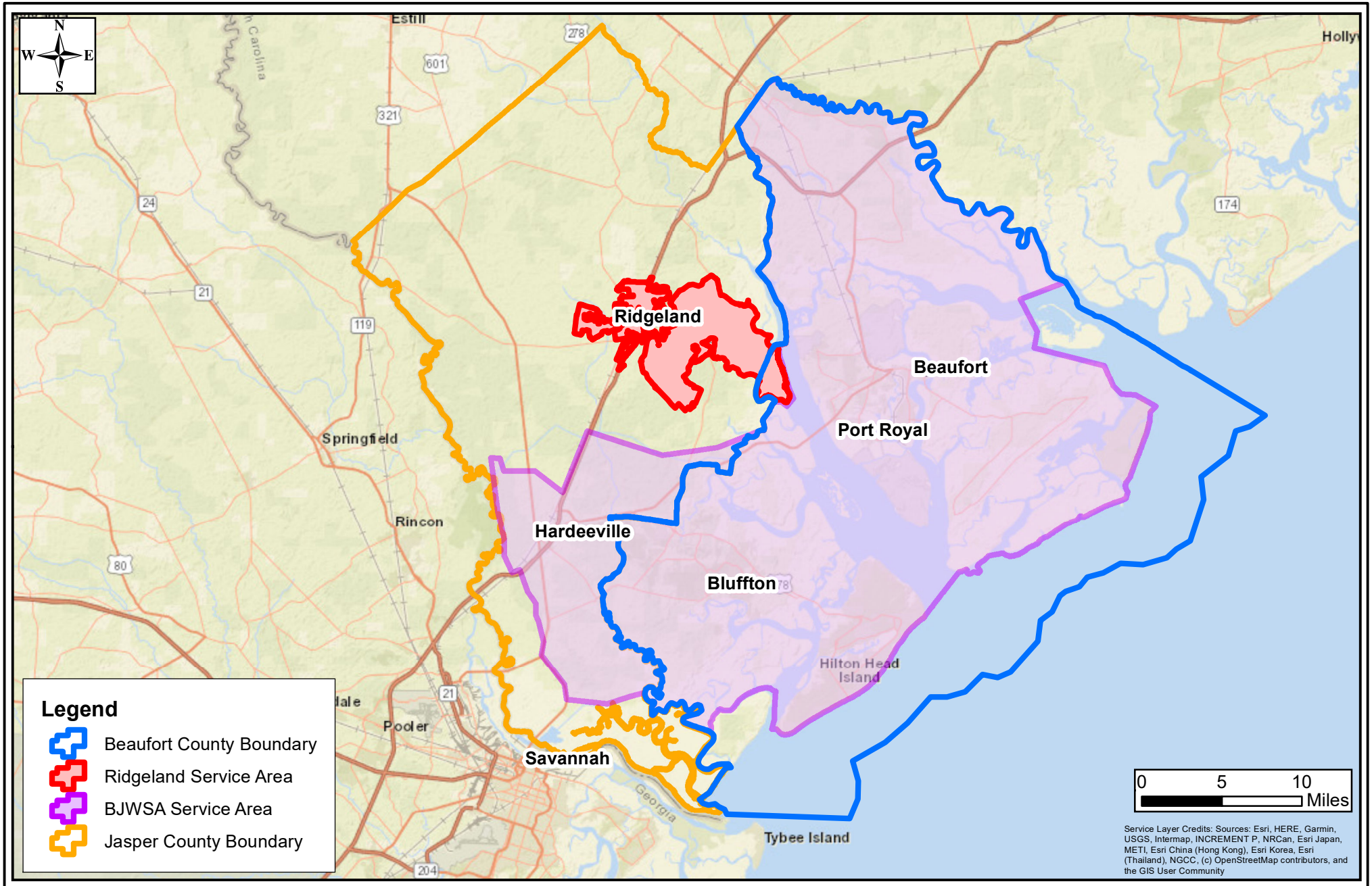

Figure 1.1
Regional Master Plan Vicinity Map

Regional Water and Sewer Master Plan

DISCLAIMER: This map is for reference and discussion purposes only. Data provided are derived from multiple sources with varying levels of accuracy. The information shown hereon is not intended for site specific use or design.

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File Name: VicinityMap Path: P:\22-1017 Regional Water and Sewer Master Planning Project\16.0 GIS\Map Document\Report\VicinityMap.mxd Date Saved: 5/4/2023 11:06:24 AM

1.3 TOWN TOPOGRAPHY, ZONING AND LAND USE CHARACTERISTICS

According to the United States Geological Survey (USGS), the topographical elevations of the Town range from a high of approximately 75 feet to a low of approximately 20 feet, North American Datum of 1983 (NAD83). The highest elevations are seen near the airport to the northwest of the Town with the elevations sloping downward toward Captain Bill Creek. Figure 1.2 depicts the topography of the Town service area.

In 2011, the Town adopted the SmartCode to provide a template for efficient growth which prioritizes development around infrastructure and density, while setting limits on outward expansion. The goal of adopting the SmartCode is to create compact, walkable mixed-use neighborhoods. The land uses throughout the Town and the surrounding area include Natural, Rural, Rural Crossroads, Neighborhood General, Neighborhood Core, and Town Center and three special districts: Exit 21, Industrial, and Planned Development District (PDD). There are three PDDs that are currently approved for development: Genesis PDD, Good Hope PDD, and Moultrie Tract PDD. According to the Town's 2017 Comprehensive Plan, approximately 78% of the Town's housing stock is single family housing (detached and attached) as well as mobile homes, while the remaining 22% are multi-family units. Figure 1.3 depicts the zoning of the Town service area.

The Town does not have zoning in the traditional sense as the intention is to build a walkable community of mixed uses. Instead, the Town and the surrounding area is divided into regional sectors in order to better control the rate and location of development. The following sectors are represented within the Town's planning region:

- Preserved Open Sector (O-1)
- Reserved Open Sector (O-2)
- Restricted Growth Sector (G-1)
- Controlled Growth Sector (G-2)
- Intended Growth Sector (G-3)
- Infill Growth Sector (G-4)
- Special Districts (SD)

Each regional sector has its own set criteria and expected development patterns which shape the way water and sewer needs are generated.

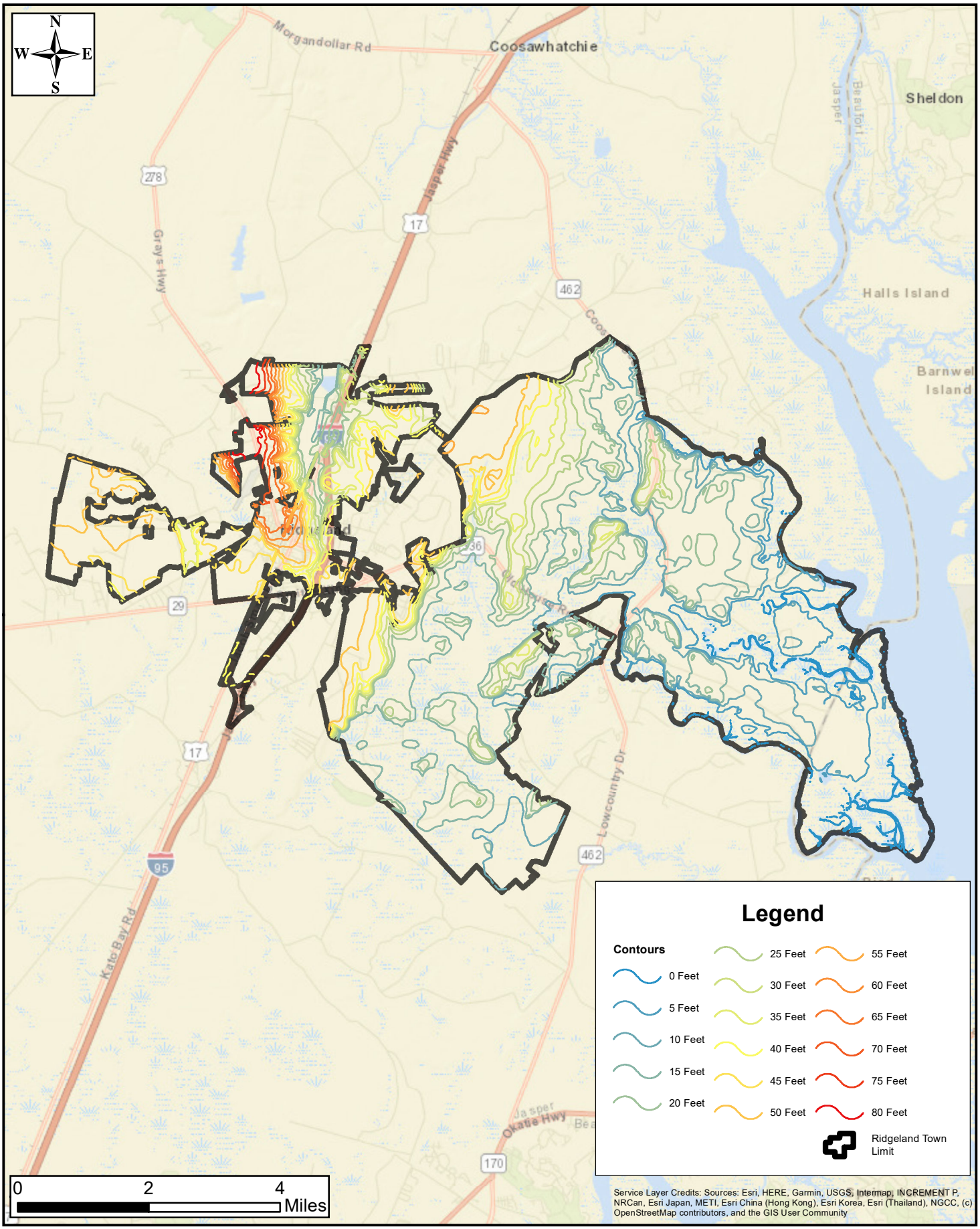

Figure 1.2
Town Topographical Contours

Regional Water and Sewer Master Plan

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File Name: Figure 1.2 Topographical Contours Path: P:\22-1017 Regional Water and Sewer Master Planning Project\16.0 GIS\Map Document\Report\Figure 1.2 Topographical Contours.mxd Date Saved: 5/4/2023 4:14:13 PM

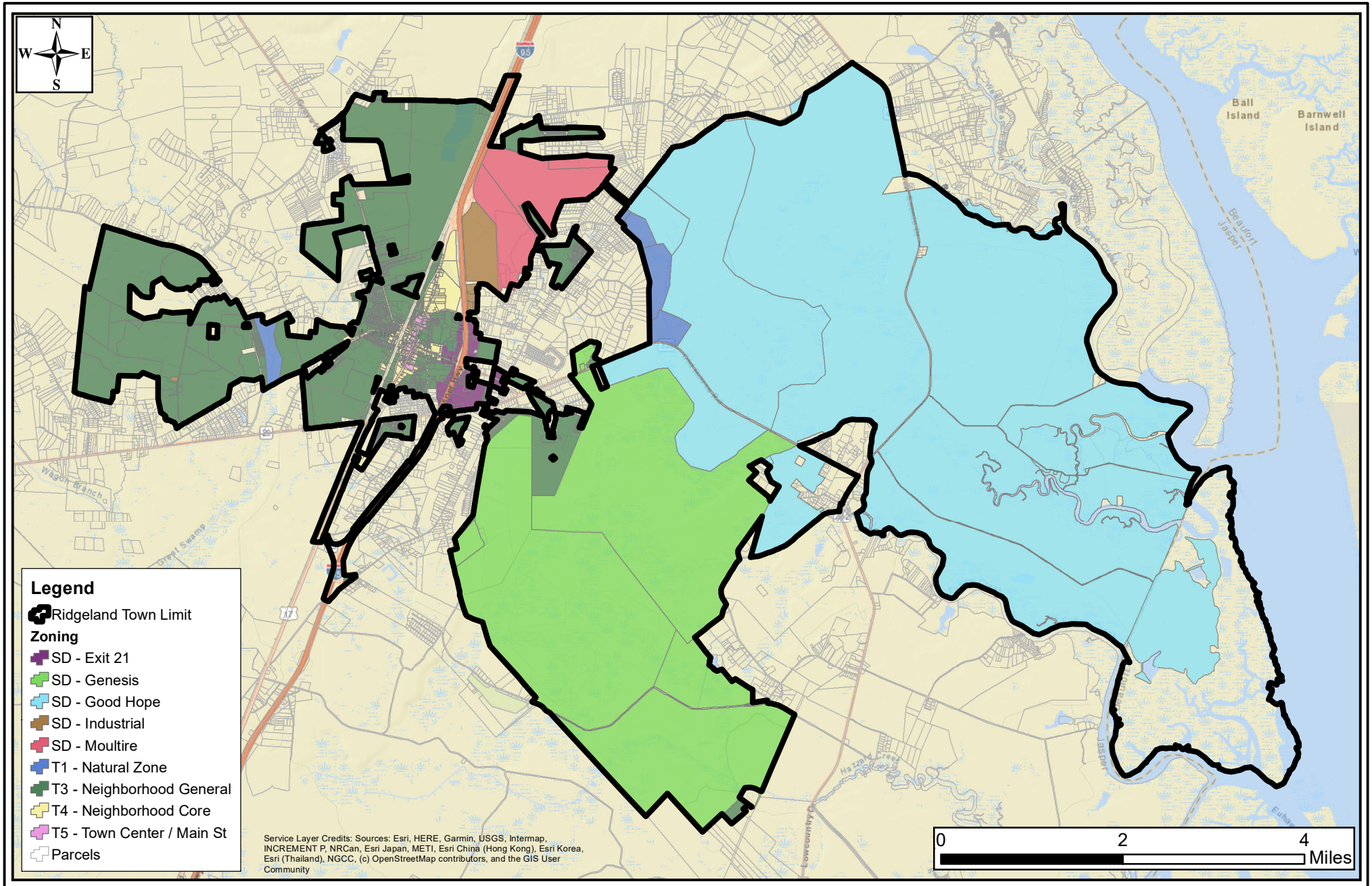

Figure 1.3
Town Zoning

Regional Water and Sewer Master Plan

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1.4 WATER SYSTEM SERVICE AREA

The Town provides water to a portion of the Town's water service area in addition to the Cypress Ridge Industrial Park and Ridgeland Claude Dean Airport. The system is made up of well sites which include disinfection, elevated storage tanks and watermains. As cataloged in the Town's GIS database, Table 1.1 provides an overview of the water system service components and Figure 1.4 depicts the physical extents of the water system service area.

Table 1.1 Water System Component Overview

Well Sites with Disinfection	Elevated Storage Tanks	Watermain Length (Miles)	Watermain Size Range (Inch)
3	5	40	2 to 12

Jasper County does not provide water services. Comparatively, BJWSA uses a combination of surface water and groundwater to meet the needs of their 139,000 customers. Their system includes conventional surface Water Treatment Plants (WTPs), aquifer-storage-recovery (ASR) wells, groundwater supply wells, pumping stations, finished water storage facilities, and watermains. Based on the information provided in the 2022 BJWSA Water and Wastewater Master Plan Update, Table 1.2 provides an overview of BJWSA's water system service components and Figure 1.5 depict the physical extents of the adjacent areas of Jasper County with water systems served by BJWSA (SOB).

Table 1.2 BJWSA Water System Component Overview

Surface Water Treatment Plants	Aquifer-Storage-Recovery Wells	Groundwater Supply Wells	Water Pumping Stations	Finished Water Storage Facilities	Watermain Length (Miles)
2	3	9	18	22	1,502

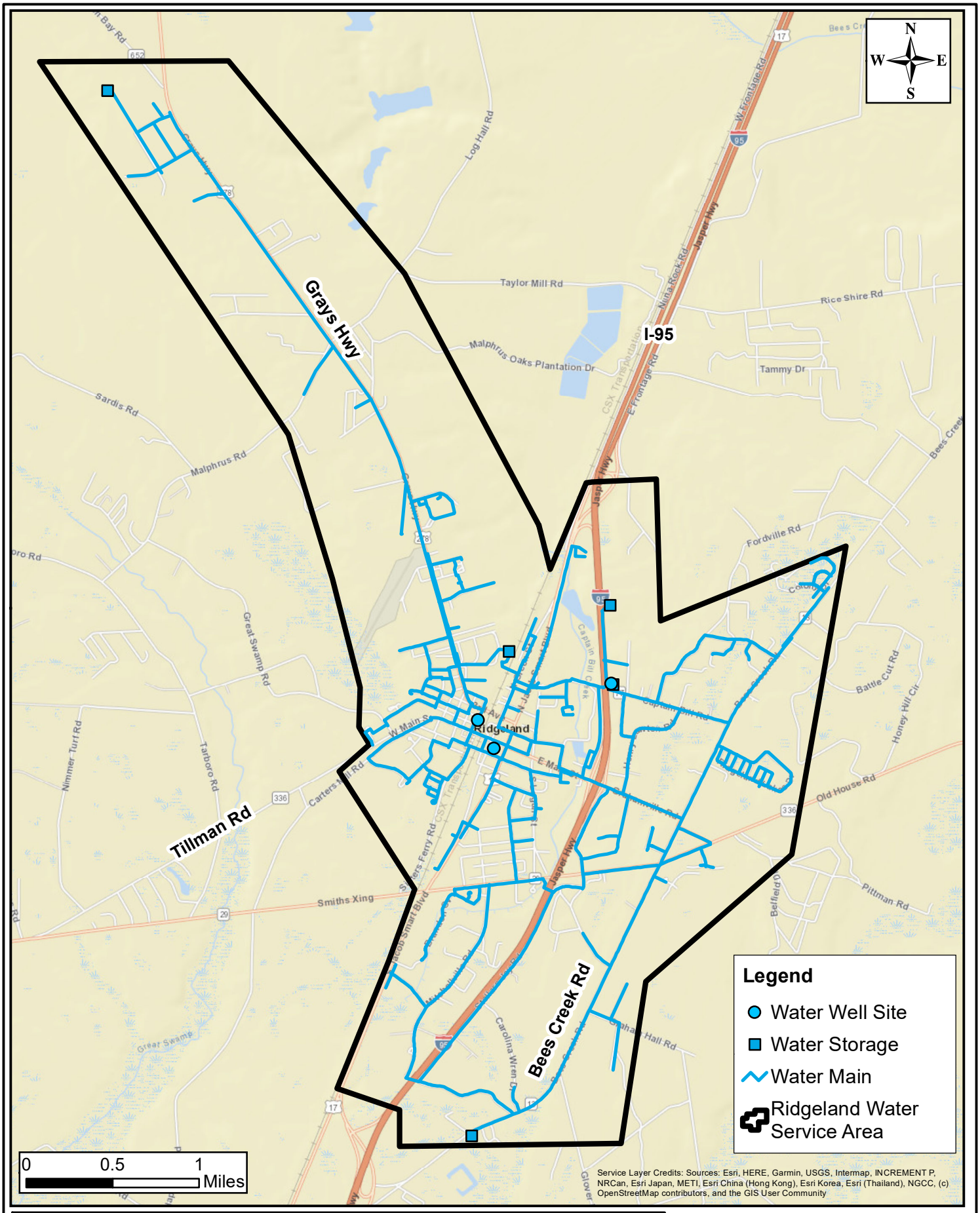

Figure 1.4
Town Water System Service Area

Regional Water and Sewer Master Plan

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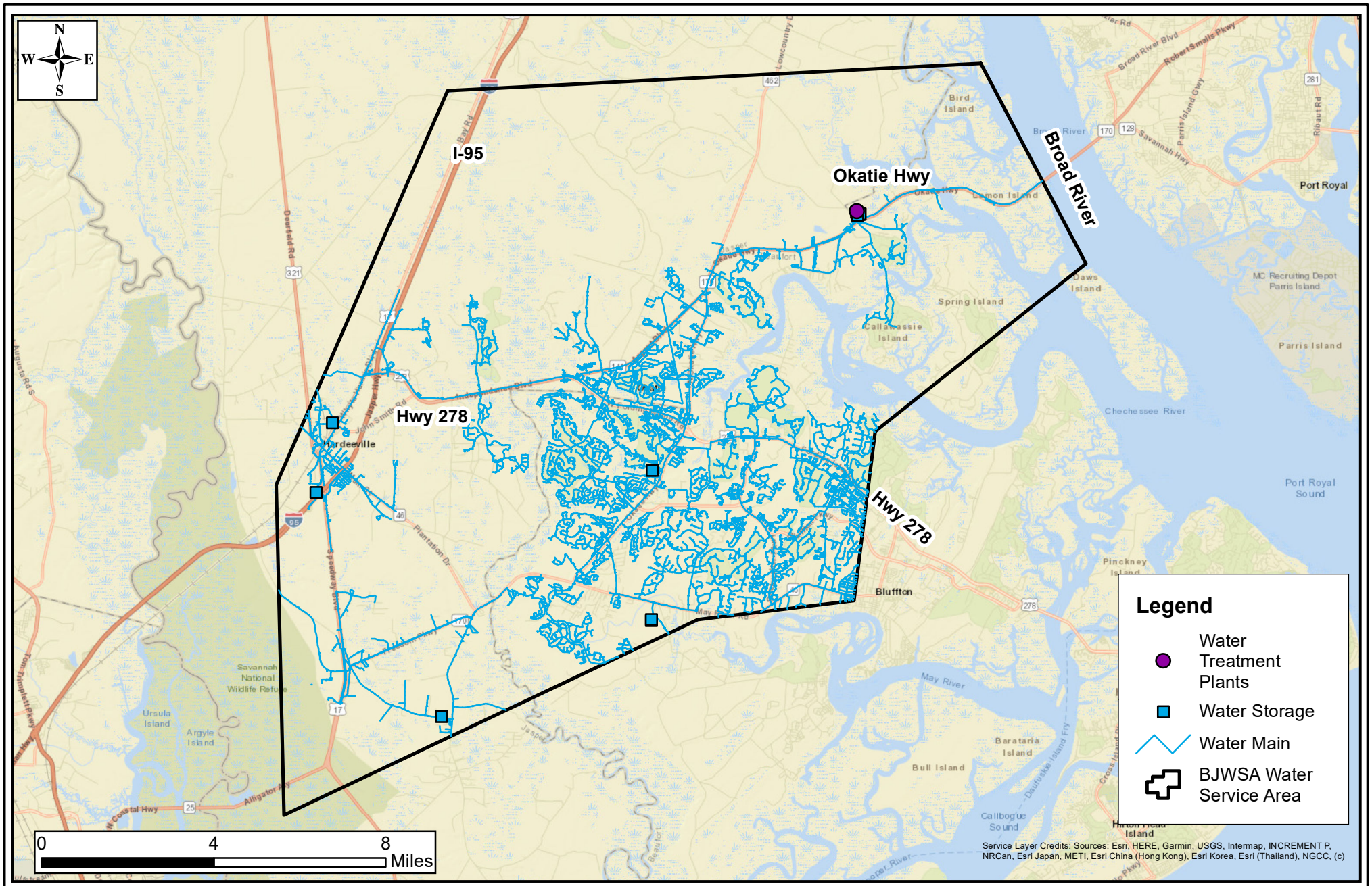

Figure 1.5
BJWSA Water System Service Area - SOB

Regional Water and Sewer Master Plan

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1.5 SEWER SYSTEM SERVICE AREA

The Town provides service to a portion of the Town's sewer service area in addition to the Cypress Ridge Industrial Park and Ridgeland Claude Dean Airport. This system includes a Water Reclamation Facility (WRF), gravity sewer mains, manholes, pump stations and their respective force mains. As cataloged in the Town's GIS database, Table 1.3 provides an overview of the sewer service system components and Figure 1.6 depicts the physical extents of the sewer system service area.

Table 1.3 Sewer System Component Overview

Water Reclamation Facility	Pump Stations	Manholes	Forcemain Length (Miles)	Forcemain Size Range (Inch)	Gravity Main Length (Miles)	Gravity Main Size Range (Inch)
1	16	519	11	2 to 8	21	6 to 12

Jasper County does not provide sewer services. Comparatively, BJWSA provides service for the area utilizing eight WRFs, gravity sewer mains, manholes, lift stations and associated force mains. As of their most recent Operating Budget, they currently provide sewer service to 44,767 retail and bulk customers. Based on the information provided in the 2022 BJWSA Water and Wastewater Master Plan Update, Table 1.4 provides an overview of BJWSA's sewer system service components and Figure 1.7 depict the physical extents of the adjacent areas of Jasper County with sewer systems served by BJWSA (SOB).

Table1.4 BJWSA Sewer System Component Overview

Water Reclamation Facility	Pump Stations	Forcemain Length (Miles)	Gravity Main Length (Miles)
8	515	370	630

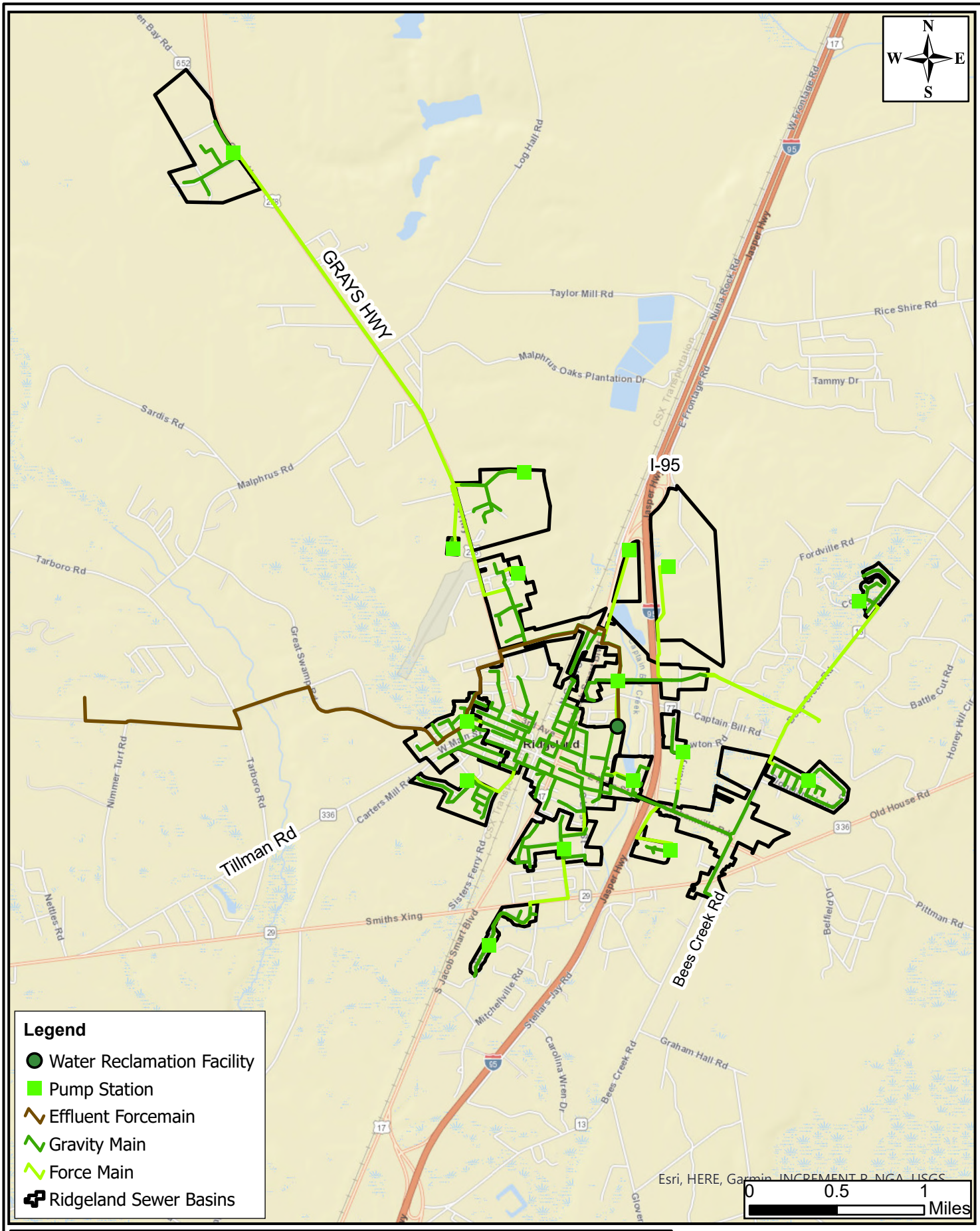

Figure 1.6 Town Sewer System Service Area

Ridgeland, SC

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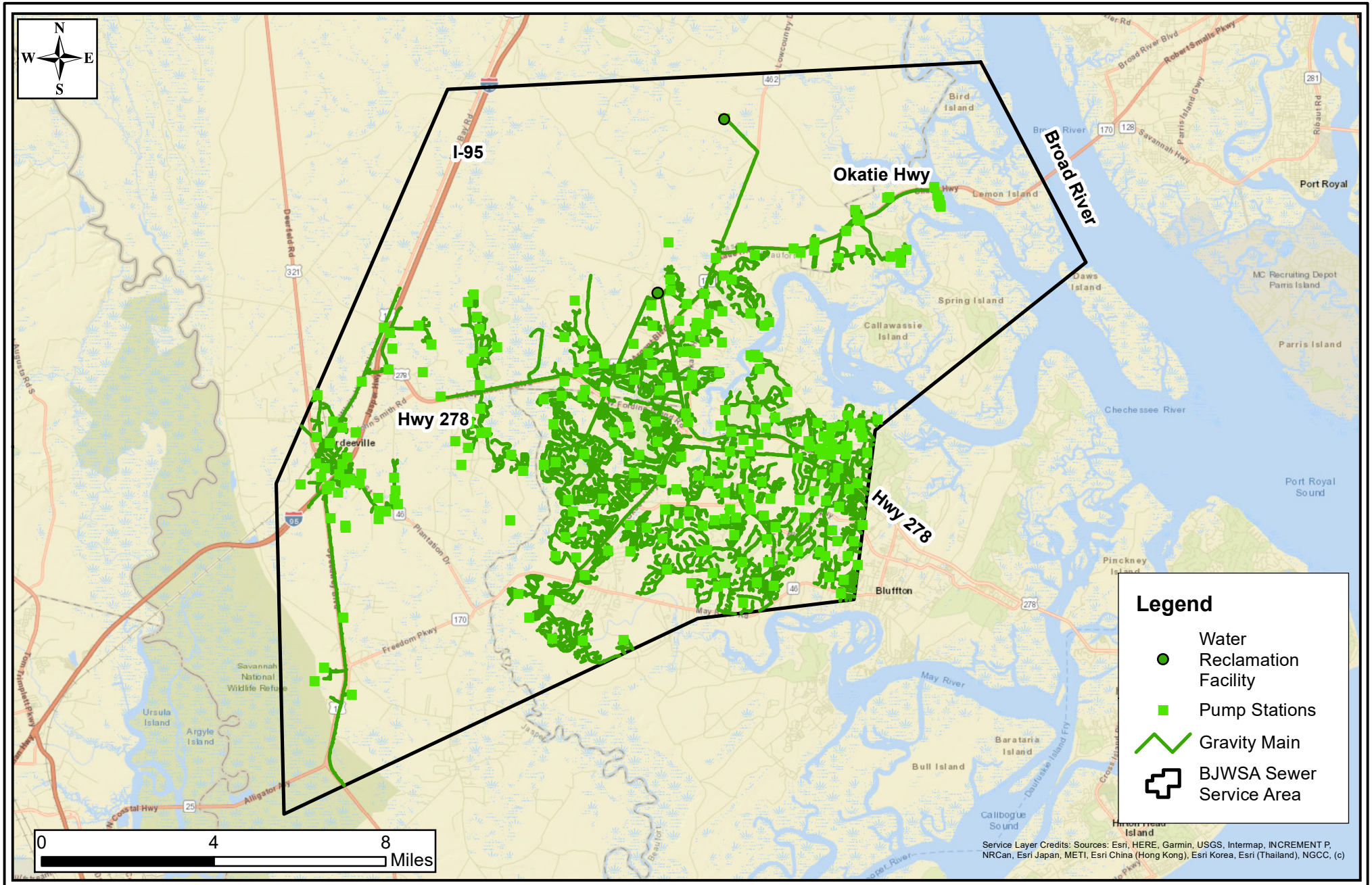

Figure 1.7
BJWSA Sewer System Service Area - SOB

Regional Water and Sewer Master Plan

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2.0 – EXISTING CONDITIONS

The goal of Section 2 is to provide a general overview of the existing water and sewer facilities mainly related to system components, historic water production and sewer generation rates, base population, per capita rates and treatment capacities. A general overview of the BJWSA water and sewer systems are addressed in the BJWSA Water and Sewer Master Plan Update. Accordingly, Section 2 of the Regional Water and Sewer Master Plan will provide a general overview of the Town of Ridgeland's water and sewer facilities and briefly discuss the system components and treatment capacities of the BJWSA water and sewer facilities.

2.1 TOWN WATER SYSTEM COMPONENTS

The Town operates and maintains a potable water system, which draws water from middle and upper Floridan aquifer wells at three different locations around the Town.

Wells one and three treat the water for distribution with liquid sodium hypochlorite, while well two currently utilizes gaseous chlorine. However, well two is in the process of converting to liquid sodium hypochlorite to standardize the Towns water disinfection process.

The Town of Ridgeland's potable water system is supplied by the following three well sites:

Town of Ridgeland Wells	Site Photo
Well #1	

Well #2	
Well #3	

The Town additionally has the following five elevated storage tanks (EST) which provide approximately 1.65 million gallons of storage:

Town of Ridgeland ESTs
High School
Cypress Ridge
Ridgeland Correctional Institution
Grahamville – Bees Creek
Captain Bill

Specific details on each of the ESTs can be found in Table 2.3 in the subsequent sections.

2.1.1. TOWN WATER PRODUCTION FACILITIES

As noted in previous sections, there are three wells that provide water for the Town's potable water system. These three wells draw water from the Floridan Aquifer, and the quality of the water is such that typically only chlorination is required for treatment. Detailed information for each facility based on the 4Waters conducted site inspections and data gathering is provided in Appendix B.

2.1.2 TOWN WATER SYSTEM PERMITS

The three facilities are permitted under 27WS002G01, 27WS002G02, and 27WS002G03 which were renewed on September 10, 2022 by the SCDHEC.

Table 2.1 provides information on the permits, the location of the wells, and the permitted aquifer withdrawal. As noted in the table, the source water for the water systems is provided from the Upper and Middle Floridan Aquifer.

Table 2.1 – Town Water System Permits – Wells

South Carolina Department of Health and Environmental Control (DHEC)	No. of Wells Permitted	Town Well ID	Total Permitted Allowed Monthly ADF (MGD)	Total Permitted Allowed Annual ADF (MGD)	Aquifer Withdrawal	Permit Expiration Date	Total No. of Wells in Use Under Permit
27WS002G01	1	Well 3	1.05	1.07	Middle Floridan	10/31/2027	1
27WS002G02	1	Well 2	0.47	0.48	Middle Floridan	10/31/2027	1
27WS002G03	1	Well 1	0.31	0.32	Upper Floridan	10/31/2027	1
Withdrawal Limit from all Sources (MGD)				1.87			

2.1.3 TOWN ELEVATED STORAGE TANKS

All wells are controlled by tank levels in the Ridgeland Prison tank, and the remaining tanks vary freely with the system pressure and are prevented from overflow by adjacent altitude valves. Operating levels throughout the year are varied to attempt proper turnover and mixing in all tanks.

Elevated storage tank information is summarized in Table 2.2.

Table 2.2 – Town Elevated Storage Tanks

Elevated Storage Facility	Facility ID	Volume (MG)	Height (ft)	Material
High School	2	0.25	140	Steel
Captain Bill	3	0.25	110	Steel
Grahamville-Bees Creek	4	0.15	140	Steel
Prison Tank	5	0.25	143	Steel
Cypress Ridge	6	0.50	115	Steel
Total Volume (MG)		1.40		

2.1.4 TOWN MAJOR WATER TRANSMISSION SYSTEMS

The purpose of the 2023 Regional Water and Sewer Master Plan is to evaluate the condition and needs of the existing potable water system and plan for future growth and expansion of the service areas. A comprehensive assessment of all components of the water systems is not necessary to achieve these goals in an effective manner. 4Waters collaborated with the Town to define the main components of the water system including water mains, source water from groundwater well, and treatment, storage, and pumping facilities. In total, these components of the system have been termed the Major Water Transmission System (MWTS). All components of the major water transmission system are public and maintained by Town staff.

The limits and components of the MWTS are described in Table 2.3 and additionally depicted in Figure 2.1.

Table 2.3- Town Major Water Transmission System

Water System Name	Entire System Water Production Facilities	MWTS Water Water Production Facilities	Entire System Elevated Storage Tanks	MWTS Water Elevated Storage Tanks	Entire System Water Main Length (Feet)	MWTS Water Main Length (Feet)	Entire System Water Main Size Range (Inch)	MWTS Water Main Size Range (Inch)
Town of Ridgeland	3	3	5	5	208,300	207,770	2 to 12	2 to 12

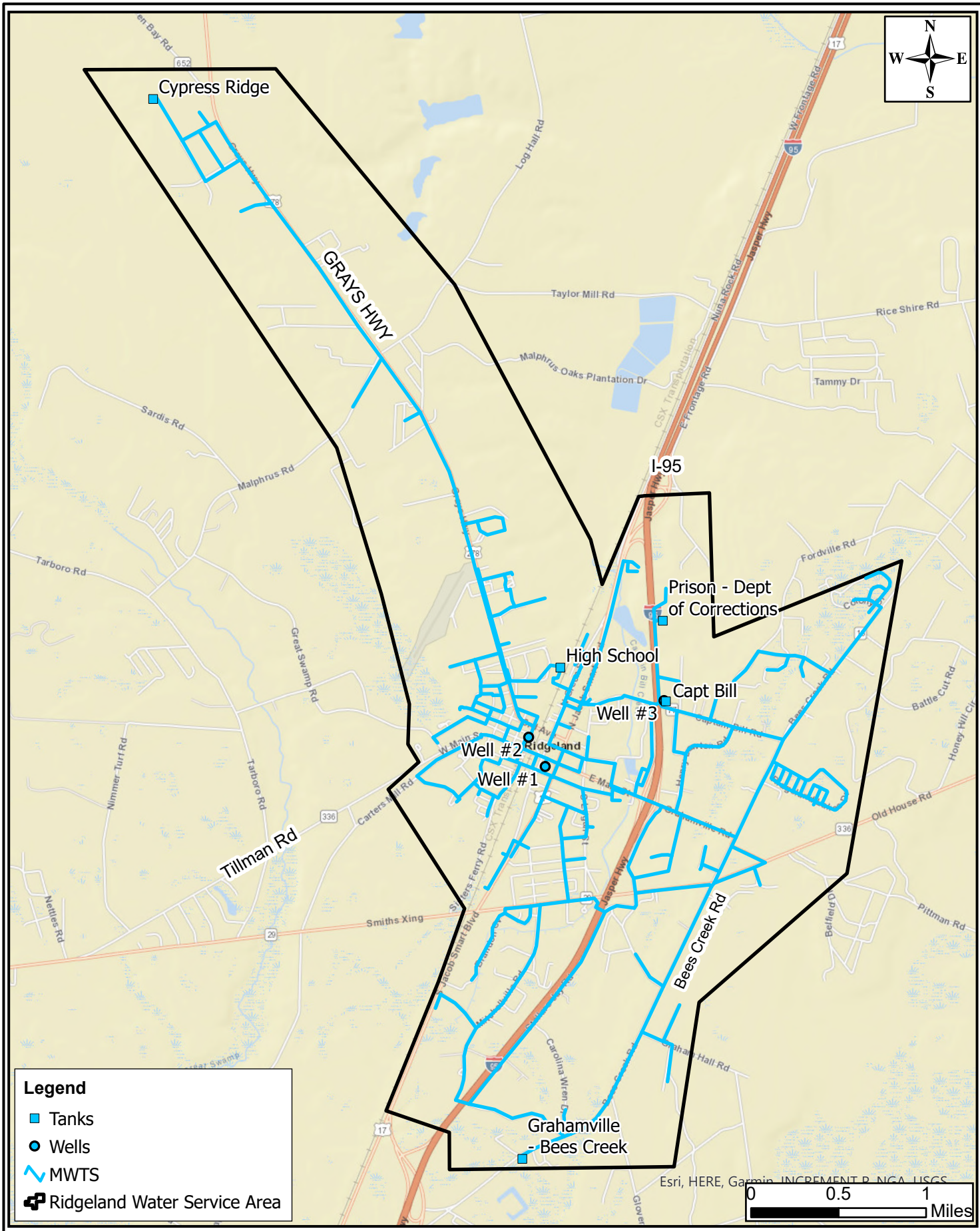

Figure 2.1 : Ridgeland Major Water Transmission System (MWTS)

Ridgeland, SC

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2.1.5 PRIVATE WELLS

Similar to other municipalities within the State of South Carolina, the Town has not been able to provide water to all developed areas within the service area. There are several reasons for this: the cost of infrastructure to serve an area may have exceeded the benefits, both economic and environmental; the low density or sparseness of construction did not make centralized water systems feasible; or areas were developed well before an organized utility department was established. The result of this, and commonly the only choice remaining for homeowners and developers, is the use of a private well system.

The data regarding permitted private wells located within the Town of Ridgeland limits was obtained from the South Carolina Department of Health and Environmental Control (SCDHEC) through a Freedom of Information Act (FOIA) Request. SCDHEC provided 4Waters with the information in the form of an Excel file. In total, the data shows that there are currently approximately 1,100 private wells located in the County, however approximately 500 are in the Town of Ridgeland limits. Figure 2.2 depicts the private well locations as derived from the SCDHEC data.

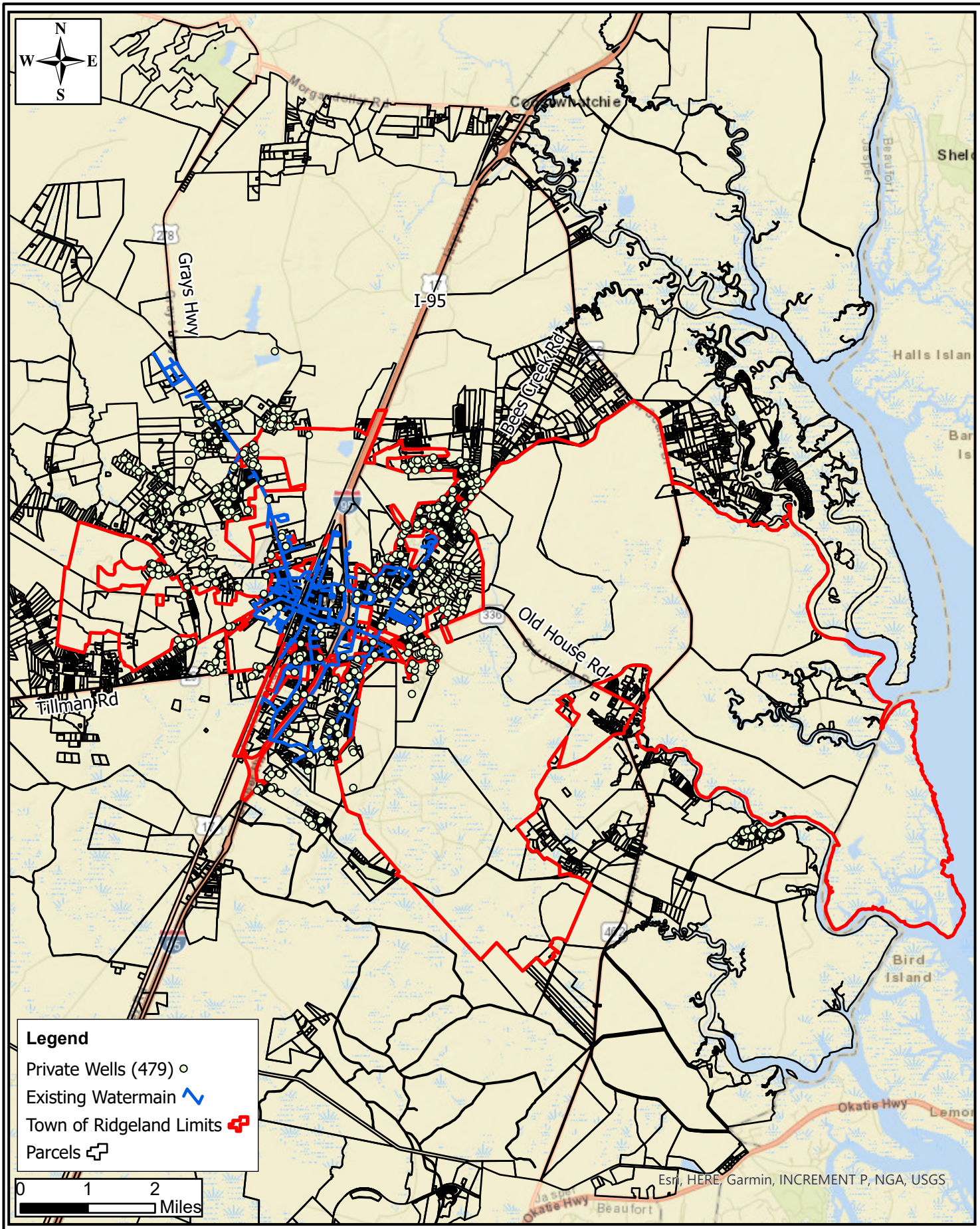

Figure 2.2 Private Wells

Ridgeland, SC

DISCLAIMER: This map is for reference and discussion purposes only. Data provided are derived from multiple sources with varying levels of accuracy. The information shown hereon is not intended for site specific use or design.

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2.1.6 TOWN BASE POPULATION FOR WATER SYSTEM AREA

Development of a base or existing population is critical for the development of the Regional Water and Sewer Master Plan, as it is used for the determination of a per capita water demand, which forms the basis for future water projections. Table 2.4 below shows the 2022 population broken out for both the Town and Prison. It was important to separate these populations as water use behaviors vary. The Town's population was derived from customer billing account data and the prison population was based on an inmate count.

Table 2.4 Town Water Service Area 2022 Population

Water System	Service Area 2022 Population
Town of Ridgeland	3,118
Ridgeland Prison	1,163
Total	4,281

2.1.7 TOWN HISTORIC WATER PRODUCTION RATES

The total monthly flow, monthly average daily flow (monthly ADF), and annual average daily flow (AADF) water production for each water system from January 2021 through December 2022 is provided in Table 2.5. The monthly ADF values for the Town of Ridgeland well systems were calculated based on total monthly water production records provided by the Town. Based on this information the average water production has slightly increased across each of the three well systems, which is likely attributable to the water systems expansion over time to increase the number of people served.

Table 2.5 – Town Average Historic Water Production for Each Well System

Date	Well #1 (MG)	Well #2 (MG)	Well #3 (MG)	Total (Total MG)
Jan-21	0.19	0.10	0.28	0.57
Feb-21	0.17	0.10	0.30	0.57
Mar-21	0.18	0.10	0.32	0.60
Apr-21	0.20	0.11	0.38	0.70
May-21	0.20	0.12	0.38	0.70
Jun-21	0.22	0.12	0.39	0.74
Jul-21	0.13	0.13	0.40	0.66
Aug-21	0.21	0.13	0.38	0.73
Sep-21	0.16	0.14	0.41	0.71
Oct-21	0.19	0.11	0.34	0.64
Nov-21	0.30	0.18	0.10	0.58
Dec-21	0.26	0.14	0.18	0.58
Jan-22	0.09	0.13	0.33	0.55
Feb-22	0.19	0.11	0.28	0.57
Mar-22	0.19	0.11	0.29	0.58
Apr-22	0.23	0.13	0.44	0.79
May-22	0.22	0.12	0.49	0.84
Jun-22	0.10	0.16	0.60	0.86
Jul-22	0.00	0.18	0.66	0.84
Aug-22	0.15	0.15	0.57	0.86
Sep-22	0.22	0.12	0.52	0.87
Oct-22	0.37	0.21	0.15	0.72
Nov-22	0.44	0.23	0.01	0.68
Dec-22	0.34	0.18	0.23	0.76
2021 AADF (MGD)	**0.20**	**0.12**	**0.32**	**0.65**
2022 AADF (MGD)	**0.21**	**0.15**	**0.38**	**0.74**

Future Average Daily Flow projections are based on population projections and the calculated per capita water demand usage. However, to determine the future Maximum Daily Flow (MDF) it is necessary to identify the maximum day water production and calculate a maximum day to average day ratio. The Average Day and Maximum Day recorded water production for the Town for 2022 are provided in Table 2.6.

Table 2.6 – Town Average and Maximum Day Historic Water Production for the Town of Ridgeland

Date	Average Day Production (MGD)	Maximum Day Production (MGD)
Jan-22	0.55	1.06
Feb-22	0.52	1.21
Mar-22	0.58	0.90
Apr-22	0.77	1.30
May-22	0.84	1.28
Jun-22	0.83	1.40
Jul-22	0.84	1.16
Aug-22	0.86	1.49
Sep-22	0.84	1.47
Oct-22	0.72	1.22
Nov-22	0.66	0.99
Dec-22	0.76	1.27
Average/Maximum	**0.73**	**1.49**

**Data Unavailable*

The Maximum Day Factors (MDF) were calculated for each system by dividing the overall Maximum Day Production by the annual ADF for 2022 as provided in Table 2.6.

The Peak Hour Flow (PHF) factor was calculated for the system by multiplying the maximum factor on the composite (Residential and Commercial) diurnal curve (1.33) by the Maximum Day Factor. The MDF and PHF for each system is presented in Table 2.7. The diurnal curve is further described in the following section.

Table 2.7 – Town Maximum Day and Peak Hour Factors

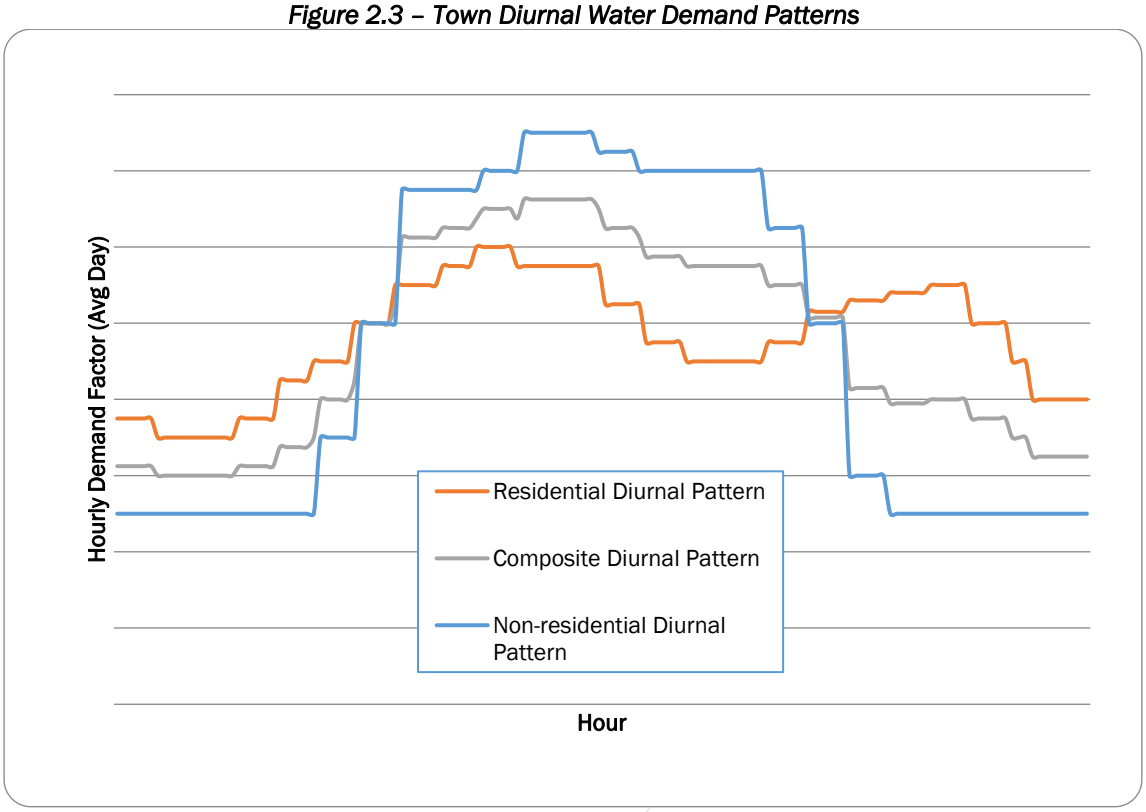
Water System	MDF Factor	PHF Factor
Town of Ridgeland	2.04	2.71

A typical range of peaking coefficients in the United States for MDF and PHF are 1.5 to 3.5 and 2.0 to 7.0, respectively. The common range for MDF is 1.8 to 2.8 and for PHF is 2.5 to 4.0. These coefficients are published in the *Water Distribution System Handbook,* Larry W. Mays, 2000. The factors calculated for the Town concur with these typical and common ranges.

2.1.8 TOWN DAILY DEMAND

Water demands vary throughout the day and can be significantly different among residential and commercial users. Daily demand variations are typically shown on a diurnal demand curve, which plots the percentage of daily demand versus time, hourly, over a 24-hour period. The residential curve developed by American Water Works Association (AWWA Manual M32, 1989) was utilized as a starting point. Model scenarios for planning purposes were performed using a single composite diurnal pattern applied to aggregated water demand projections. Figure 2.3 displays the diurnal pattern used for this study.

Figure 2.3 – Town Diurnal Water Demand Patterns



2.1.9 TOWN SEASONAL CHANGES

Water demand for the water system were seasonal in nature, having consistent increase from April through September. This seasonal increase is most likely due to higher irrigation uses during the summer months. The hydraulic model scenarios included modeling of maximum day conditions, which exceed the peak demands experienced during the high seasonal use.

2.1.10 TOWN WATER USAGE PER CAPITA

Development of a per capita value is critical to the development of the Regional Water and Sewer Master Plan, as it is used for the determination of the projected water usage rate through 2043. The per capita water usage was evaluated by dividing the monthly average water production/consumption for the service area by the base water population for both the Town and Prison. It was important to separate these two per capita rates as the water usage behavior for the Town varies from the usage by the Prison inmate population. The water usage per capita rates for the service area are provided in Table 2.8.

Table 2.8 – Town Water System Per Capita Water Usage Rate

Water System User Type	Per Capita Rate (gpc/d)
Town of Ridgeland	151
Ridgeland Prison	180

2.2 BJWSA WATER SYSTEM COMPONENTS AND CAPACITIES

As mentioned in Section 1, the BJWSA water system consists of two surface water treatment plants (WTP), three aquifer-storage recovery wells (ASR), nine groundwater supply wells, 18 water pumping stations, 22 finished water storage facilities and over 1,500 miles of watermain.

Table 2.9 below provides a summary of the projected BJWSA water system capacities as provided in the BJWSA 2015 Water and Wastewater Master Plan.

Table 2.9 – BJWSA Water System Capacity

Capacity Source*	Total (Total MGD)
BJWSA Permitted WTP Capacity	39.00
Permitted ASR Capacity	10.44
Permitted Auxiliary Well Capacity	7.20
Total System Capacity	**56.64**

**Based on Available information from the 2015 BJWSA Master Plan*

2.3 TOWN SEWER SYSTEM COMPONENTS

2.3.1 TOWN WATER RECLAMATION FACILITY

The Town owns and operates the Town of Ridgeland Jimmy Mixson Water Reclamation Facility (WRF), which is located at 366 Preacher Road. The facility treats the wastewater collected from a 5.6 square-mile area of the Town of Ridgeland to achieve wastewater treatment standards in line with the National Pollutant Discharge Elimination System (NPDES) permit requirements for discharge of treated wastewater to state waters under the South Carolina Department of Health and Environmental Control (SCDHEC) Permit Number SCR10Z2HP (issued December 2018).The WRF has a permitted capacity of 1.6 MGD Average Design Flow (ADF).

Jimmy Mixson Water Reclamation Facility

The facility generally consists of the following:

- Influent and Headworks
  - An influent pump station consisting of two submersible pumps
  - A combined screening and grit tank headworks consisting of a 1/8-inch screen with spiral brush and grit settling tank with horizontal and vertical grit conveyor.
- Treatment
  - Two Intermittent Cycle Extend Aeration System (ICEAS) basins, which are modified conventional sequential batch reactors (SBRs), with aerators and decanters in each basin and three blowers that provide oxygen for the system
  - A post-equalization pond with aerator
  - One ultrascreen filtration
- Disinfection
  - Two banks of UV disinfection in one channel
- Solids Handling
  - One sludge holding pond aerated by 12 surface aerators
  - Sludge dewatering with permeable Geotube bags
  - Disposal at Hickory Hill Landfill
- Disposal
  - Effluent pipe which outfalls to Captain Bill Creek
  - Public access reuse system
    - Public access reuse irrigation system at Nimmer Turf Farm with three vertical turbine pumps.

The WRF discharges its effluent through two outfalls: surface water discharge to Captain Bill Creek and a land application discharge to a public access reuse system. Table 2.10 provides information on the permit parameters.

Table 2.10 Town Sewer System Permit – WRF

Sewer System	SCDHEC Permit No.	Discharge Method	Effective Date	Expiration Date	Permit Parameters	Discharge Limitations: Pounds per Day		Discharge Limitations: Monthly/Weekly Average	
						Interim	Final	Interim	Final
Town of Ridgeland Jimmy Mixson Water Reclamation Facility	SC0049158	1. Land application discharge to a public access reuse system	12/17/2018	12/17/2023	Flow	--		0.8 MGD	
					$CBOD_5$	167 (Monthly Average) / 251 (Weekly Average)		25.0 mg/L / 40.0 mg/L	
					TSS	600 (Monthly Average) / 900 (Weekly Average)		90.0 mg/L / 135.0 mg/L	
					Nitrates (Total as N)	--		Monitor and Report	
					Hardness as $CaCO_3$	--		Monitor and Report	
					DO	--		1.0 mg/L minimum, at all times	
					pH	--		6.0-8.5	
		2. Surface water discharge to Captain Bill Creek			Flow	--		Monitor and Report	
					BOD_5	107 (Monthly Average) / 161 (Weekly Average)		8.0 mg/L / 12.0 mg/L	
					TSS	400 (Monthly Average) / 600 (Weekly Average)		30.0 mg/L / 45 mg/L	
					NH_3-N (Mar-Oct)	13 (Monthly Average) / 20 (Weekly Average)		1.0 mg/L / 1.5 mg/L	
					NH_3-N (Nov-Feb)	44 (Monthly Average) / 66 (Weekly Average)		3.3 mg/L / 4.9 mg/L	
					UOD (Mar-Oct)	227 (Monthly Average) / 341 (Weekly Average)		17.0 mg/L / 25.5 mg/L	
					UOD (Nov-Feb)	460 (Monthly Average) / 689 (Weekly Average)		34.4 mg/L / 51.6 mg/L	
					TRC	0.15 (Monthly Average) / 0.25 (Daily Maximum)		0.011 mg/L / 0.019 mg/L (Daily Maximum)	
					DO	--		6.0 mg/L minimum, at all times	
					pH	--		6.0-8.5	
					BOD_5 (% Removal)	--		85% (Minimum, Monthly Average)	
					TSS (% Removal)	--		85% (Minimum, Monthly Average)	
					Hardness as $CaCO_3$	--		Monitor and Report	
					Total Cadmium (Cd)	Monitor and Report	0.012 (Monthly Average) / 0.023 (Daily Maximum)	Monitor and Report	0.0009 mg/L / 0.0018 mg/L (Daily Maximum)
					Total Copper (Cu)	Monitor and Report	0.130 (Monthly Average) / 0.169 (Daily Maximum)	Monitor and Report	0.0097 mg/L / 0.0127 mg/L (Daily Maximum)
					Total Lead (Pb)	Monitor and Report	0.047 (Monthly Average) / 1.212 (Daily Maximum)	Monitor and Report	0.0035 mg/L / 0.0908 mg/L (Daily Maximum)
					Total Zinc (Zn)	Monitor and Report	2.137 (Monthly Average) / 2.137 (Daily Maximum)	Monitor and Report	0.1601 mg/L / 0.1601 mg/L (Daily Maximum)
					Total Mercury (Hg)	0.0007 (Monthly Average) / 0.001 (Daily Maximum)		0.000051 mg/L / 0.000075 mg/L (Daily Maximum)	

2.3.2 TOWN FORCEMAIN AND PUMP STATION SYSTEMS

Forcemains

The Town sewer system includes approximately 60, 000 LF of forcemain which varies in size from 2- to 6- inch piping. Roughly two-thirds of the pump stations discharge to either a manhole or directly to another pump station. PS1, PS3, PS4, PS5, PS10 and PS12 are all manifolded stations.

The forcemains are constructed of polyvinyl chloride (PVC) and ductile iron, however, the exact length of each material is unknown.

Additionally, there is 15,600 LF of effluent forcemain from the WRF to a land application site.

Pump Stations

As noted in Section 1.5, there are 16 pump stations in the Town's sewer system. Table 2.11 below provides a general overview of each pump stations, then the subsequent sections provide a more specific table, site picture, and flow schematic with information of the pump stations including location, station type, wet well size and depth, piping material, pump information and discharge location. Each pump station table includes information representing the results of field conducted drawdown testing.

Additionally, Figure 2.4 is provided below to show an overall flow schematic of the City's collection and pumping system that details the pump station routes to the WRF.

Table 2.11 – Town Pump Station Summary

Pump Station Number	Location	Pump Type	Pump Discharge Size (In)	Pump Mfc and Model	Motor HP	No. Pumps
PS1	250 First Ave	Submersible	6"	ABS	10	2
PS2	276 Wise St	Submersible	6"	ABS	3.8	2
PS3	11306 North Jacob Smart Blvd	Submersible	10"	ABS	10	3
PS4	123 James Taylor Dr	Submersible	6"	ABS	4	2
PS5	1514 Grays Hwy	Grinder	2"	PIRANHA	2.41	2
PS6	135 Correctional Rd	Submersible	4"	ABS	15	2
PS7	655 Wood Duck St	Submersible	4"	BARMESA	7.5	2
PS8	4399 Grays Hwy	Submersible	4"	ABS	15	2
PS9	2070 Grays Hwy	Submersible	4"	ABS	23	2
PS10	7 Spruce Pine Rd	Submersible	4"	ABS	10	2
PS11	343 Sycamore Dr	Submersible	4"	ABS	14.1	2
PS12	12038 North Jacob Smart Blvd	Submersible	4"	ABS	2.9	2
PS13	677 Brandon Cove	Submersible	4"	ABS	12	2
PS14	1522 Colony Dr	Submersible	4"	ABS	10	2
PS15	407 Firefly Dr	Submersible	6"	ABS	4.7	2
PS16	1765 Grays Hwy	Grinder	2"	ABS	2	2

Pump Station No. 1

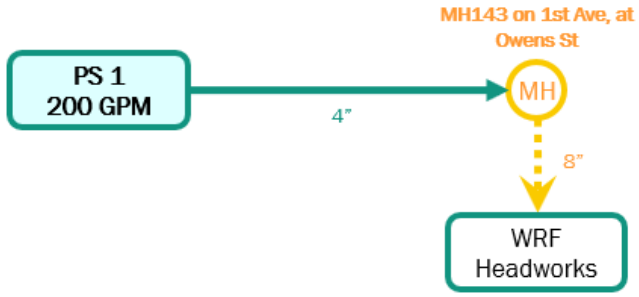
PS-1			
Location:	1st Avenue	Type:	Duplex Submersible

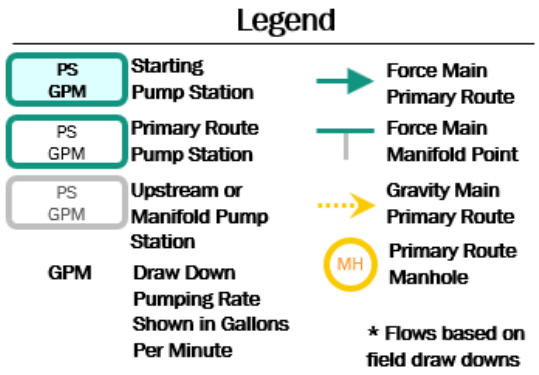
Wet Well	
Size:	8-feet
Depth:	22 feet
Material/ Coating:	Concrete / Coal Tar Epoxy
Generator	Yes

Pump	
Draw Down Rating:	194 gpm @ 32.6' TDH/163 gpm @ 32.8' TDH
Manufacturer / Model:	ABS Submersible
Horsepower:	10 HP

Discharge	
Piping Size:	6-inch
Piping Material:	Ductile Iron
Location:	MH143 on 1st Ave, at Owens St

Pump Station No. 1



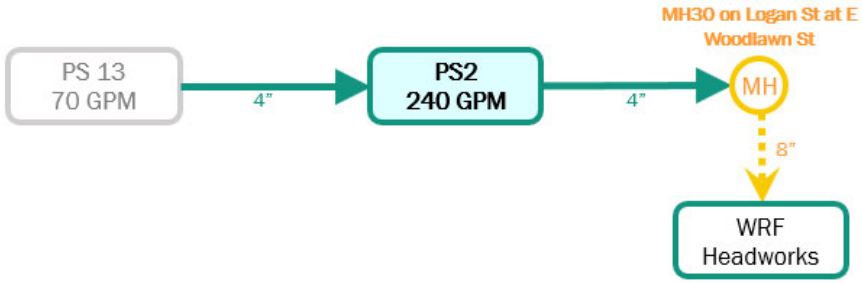


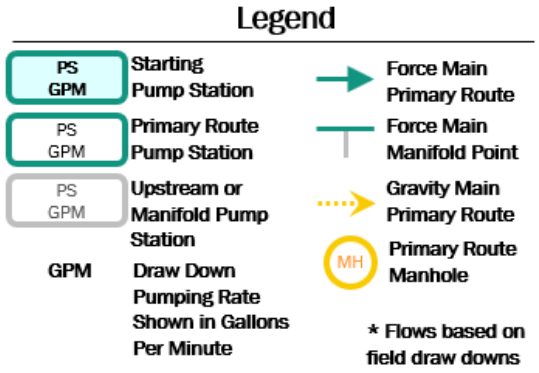
Pump Station No. 2

PS-2			
Location:	Wise Street	Type:	Duplex Submersible

Wet Well		Pump		Discharge	
Size:	8-feet	Draw Down Rating:	213 gpm /244 gpm	Piping Size:	6-inch
Depth:	20 feet	Manufacturer / Model:	ABS/SFP100C CB1	Piping Material:	Ductile iron
Material/ Coating:	Concrete/ Green Coating	Horsepower:	3.8 HP	Location:	MH30 on Logan St at E Woodlawn St
Generator	Yes				

Pump Station No. 2



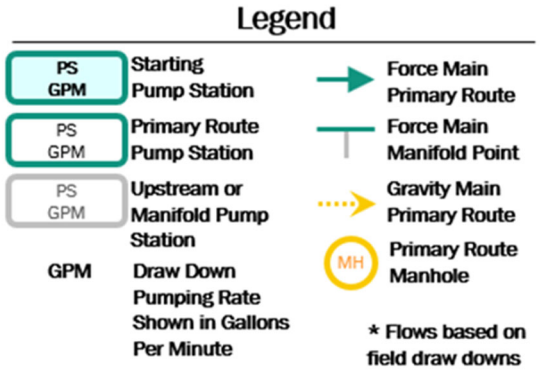


Pump Station No. 3

PS-3			
Location:	11306 North Jacob Smart Blvd	Type:	Triplex Submersible

Wet Well		Pump		Discharge	
Size:	8-feet	Draw Down Rating:	385 gpm (no pressure reading)	Piping Size:	6-inch
Depth:	23 feet	Manufacturer / Model:	Sulzer/ ABS / XFP105J-CB2 15" IMP	Piping Material:	Ductile Iron
Material/ Coating:	Concrete / Coal Tar Epoxy	Horsepower:	10 HP	Location:	WRF
Generator	No				

Pump Station No. 3

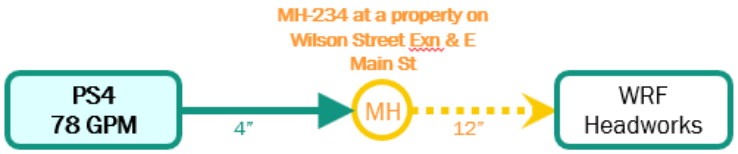


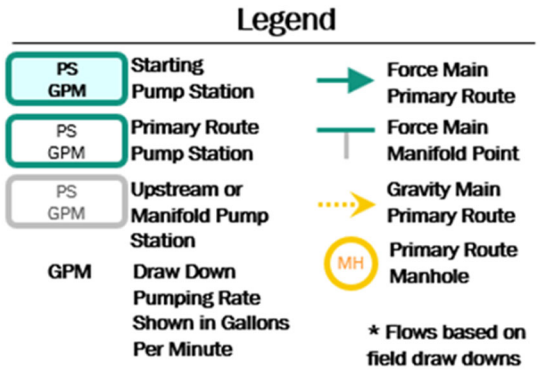
Pump Station No. 4

PS-4			
Location:	123 James Taylor Drive	Type:	Duplex Submersible

Wet Well		Pump		Discharge	
Size:	6-feet	Draw Down Rating:	78 gpm (no pressure reading)	Piping Size:	4-inch
Depth:	19 feet	Manufacturer / Model:	ABS / XFP100 CB1 10 1/3" IMP	Piping Material:	Ductile Iron
Material / Coating:	Concrete / None	Horsepower:	4 HP	Location:	MH-234 at a property on Wilson Street Exn & E Main St
Generator	Receptacle				

Pump Station No. 4

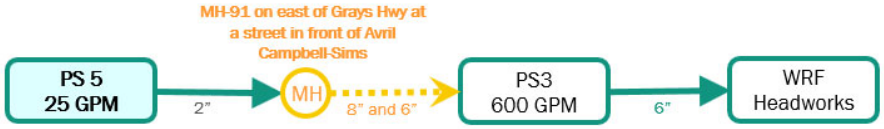


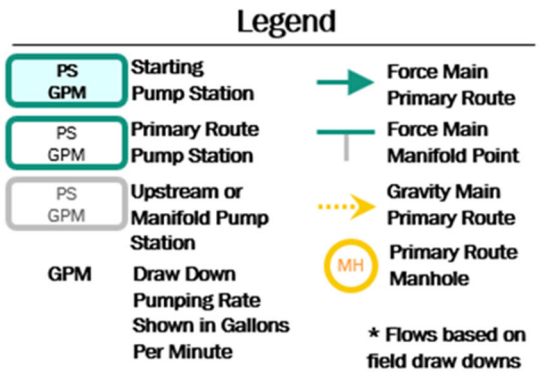


Pump Station No. 5

PS-5					
Location:	1514 Grays Highway		Type:	Duplex Submersible - Grinder	
Wet Well		**Pump**		**Discharge**	
Size:	4-feet	Draw Down Rating:	23 gpm (no pressure reading)	Piping Size:	2-inch
Depth:	10 feet	Manufacturer / Model:	Sulzer / PIRANHA S20/2D 5-2/3 Inch Imp	Piping Material:	PVC
Material/ Coating:	Fiberglass / None	Horsepower:	2.41 HP	Location:	MH-91 on east of Grays Hwy at a street in front of Avril Campbell Sims
Generator	Yes				

Pump Station No. 5



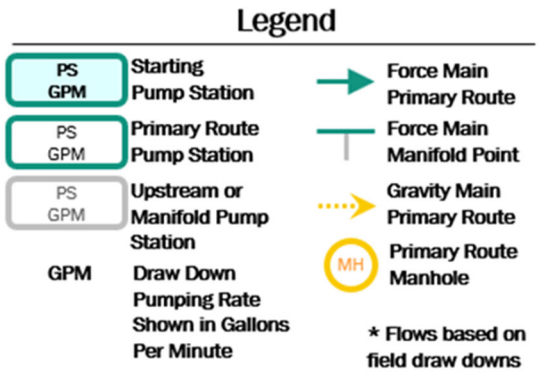


Pump Station No. 6

PS-6			
Location:	135 Correctional Road	Type:	Duplex Submersible

Wet Well		Pump		Discharge	
Size:	8-foot	Draw Down Rating:	338 gpm (no pressure reading)	Piping Size:	4-inch
Depth:	18 feet	Manufacturer / Model:	ABS / XFP100E CB1.1-PE105/4	Piping Material:	Ductile Iron
Material/ Coating:	Concrete / None	Horsepower:	14.1 HP	Location:	MH-126 on east of Jasper Hwy at west of Grayco Lumber And Hardware
Generator	Yes				

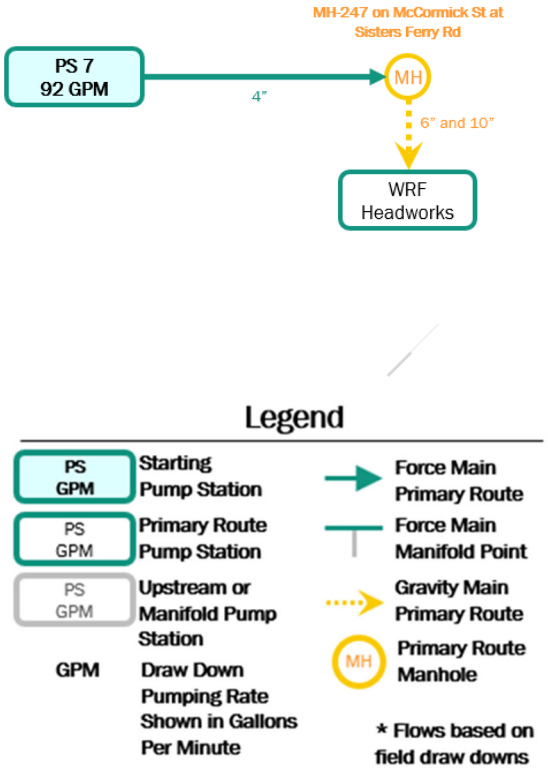
Pump Station No. 6



Pump Station No. 7

PS-7					
Location:	Carters Mill		Type:	Submersible	
Wet Well		**Pump**		**Discharge**	
Size:	6-feet –	Draw Down Rating:	127 gpm (no pressure reading)	Piping Size:	4-inch
Depth:	18	Manufacturer / Model:	Roto-Blade/CUT753	Piping Material:	Ductile Iron
Material/ Coating:	Concrete/None	Horsepower:	7.5 HP	Location:	MH-247 on McCormick St at Sisters Ferry Rd
Generator	Yes				

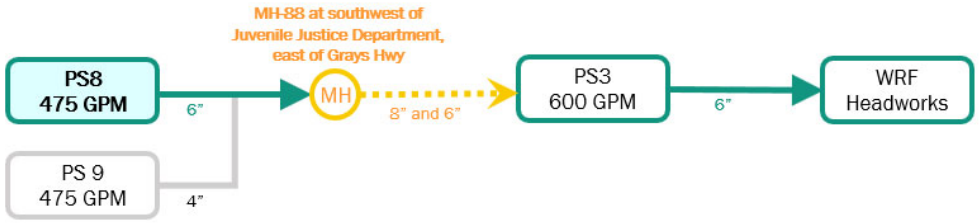
Pump Station No. 7

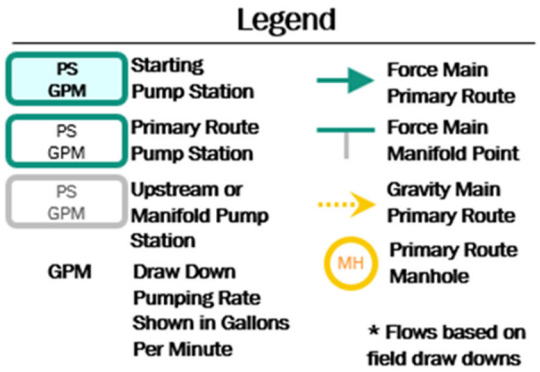


Pump Station No. 8

PS-8					
Location:	4399 Grays Highway		Type:	Duplex Submersible	
Wet Well			Pump		Discharge	
Size:	8 feet		Draw Down Rating:	472 gpm @ 67.3' TDH/545 gpm @ 121.5' TDH	Piping Size:	4-inch
Depth:	20 feet		Manufacturer / Model:	Flygt / 3140.180-0546	Piping Material:	Ductile Iron
Material/ Coating:	Concrete / None		Horsepower:	15 HP	Location:	MH-88 at southwest of Juvenile Justice Department, east of Grays Hwy
Generator	Receptacle					

Pump Station No. 8

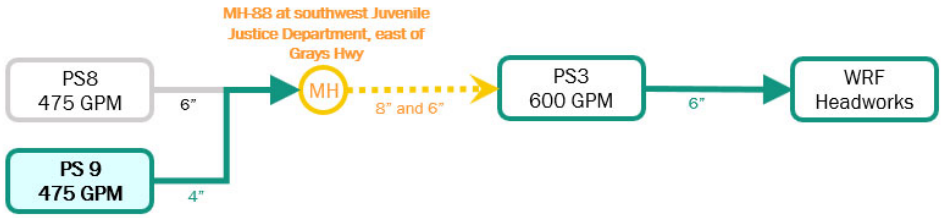


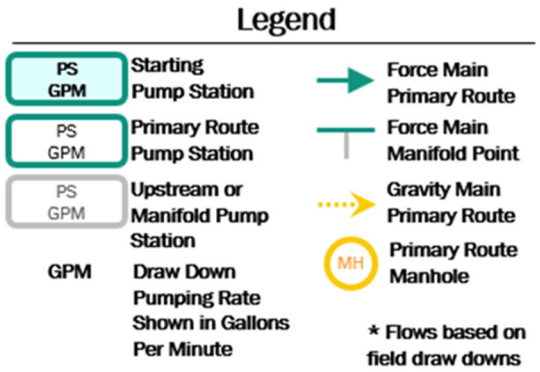


Pump Station No. 9

PS-9					
Location:	2070 Grays Highway		Type:	Duplex Submersible	
Wet Well			Pump		Discharge
Size	8-foot		Draw Down Rating:	473 gpm @ 100.1' TDH/492 gpm @ 102.5' TDH	Piping Size:	4-inch
Depth:	13 feet		Manufacturer / Model:	Flygt	Piping Material:	Ductile Iron
Material/ Coating:	Concrete / None		Horsepower:	23 HP	Location:	MH-88 at southwest of Juvenile Justice Department, east of Grays Hwy
Generator	Receptacle					

Pump Station No. 9



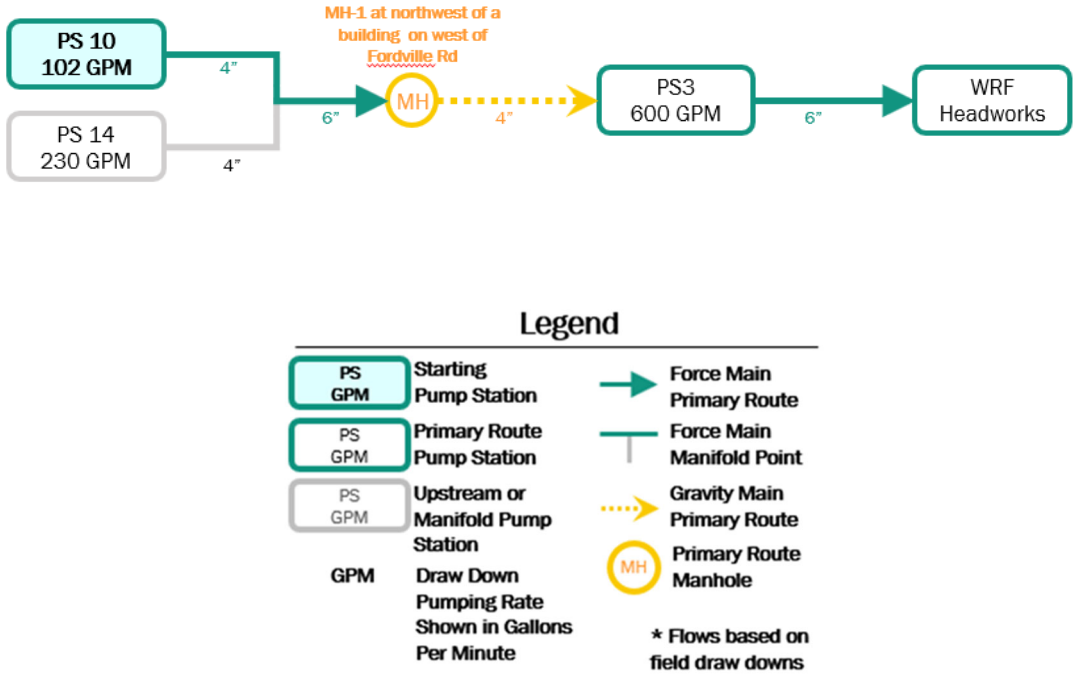


Pump Station No. 10

PS-10			
Location:	Ridgeland Lakes	Type:	Submersible

Wet Well		Pump		Discharge	
Size:	6-foot	Draw Down Rating:	102 gpm (no pressure reading)	Piping Size:	4-inch
Depth:	25 feet	Manufacturer / Model:	ABS AFP 104	Piping Material:	Ductile Iron
Material/ Coating:	Concrete/Coal Tar	Horsepower:	10 HP	Location:	MH-1 at northwest of a building on west of Fordville Rd
Generator	Yes				

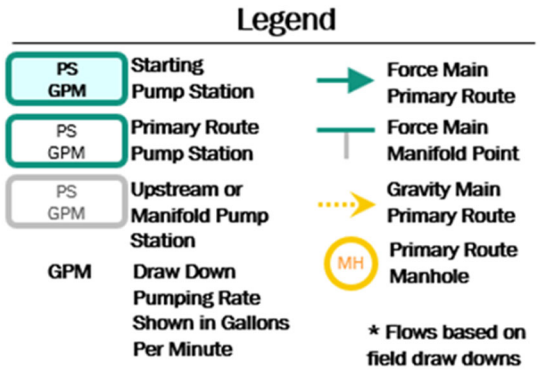
Pump Station No. 10



Pump Station No. 11

PS-11					
Location:	Camping World		Type:	Submersible	
Wet Well		Pump		Discharge	
Size:	6-feet	Draw Down Rating:	321 gpm (no pressure reading)	Piping Size:	4-inch
Depth:	24 feet	Manufacturer / Model:	ABS/XFP100E-CB.1	Piping Material:	Ductile Iron
Material/ Coating:	Concrete/Coal Tar	Horsepower:	14.1 HP	Location:	MH-26 on Grahamville Rd at Sycamore Dr
Generator	Yes				

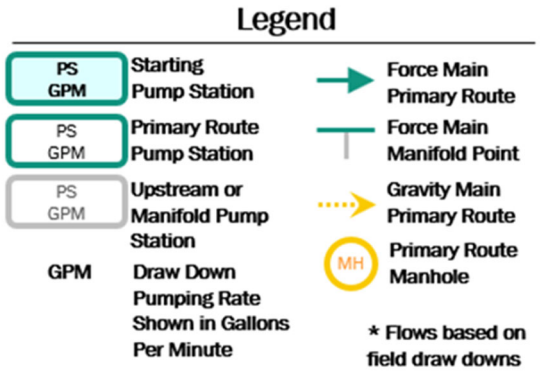
Pump Station No. 11



Pump Station No. 12

PS-12							
Location:	12038 North Jacob Smart Blvd			Type:	Duplex Submersible		
Wet Well				Pump		Discharge	
Size:	6-foot			Draw Down Rating:	76 gpm @ 17.6' TDH	Piping Size:	4-inch
Depth:	11 feet			Manufacturer / Model:	ABS M22/4D	Piping Material:	Ductile Iron
Material/ Coating:	Concrete / Coal Tar Epoxy			Horsepower:	2.9 HP	Location:	MH-127 on North Jacob Smart Boulevard
Generator		Receptacle					

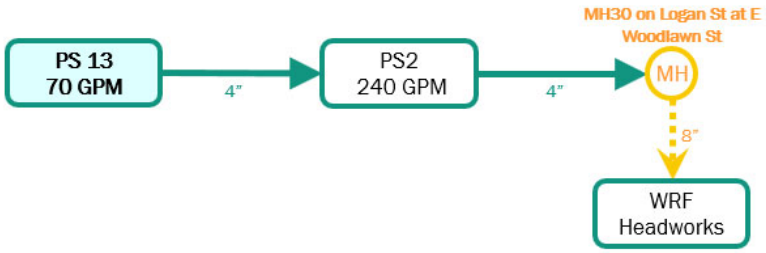
Pump Station No. 12

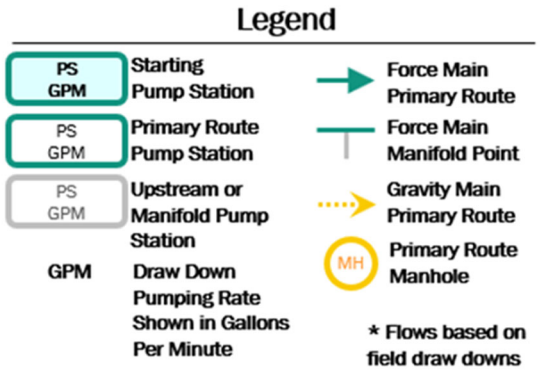


Pump Station No. 13

PS-13					
Location:	North Ridge Sub.		Type:	Submersible	
Wet Well			Pump		Discharge	
Size:	6-foot		Draw Down Rating:	70 gpm (no pressure reading)	Piping Size:	4-inch
Depth:	20 feet		Manufacturer / Model:	ABS/AFP 1049	Piping Material:	Ductile iron
Material/ Coating:	Concrete/Coal Tar		Horsepower:	12 HP	Location:	PS2
Generator	Yes					

Pump Station No. 13

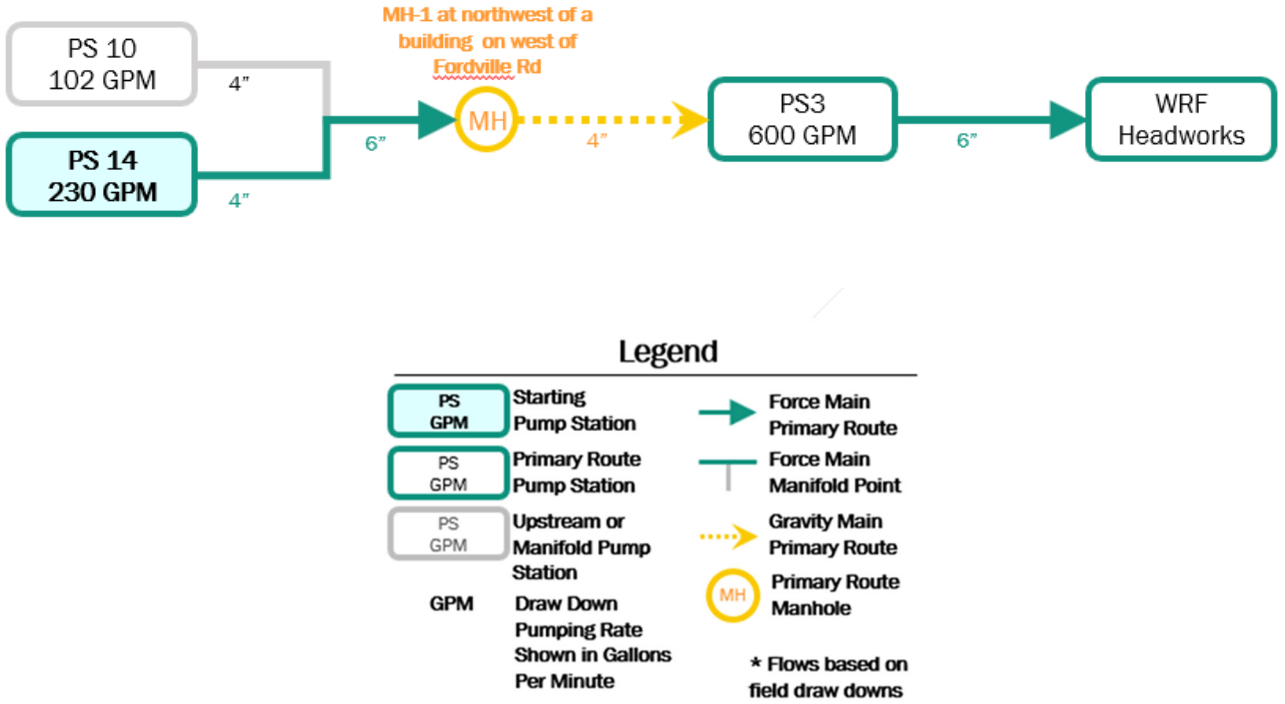




Pump Station No. 14

PS-14					
Location:	Bees Creek Plantation		Type:	Submersible	
Wet Well			Pump		Discharge	
Size:	6-feet		Draw Down Rating:	229 gpm @ 65.8 TDH/ 211 gpm @ 66.5 TDH	Piping Size:	4-inch
Depth:	27 feet		Manufacturer / Model:	ABS/AFP1049 M75/4	Piping Material:	Ductile iron
Material/ Coating:	Concrete/None		Horsepower:	10 HP	Location:	MH-1 at northwest of a building, on west of Fordville Rd
Generator	Yes					

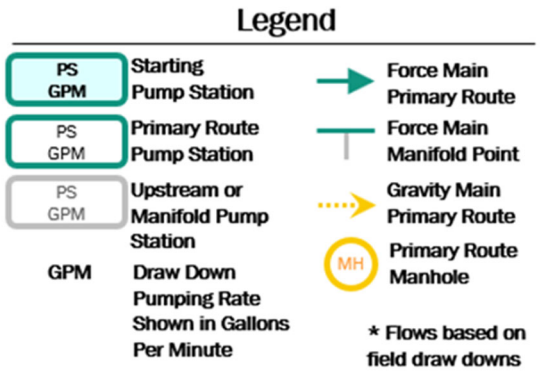
Pump Station No. 14



Pump Station No. 15

PS-15					
Location:	Firefly Dr. Next to Cell Tower		Type:	Submersible	
Wet Well			Pump		Discharge	
Size:	6-foot		Draw Down Rating:	247 gpm (no pressure reading)	Piping Size:	6-inch
Depth:	23 feet		Manufacturer / Model:	Sulzer/AFP 1040 M35	Piping Material:	Ductile iron
Material/ Coating:	Concrete/Coal Tar		Horsepower:	4.7HP	Location:	MH on Henry Lawton Rd at Allen Dr
Generator	Yes					

Pump Station No. 15



Pump Station No. 16

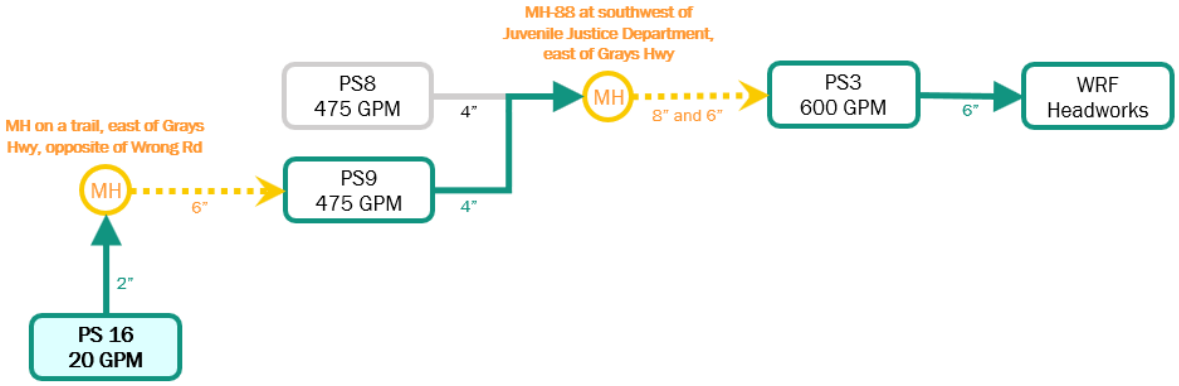
PS-16			
Location:	Airport	Type:	Submersible

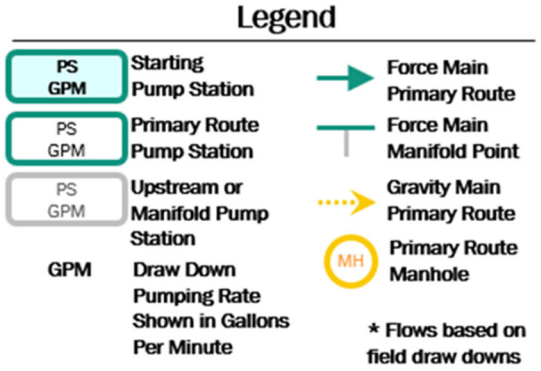
Wet Well	
Size:	5-feet
Depth:	22 feet
Material/ Coating:	Concrete/ Sewpercoat
Generator	Yes

Pump	
Draw Down Rating:	49 gpm (no pressure reading)
Manufacturer / Model:	Grinder/ABS Sulzer Piranha S-20/2D, 5.625"
Horsepower:	2 HP

Discharge	
Piping Size:	2-inch
Piping Material:	PVC
Location:	MH on a trail, east of Grays Hwy, opposite of Wrong Rd

Pump Station No. 16





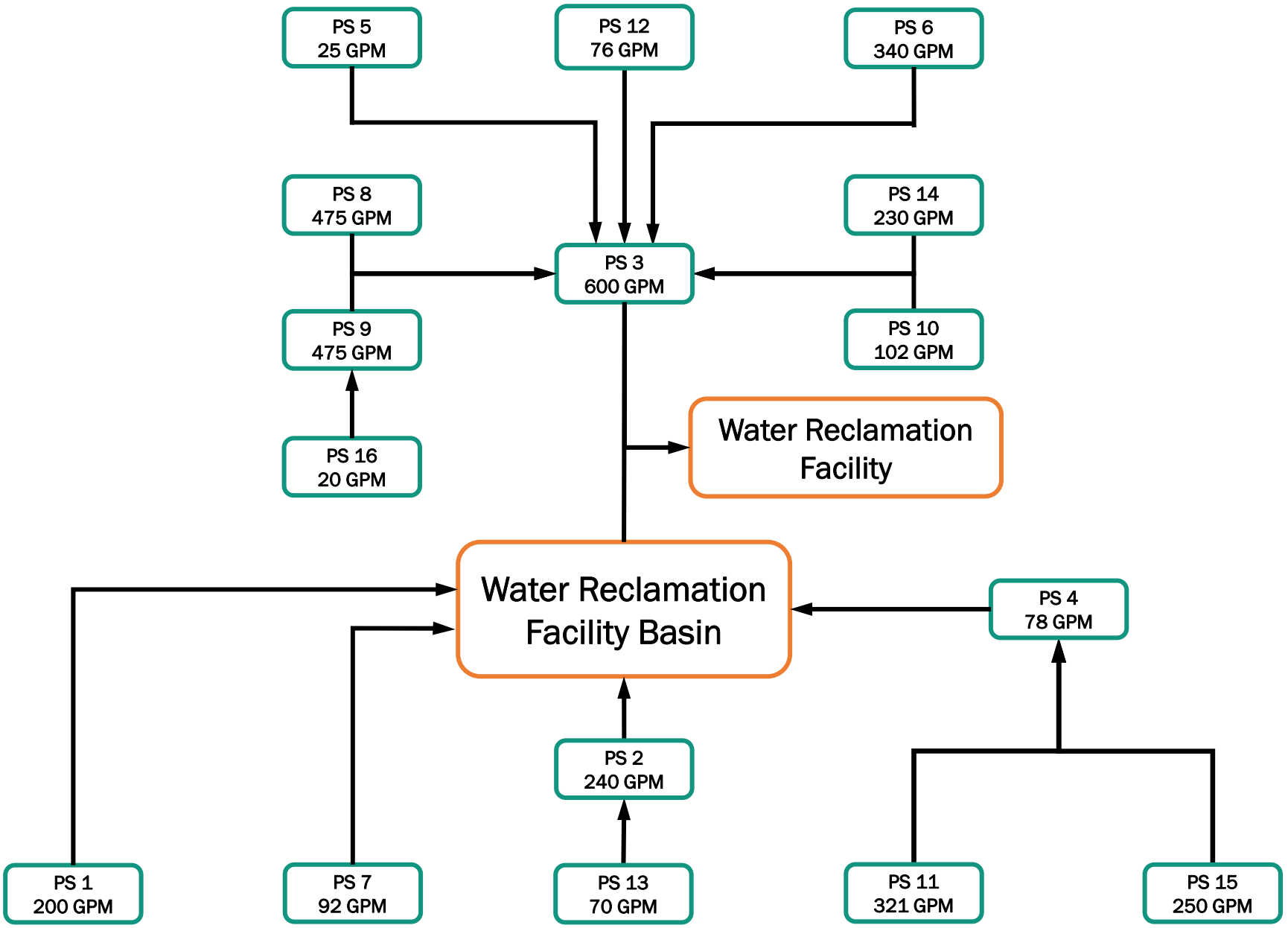


Figure 2.4: Wastewater Collection System Schematic

Town of Ridgeland, South Carolina

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2.3.3 TOWN GRAVITY SEWER SYSTEMS

The Town's pumping and collection system, as noted in Section 1.5, utilizes approximately 11 miles of forcemain and has been designed with gravity sewer mains that totals around 21 miles with approximately 524 manholes. A design of this nature can be advantageous as it reduces the power requirements for pump stations by allowing for shortened forcemains that discharge to the gravity sewer system and reduces the need to manifold forcemains. Both of these factors can increase total dynamic head losses when they occur in the system.

The gravity sewer mains range in size from 6- to 12-inch with an 18-inch gravity sewer main discharging from the WRF to the Captain Bill Creek surface water discharge. The gravity sewer mains are constructed of PVC, ductile/cast iron and vitrified clay; however, the exact length of each material is unknown.

The manholes in the system are constructed of precast concrete or in older sewer basins of the system some of the manholes are constructed of brick. In parts of the system, the manhole covers are deteriorating and allowing leakage into the system.

2.3.4 TOWN MAJOR SEWER TRANSMISSION SYSTEMS

The purpose of the 2023 Regional Water and Sewer Master Plan is to evaluate the condition and needs of the existing sewer system and plan for future growth and expansion of the service areas. A comprehensive assessment of all components of the sewer systems is not necessary to achieve these goals in an effective manner. As such, 4Waters collaborated with City staff to define the components of the sewer systems which represent the major backbone of the sewer collection and transmission systems including gravity sewer mains, pump stations, forcemains, and the WRF. In total, these components of the systems have been termed the Major Transmission Systems (MTS). All the components of the MTS are public and are maintained by the Town.

The limits and components of the MTS are described in Table 2.12. Additionally, Figure 2.5 depicts each of the 16 MTS pump station basins.

Table 2.12 – Town Entire and Major Sewer Transmission System Comparison

Entire System Pump Stations	MSTS Pump Stations	Entire System Manholes	MSTS Manholes	Entire System Forcemain Length (Feet)	MSTS Forcemain Length (Feet)	Entire System Forcemain Size Range (Inch)	MSTS System Forcemain Size Range (Inch)	Entire System Gravity Main Length (Feet)	MSTS System Gravity Main Length (Feet)	Entire System Gravity Main Size Range (Inch)	MSTS System Gravity Main Size Range (Inch)
16	16	524	86	58,675	54,565	2 to 6	2 to 6	112,347	19,619	4 to 12	6 to 12

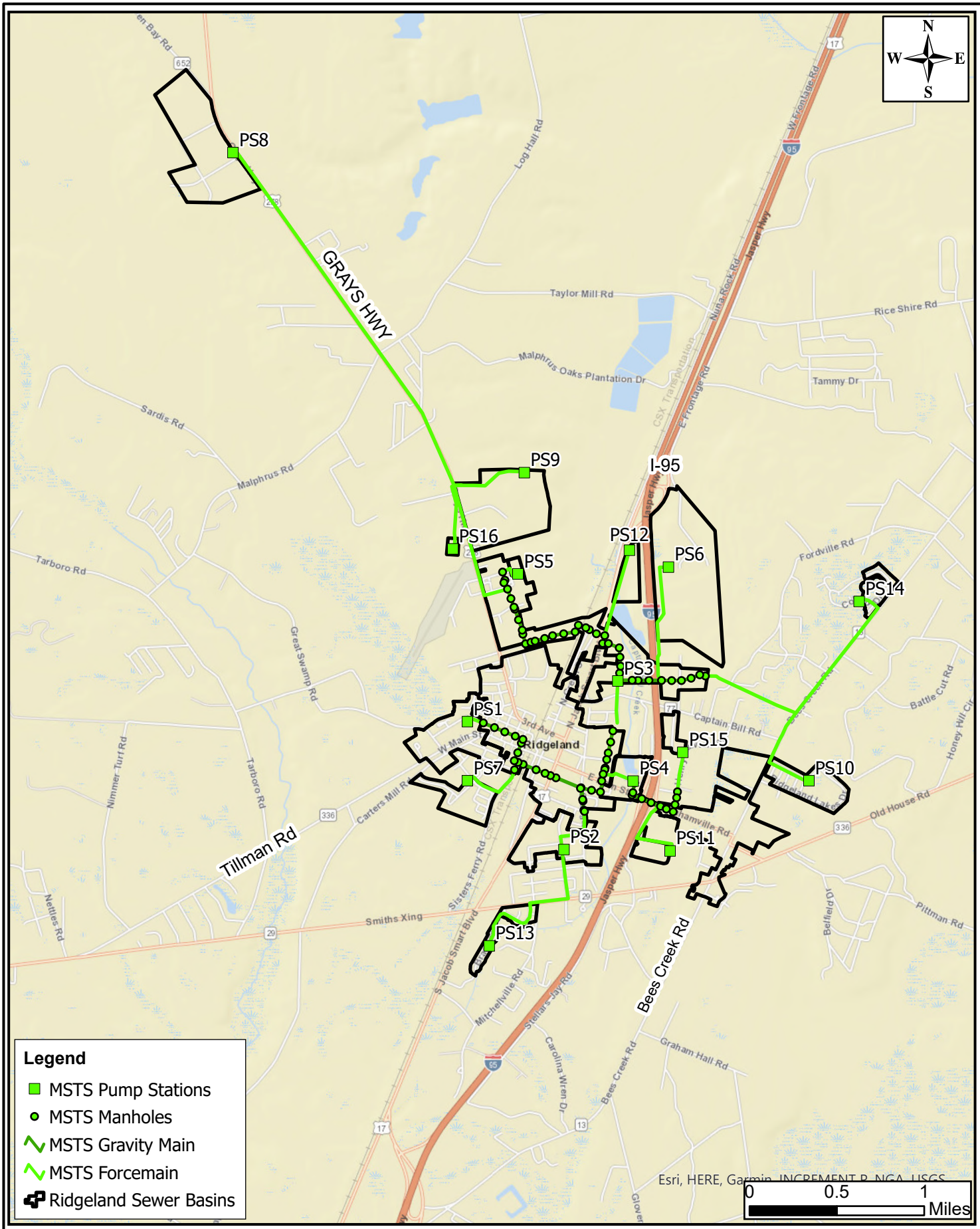

Figure 2.5 : Ridgeland Major Sewer Transmission System (MSTS)

Ridgeland, SC

DISCLAIMER: This map is for reference and discussion purposes only. Data provided are derived from multiple sources with varying levels of accuracy. The information shown hereon is not intended for site specific use or design.

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2.3.5 ON-SITE WASTEWATER DISPOSAL SYSTEMS

Similar to other municipalities within the State of South Carolina, the Town has not been able to provide sewer to all developed areas within the service area. There are several reasons for this: the cost of infrastructure to serve an area may have exceeded the benefits, both economic and environmental; the low density or sparseness of construction did not make centralized sewer systems feasible; or areas were developed well before an organized utility department was established. The result of this, and commonly the only choice remaining for homeowners and developers, is the use of on-site septic systems.

As with the data for the private wells discussed previously, data regarding permitted septic tanks located within the limits of the Town of Ridgeland were obtained from the SCDHEC through a Freedom of FOIA Request. However, unlike the permit information for private wells, the permits for septic tanks are still maintained in a physical format and were not available digitally. Once a digital copy of the scanned permits could be collected for review, almost 10,000 pages of data was reviewed in order to determine locations and age of the septic tanks if it was known. It appears most of the data in the files from SCDHEC is dated within the last 20 years. It is with that understanding that there would be a need for visual inspection of the service area to determine septic users that pre date the early 2000s. The below process was used to compile the data:

- Manually review all 10,000 pages of data to build a spreadsheet with information concerning Parel Number (TMS), Permit Date (if available), Physical Address.
    - The data yielded 380 usable permits, however many didn't have adequate address information to determine an exact location.
    - 161 permits had adequate addresses to physically locate, which were deemed as "Known".
    - If the location was unknow the following method was used to determine either an "Assumed" or "Observed" status.
        - For the Assumed status, 23 were determined based on partial address information.
        - For the "Observed" status, 2,614 were located. These were determined based on visual inspection of aerial imagery and vicinity to the existing Town sewer system. Visual inspection of aerial imagery was used to determine if an existing house was present and outside of the sewer system service area. It is anticipated that many of these "Observed" status septic systems were installed prior to 2000 and therefore not part of SCDHECs permit system.

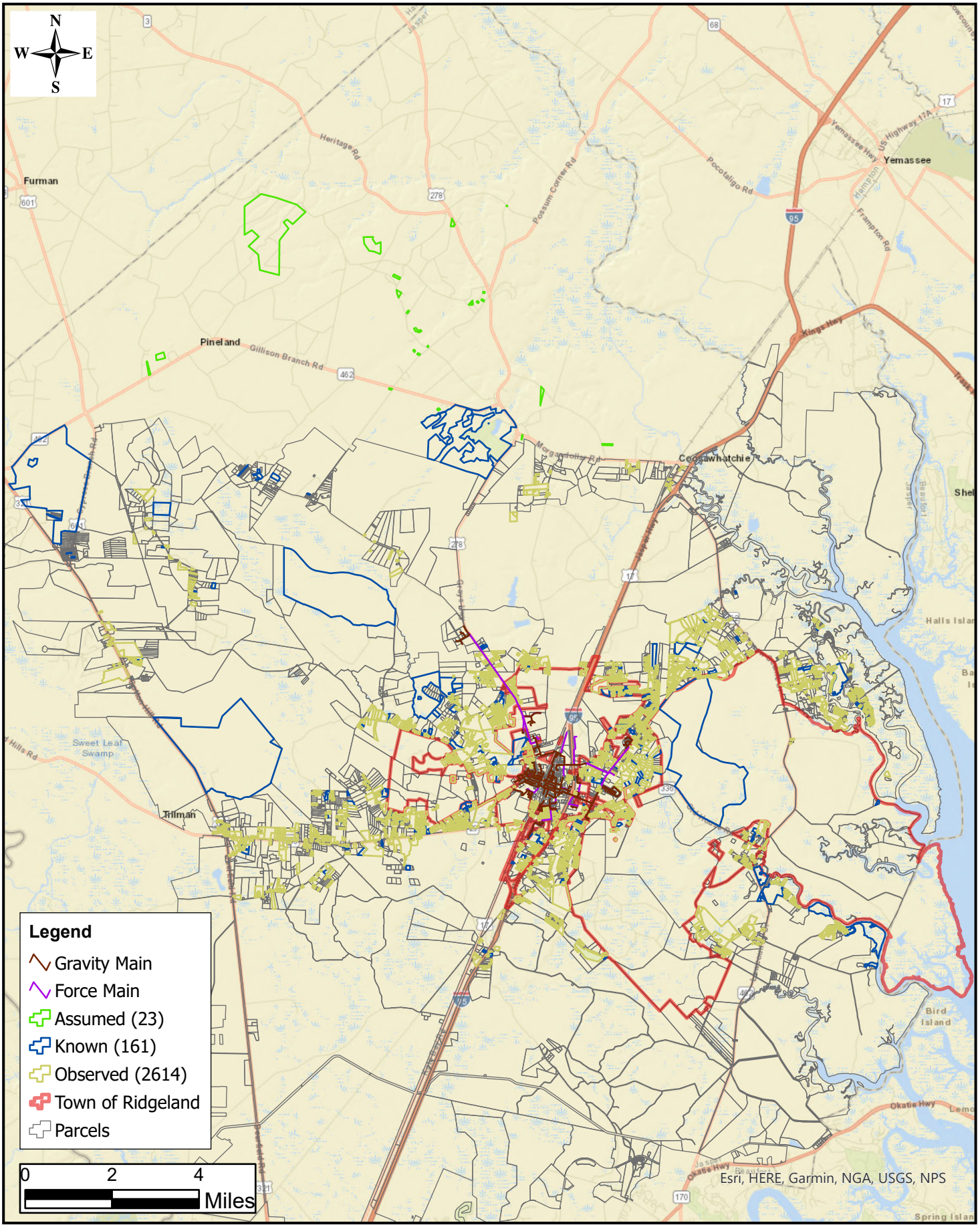

Figure 2.6 Septic Areas

Ridgeland, SC

DISCLAIMER: This map is for reference and discussion purposes only. Data provided are derived from multiple sources with varying levels of accuracy. The information shown hereon is not intended for site specific use or design.

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2.3.6 TOWN BASE POPULATION FOR SEWER SYSTEM

Development of a base or existing population is critical to the Regional Water and Sewer Master Plan, as it is the foundation for the development of the sewer generation rates for each pump station basin. As previously mentioned, a pump station basin represents the extents of an area served by a specific pump station and the corresponding gravity mains flowing to it.

4Waters examined GIS data including sewer pump station basins, parcels, zoning/land use type, and aerial imagery to determine an overall number of households within a specified pump station basin. Table 2.13 below shows a breakdown of the number of households and population (single family or multifamily) for each basin and if the pump station basin received sewer flows from a commercial or institutional type contributor. Additionally, the number of inmates at the Ridgeland Prison is included for pump station basin 6. Based on the estimated projections, the total number of people is 3,345.

Table 2.13 – Town Households and Population (Single/Multi Family) and Commercial per Basin

Pump Station Number/Basin	Single Family (# of House Holds)	Single Family Population (People)*	Multi Family (# of House Holds)	Multi Family Population (People)**	Prison (People)***	Commercial / Institutional / Industrial Component
WRF	276	693	3	6	0	Yes
PS-1	72	181	80	160	0	Yes
PS-2	47	118	0	0	0	Yes
PS-3	0	0	0	0	0	Yes
PS-4	0	0	0	0	0	Yes
PS-5	0	0	0	0	0	Yes
PS-6	0	0	0	0	1,136	Yes
PS-7	158	316	0	0	0	No
PS-8	0	0	0	0	0	Yes
PS-9	0	0	0	0	0	Yes
PS-10	140	351	0	0	0	No
PS-11	0	0	0	0	0	Yes
PS-12	0	0	0	0	0	Yes
PS-13	69	173	0	0	0	No
PS-14	80	201	0	0	0	No
PS-15	4	10	0	0	0	Yes
PS-16	0	0	0	0	0	Yes
Total	**846**	**2,043**	**83**	**166**	**1,136**	**-**
Total People	**3,345**					**-**

**Utilizes 2.51 people per single family house hold as indicated in the US Census for Ridgeland in 2020*

***Utilizes 2.0 people per multi family house hold based on research provided by the US Census*

****Basin 6 represents the Prison and 1,136 inmates*

2.3.7 TOWN SEWER GENERATION RATES

In order to develop sewer generation rates for each sewer basin, an Average Daily Flow (ADF) was estimated. To determine the per capita sewer generation rate, the ADF of the WRF must first be determined. This was accomplished by taking the ADF from 2022 of both the two discharge points of the WRF: the Nimmer Sod Farm and Captain Bill Creek. Table 2.14 shows the breakdown of the different discharges.

Table 2.14 – Town Average Historic Wastewater Flow Rates

Date	Sod Farm Monthly ADF (MGD)	Creek Monthly ADF (MGD)	Total Flow Monthly ADF (MGD)
Jan-22	0.004	0.539	0.543
Feb-22	0.007	0.548	0.555
Mar-22	0.109	0.436	0.545
Apr-22	0.180	0.440	0.620
May-22	0.298	0.339	0.637
Jun-22	0.220	0.315	0.535
Jul-22	0.144	0.406	0.550
Aug-22	0.020	0.543	0.563
Sep-22	0.000	0.614	0.614
Oct-22	0.172	0.314	0.486
Nov-22	0.000	0.481	0.481
Dec-22	0.000	0.516	0.516
2022 AADF (MGD)	**0.096**	**0.458**	**0.554**

From there, the historical ADF sewer flow was divided by the estimated population to derive the per capita sewer flow for both the Town and Prison. It was important to separate these two per capita rates as the sewer usage behavior for the Town varies from the usage by the Prison inmate population. The sewer generation per capita rates for the service area are provided in Table 2.15.

Table 2.15 – Town Sewer System Per Capita Sewer Usage Rate

Sewer System	Per Capita Rate (gpc/d)
Town of Ridgeland	169
Ridgeland Prison	178

2.4 BJWSA SEWER SYSTEM COMPONENTS AND CAPACITIES

As mentioned in Section 1, the BJWSA sewer system consists of eight water reclamation facilities, 515 pump stations, 370 miles of forcemain and 630 miles of gravity main.

Table 2.16 below provides a summary of the BJWSA sewer system capacities as provided in the BJWSA 2021 Wastewater Report.

Table 2.16 – BJWSA Sewer System Capacity

Water Reclamation Facility or Wastewater Treatment Facility (SOB)	2020 Average	Permit Limit	Units
Cherry Point WRF	5.77	7.50	MGD monthly average
Hardeeville WRF	0.52	1.01	MGD weekly average
Palmetto Bluff WWTP	0.158	0.50	MGD daily maximum
Palm Key WWTP	0.0037	0.066	MGD weekly average

**Based on the BJWSA 2021 Wastewater Report*

3.0 CURRENT STATE ASSESSMENT

One of the primary tasks of the 2023 Regional Water and Sewer Master Plan is the general evaluation of the existing facilities within the major water and sewer transmission systems. The BJWSA water and sewer system condition assessments are addressed in the BJWSA Water & Wastewater 2022 Master Plan Update, specifically in Technical Memorandum No. 2 (TM2): System Update and Assessment (Water Distribution and Wastewater Collection). Accordingly, Section 3 of the Regional Water and Sewer Master Plan will only address the condition of the Town of Ridgeland's major water and sewer system facilities.

The Town of Ridgeland (Town) has undertaken various recent assessments of the water and sewer systems including an evaluation in 2019 which resulted in development of a Water and Sewer Capital Improvement Plan (CIP) which was used to support grant applications. In late 2020, the Town was awarded significant grant funding by the US Economic Development Administration (EDA) to assist with the rehabilitation of seven pump stations (PS3, PS4, PS5, PS6, PS8, PS9, and PS12), Well No. 2, the water and sewer Supervisory Control and Data Acquisition (SCADA) system, and sewer collection system rehabilitation within sewer basins PS3, PS4, and WRF. Additionally in July 2022, the Town was awarded a Community Development Block Grant (CDBG) for rehabilitation of Well No. 3. Each of these projects has resulted in additional assessments and design of improvements for the facilities. The findings of the assessments and design efforts noted for the grant funded projects have been extrapolated and used to inform changes in the water and sewer systems and other rehabilitation efforts needed to correct deficiencies in addition to the field inspections conducted as part of this master plan evaluation. A summary of the field evaluations and status of the facilities is detailed in Sections 3.1 and 3.2.

4Waters utilized assessment forms to compile the field data gathered for the various system components and documented facility conditions with photographs of major components. The site assessment documentation is provided in Appendix B. This information has been finalized in Microsoft Excel and can be integrated with the Town's water and sewer GIS database.

Chatham Engineering, an electrical engineering firm located in Savannah, accompanied 4Waters staff on the field inspections and provided the electrical and controls system assessments. Chatham Engineering regularly provides electrical engineering design and evaluation services to Ridgeland and has assisted in developing new electrical and controls standards for the Town's water and sewer infrastructure. Deficiencies identified by Chatham Engineering are included in the summaries in Section 3.1 and 3.2, and the full electrical assessment reports and recommendations are provided in Appendix B. In conjunction with the field inspections, multiple meetings and interviews were conducted with Town management and water and sewer operations staff to gather information on existing conditions, concerns and needs that staff had identified.

3.0.1 COMPONENT ASSESSMENT EVALUATION SYSTEM

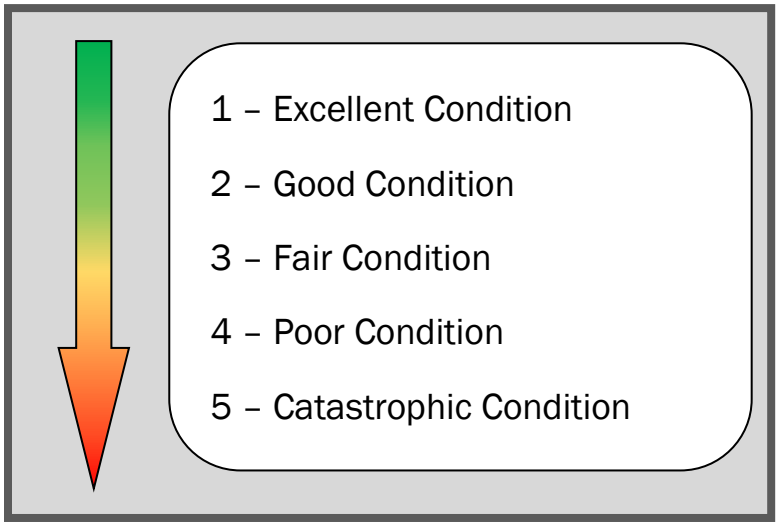
Probability of Failure Scoring

Based on the visual inspections of the facilities and the information gathered from Town water and sewer management and operations staff, each water and sewer component was evaluated. A numerical ranking system with a scale of 1 to 5 was used to rate the civil, mechanical, and electrical condition of the facilities. This ranking is representative of the Probability of Failure for each facility. On this scale, 1 is indicative of a facility in apparent excellent operational condition with no visible mechanical or electrical issues or code violations. A score of 5 indicates significant civil, mechanical, or electrical problems at a facility which impedes operation or efficiency of the system and which will likely cause complete and imminent failure of the systems. A facility with a score of 4 or 5 would be recommended for immediate attention.

The focus of the assessments is the ability of a facility to meet its operational requirements and to determine any necessary capital improvements and a schedule for upgrade. Hydraulic analysis and evaluation of the water and sewer facilities has been conducted and is described in Sections 5.0 – Water Systems Hydraulic Model and 6.0 – Sewer Systems Hydraulic Model. The combination of the field

and hydraulic assessments has been utilized to develop an overall Probability of Failure assessment score for a facility and the necessary rehabilitation efforts. A risk assessment which incorporates the Probability of Failure score is used to prioritize the water and sewer projects and is presented in Section 7.0 Master Plan Implementation of the report.

Figure 3.1 Component Assessment Scoring



3.0.2 ROUTINE PREVENTATIVE MAINTENANCE

Routine preventative maintenance is a vital element of achieving efficient operations and maintaining the assets of a utility system. The goal of preventative maintenance is to preserve and enhance equipment reliability by replacing worn components in a just-in-time manner to extend the life of the equipment and preclude failure. Preventive maintenance activities include equipment checks, partial or complete overhauls at specified periods, oil changes, lubrication, etc., and possibly altering conditions at a facility to enhance system efficiency. Additionally, during routine maintenance and inspections, staff can record equipment deterioration levels and appropriately schedule work orders to replace or repair worn parts prior to system failure.

Long-term benefits of preventive maintenance include:

- Improved system reliability.
- Decreased cost of replacement.
- Decreased system downtime.
- Better spare inventory management.

Long-term effects and cost comparisons usually favor preventive maintenance over performing maintenance actions only when the system fails. The Town Water & Sewer operations staff regularly conduct site visits and inspections to the water wells and sewer pump stations; issues or concerns with equipment or operations are noted during the site visits.

Routine preventative maintenance was not a primary focus of the facility assessments although the general condition is reported in the summary reports in Appendix B. Unless a lack of routine preventative maintenance was evident by the poor condition of a facility or component and warranted inclusion on a Capital Improvement Project (CIP), it was not included in the assessment lists in Sections 3.1 and 3.2.

3.1 TOWN WATER SYSTEM COMPONENTS

The following sections summarize the assessments of the physical condition and capacity of the water production facilities and the storage tanks. The WaterGEMs hydraulic model of the water systems as described in Section 5.0 provides additional information on the hydraulic condition of the system and the capability of the water systems to meet the flow and pressure requirements of the users. Recommendations for rehabilitation capital improvements are provided in Section 7.0 Master Plan Implementation.

3.1.1 TOWN WATER PRODUCTION FACILITIES

4Waters and Chatham Engineering with Town Water & Sewer Department operations staff conducted field inspection of the Well No. 1 water production facility in September 2022. The team has also inspected Well No. 2 and Well No. 3 water production facilities recently for the EDA Water and Sewer Resiliency Improvements project design which includes Well No. 2 and the 2022 CDBG Well No. 3 Improvements design project. 4Waters conducted the civil and mechanical evaluations and Chatham Engineering conducted the electrical system evaluations. The civil and mechanical assessments evaluated the pumps, piping, wells, chemical feed systems, buildings and site conditions. The electrical assessments evaluated the electrical service, generator, generator disconnect, automatic transfer switch, generator fuel storage, well disconnect, well pump electrical, power distribution equipment, lighting, and SCADA system at the facilities. A summary of the noted deficiencies is provided below by well site/water production facility. There are no ground storage tank facilities in the Town's water system; all storage is provided in elevated storage tanks. Section 3.1.2 provides condition assessment information on the elevated storage tanks.

Overall the facilities which were visited were generally secure, well maintained, and the sites were neat and clear. It appears that good housekeeping measures are maintained along with important routine maintenance efforts. The deficiencies noted at the facilities and overall condition are documented below.

Well Site No. 1 (September 2022 Site Visit)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	2.0	**1.5**

Well Site No. 1 had substantial rehabilitation construction in 2011 including new vertical turbine well pump, piping, well building, and generator/fuel tank.

Civil/Mechanical

- Corrosion on DIP well discharge piping
- Significant corrosion at chemical injection points
- Sodium Hypochlorite solution should be relocated to chlorine room to protect electrical equipment.

Electrical

- No deficiencies other than SCADA equipment upgrade to new Town standard which is included as part of the 2023 Water and Sewer Resiliency Improvements project.
- The well electrical system is in excellent condition. All grounding is correct. The surge protection is of good quality and fully operational. The SCADA system does not conform to the new specifications. The generator is a diesel fueled type with a separate tank located outside of the building; while this does not conform to the new standard, this generator is in excellent condition, replacement is not recommended.

Well Site No. 2 (October 13, 2021 Site Visit)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	2.5	3.0

Well Site No. 2 is part of the 2023 Water and Sewer Resiliency Improvements project funded in part by the EDA grant. The project is scheduled to begin construction in late summer or fall 2023. The project improvements include building expansion for a separate chemical storage room, new Trichlor chlorination system, hydroblast/painting of DIP well header piping, new electrical control panel, new electrical service, new grounding system, new emergency generator, automatic transfer switch and propane fuel tank.

Civil/Mechanical

- Well discharge piping header needs to be painted; some corrosion near phosphate injection site
- Chemical feeds need to be relocated to separate room to reduce corrosion/deterioration of electrical equipment
- 2015 DHEC inspection makes note that flowmeter should be downstream of blowoff so capture all water use (will not be resolved by 2023 project)

Electrical

- No emergency backup generator/power
- The control panel is reaching the end of its useful life and components need to be replaced to alleviate concerns (Town) regarding reliability of the controls;
- The electrical service needs to be overhauled and upgraded to 480 volt;
- The SCADA system does not conform to the new specifications.

Well Site No. 3 (March 4, 2022 Site Visit)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	3.5	4.0

Well Site No. 3 is part of the 2022 CDBG funded Well 3 Improvements project. The project is scheduled to begin construction in fall 2023. The project improvements include building expansion for a separate chemical storage room, replacement of DIP well header piping, new electrical control panel, new electrical service, new grounding system, and new automatic transfer switch.

Civil/Mechanical

- Well discharge piping header in building is corroded; needs replacement
- The control panel is reaching the end of its useful life and components need to be replaced to alleviate concerns (Town) regarding reliability of the controls;
- The electrical service needs to be overhauled and upgraded
- Chemical feeds need to be relocated to separate room to reduce corrosion/deterioration of electrical equipment
- Doors corroded
- 2015 DHEC inspection makes note that flowmeter should be downstream of blowoff to capture all water use

Electrical

- The control panel is reaching the end of its useful life and components need to be replaced to alleviate concerns (Town) regarding reliability of the controls;
- The electrical service needs to be overhauled and upgraded
- Need to replace the ATS inside the building
- Need new electrical distribution inside the building
- Need new grounding system
- The SCADA system does not conform to the new specifications.

3.1.1.1 TOWN SOURCE WATER ASSESSMENT

As noted in Section 2.1, the source water for the three wells that are operated and maintained by the Town of Ridgeland is groundwater that is pumped from the upper and middle Floridan Aquifer. The Upper Floridan Aquifer is often used as a primary water source for the public water supply, for agricultural uses, and industrial uses when surface waters are not available. According to the "Distribution, Sources, and Migration of Relict and Modern Salt Water in the Upper Floridan Aquifer, Southern Beaufort County, South Carolina, and adjacent parts of Georgia", Technical Publication 017-2020 prepared by the South Carolina Department of Health and Environmental Control (SCDHEC), Bureau of Water, in conjunction with the Georgia Department of Natural Resources, the South Carolina Department of Natural Resources, and the Beaufort-Jasper Water & Sewer Authority, increased chloride concentrations were documented northwest of Hilton Head Island in the Upper Floridan Aquifer in the early 1970s. It is believed that the intrusion of saltwater into the Upper Floridan Aquifer in 1953, and the plume caused by groundwater withdrawals and the subsequent intrusion has migrated inland approximately two miles. As of late, saltwater contamination has been limited to areas directly adjacent to the coast. However, with the location of the Upper Floridan Aquifer and the relative thinness and permeability of the upper confining layer, the Upper Floridan Aquifer is very susceptible to saltwater intrusion with the increased drawdown of the aquifer with continued usage. If usage of the groundwater within the Upper and Middle Floridan Aquifers continues at unsustainable rates, saltwater will continue to migrate towards the areas where groundwater is being pumped out. While saltwater intrusion is not currently a concern for the Town of Ridgeland, it is something to be aware of in the event it does become an issue in the future as a result of sea level rise and the continued migration of saltwater inland.

Jasper County is considered to be a part of the Lowcountry Capacity Use Area (Lowcountry Area) by SCDHEC. The Lowcountry Area was created in 1981 as a part of the Capacity Use Program and so is required to maintain a Groundwater Management Plan. The Lowcountry Groundwater Management Plan (LGMP) set forth three goals: "ensure sustainable development of the groundwater resource by management of groundwater withdrawals, protect groundwater quality from saltwater intrusion, and monitor groundwater water quality and quantity to evaluate conditions" (SCDHEC 2021).

The "Lowcountry Capacity Use Area 2021 Groundwater Evaluation Report", Technical Report 011-2021 prepared by SCDHEC, Bureau of Water, is the most up-to-date reporting on this Capacity Use Area that is publicly available for review. According to the report, Jasper has the fewest number of permitted well facilities and the lowest usage of the four counties that make up the Lowcountry Area. Of the 46 wells permitted, 29 of the wells are for irrigation purposes. Over the last 20 years, Jasper County has seen a small population increase, but the reported water usage has not seen much change over the same period. Of the three aquifer systems utilized by the Lowcountry Area, the Floridan Aquifer System, and specifically the Upper Floridan Aquifer, is the most used groundwater resource and the Floridan Aquifer System is the only aquifer system that Jasper County draws from. The Upper Floridan Aquifer is also the most heavily impacted by not only local withdrawals in Jasper and Beaufort Counties but by the pumping cone in Savannah, GA. A pumping cone, also known as a cone of depression, is the lowering of the aquifer water table near the well and can change the direction of groundwater flow within the area of influence. If the pumping cone for two or more wells overlap, it can result in a greater combined area of influence.

The report offers two recommendations related to the Floridan Aquifer System that should be considered as all of Jasper County, including the Town of Ridgeland, depend on this groundwater source. The first recommendation is that any new permits for withdrawal or increases to existing permits should include a groundwater model to ensure that the new or increased withdrawal will not negatively impact the water quantity or quality for the aquifer for the existing users. The second recommendation is that users should tap into deeper aquifers in order to relieve demand and not overtax the Aquifer System.

3.1.1.2 TOWN WATER PRODUCTION FACILITY AVAILABLE CAPACITY

Section 2.2.3 provides an analysis of the historic water production for the three wells over two-year period from January 2021 through December 2022 to assess the current annual average daily flow (AADF) and the change in AADF during the analysis period. This information was utilized to develop the per capita water usage for the water system as described in Section 2.2.6.

Table 3.1 below provides a comparison of the historic and permitted monthly average daily flow (ADF) and annual average daily flow (AADF) for each of the three wells over the recent two-year period of 2021 through 2022 to assess available capacity for each well and the water system. Based on the calculated historic water production rates, all three wells and the water system as a whole currently have sufficient available permitted groundwater withdrawal capacity. The AADFs for each 12-month period from January through December of 2021 and 2022 are provided in Table 3.1. The data indicates water production/consumption increased 15% from 2021 to 2022.

Based on the 2021/2022 AADF, the Town water system is currently utilizing 35 to 40% of the permitted water system AADF groundwater withdrawal capacity. Well No 1 is utilizing 63 to 66%, Well No 2 is utilizing 26 to 32%, and Well No 3 is utilizing 30 to 36% of the individual permitted groundwater withdrawal for the respective wells. It is noted that Well No. 1 was pumped beyond the permitted monthly ADF limit in October through December 2022, but this was necessary due to issues with the well pump at Well No. 3 which limited production.

This analysis is based strictly on water production records and does not assess any water losses in the system which could, if rehabilitated, reduce the necessary water production rate. An evaluation of the available capacity of the water production facility equipment and the distribution system is provided in Section 5.0 Water System Hydraulic Model.

Table 3.1 Water System Historic and Permitted Monthly ADF and AADF

Date	Well #1 (MGal)	Well #2 (MGal)	Well #3 (MGal)	Total (Total MGal)
Jan-21	0.19	0.10	0.28	0.57
Feb-21	0.17	0.10	0.30	0.57
Mar-21	0.18	0.10	0.32	0.60
Apr-21	0.20	0.11	0.38	0.70
May-21	0.20	0.12	0.38	0.70
Jun-21	0.22	0.12	0.39	0.74
Jul-21	0.13	0.13	0.40	0.66
Aug-21	0.21	0.13	0.38	0.73
Sep-21	0.16	0.14	0.41	0.71
Oct-21	0.19	0.11	0.34	0.64
Nov-21	0.30	0.18	0.10	0.58
Dec-21	0.26	0.14	0.18	0.58
Jan-22	0.09	0.13	0.33	0.55
Feb-22	0.19	0.11	0.28	0.57
Mar-22	0.19	0.11	0.29	0.58
Apr-22	0.23	0.13	0.44	0.79
May-22	0.22	0.12	0.49	0.84
Jun-22	0.10	0.16	0.60	0.86
Jul-22	0.00	0.18	0.66	0.84
Aug-22	0.15	0.15	0.57	0.86
Sep-22	0.22	0.12	0.52	0.87
Oct-22	0.37	0.21	0.15	0.72
Nov-22	0.44	0.23	0.01	0.68
Dec-22	0.34	0.18	0.23	0.76
Average Monthly ADF (MGD)	**0.21**	**0.14**	**0.35**	
Maximum Monthly ADF (MGD)	**0.44**	**0.23**	**0.66**	
Permitted Water System Withdrawal Limits Monthly ADF (MGD)	**0.31**	**0.47**	**1.05**	
2021 AADF (MGD)	**0.20**	**0.12**	**0.32**	**0.65**
2022 AADF (MGD)	**0.21**	**0.15**	**0.38**	**0.74**
Permitted Water System Withdrawal Limits Annual ADF (MGD)	**0.32**	**0.48**	**1.07**	**1.86**

3.1.2 TOWN WATER STORAGE CAPACITY AND CONDITION

3.1.2.1 TOWN AVAILABLE WATER STORAGE CAPACITY

The Town's water system only utilizes elevated storage tanks (EST); there are no ground storage tanks. Sections 2.1.1.1 Water Production Facilities and 2.1.1.3 Elevated Storage Tanks provide information on the number, location and specifications of the storage tanks in the Town's water system. A summary of the water system storage capacity is provided in Table 3.2 below.

Table 3.2 Storage Tank Capacity and Requirements

Ridgeland Water System		SCDHEC Storage Capacity Requirements (Maximum Applies)		Excess Capacity Over Regulatory Requirements (Mgals)
Total No. of ESTs	Total EST Volume (Mgals)	2 Hr Combined Peak Hr Domestic + Fire Flow (MGD)	50% of Max Daily Consumption (MGD)	
5	1.40	0.31	0.86	0.54

Notes:

Peak Hour is based on an average of the peak hourly flow from 2021 and 2022 based on peaking factor applied to AADF

Fire flow of 1,000 gallons/minute

Maximum Daily is average of maximum daily from 2021 and 2022

Determining the proper quantity of water storage is a balance between ensuring sufficient water is available for typical water demands and fire protection and avoiding excessive storage which can lead to slow turnover from tanks and result in deteriorated water quality. There are several guidelines for developing a suitable storage capacity. In South Carolina, the Department of Health and Environmental Control (DHEC) has published Finished Water Storage Sizing requirements under Regulation 61-58.4 Finished Water Pumping, Storage, and Distribution Facilities.

Table 3.2 above presents the total storage capacity of the Town's water system and the required storage volume based on the DHEC regulations which are based on both the peak hourly flow + fire flow and the maximum daily flow. The 2021 and 2022 well production records were utilized to calculate the flow quantities. Based on this evaluation, the Town's water system has sufficient water storage capacity for the current water system and has 0.54 million gallons available to support growth and development.

Further evaluation of the necessary water storage capacity for growth and development during the 20 year period is presented in Sections 4.0 Future Conditions (necessary capacity) and 5.0 Water System Hydraulic Model (recommended storage construction) of the Master Plan.

3.1.2.2 TOWN WATER STORAGE FACILITY CONDITION

The South Carolina DHEC prefers inspection for structural and coating integrity and cleaning of finished water storage tanks every three years. In 2020, US EPA addended the Revised Total Coliform Rule (RTCR) to include finished water storage facility inspection requirements or recommendations which will likely be implemented by states. The US EPA State Implementation Guidance – Final document for the Revised Total Coliform Rule was issued June 2020. The goal of the rule change is to have public water systems periodically inspect the interior and exterior of their finished water storage facilities, at a minimum, and to correct any sanitary defects found which if not remedied can result in breaches and accumulation of sediment, animals, insects, and other contaminants which can lead to public health issues.

The Town already implements such inspections, maintenance and repairs at their elevated storage tanks with outside contractors. The deficiencies noted from the most recent EST December 2019/January 2020 inspections are provided below. The Town should review the current tank and maintenance inspection practices against the US EPA rule change and alter procedures as necessary for compliance. The tank inspections and cleaning are considered to be an operation and maintenance effort and accordingly have not been included in the capital improvement plans and program.

Tank No. 2 – High School EST (December 2019 Inspection)	
Overall Facility Probability of Failure Score:	**3.5**

Deficiencies/Recommendations:

- Exterior Coating (Fair/Poor): wearing thin and chalking; delamination and cracking in coating on sidewalls and knuckle of tank roof.
    - Recommend renovate exterior coating to prevent adhesion loss of current coating and to prevent rust/corrosion.
- Roof Vent – New 24" pallet type roof vent needed.
- Interior Coating (Good/Fair): Should continue to protect the substrate for 4 – 5 more years.

Tank No. 3 – Captain Bill (Co-Located Well 3) EST (January 2020 Inspection)	
Overall Facility Probability of Failure Score:	**3.0**

Deficiencies/Recommendations:

- Access Ladders: Install ladder gate to prevent unauthorized access.
- Interior Coating (Fair): Recommendation at next washout to perform chemical clean washout to remove heavy iron/manganese buildup and biofilm. Should continue to protect steel substrate for another 3 – 5 years before next paint cycle.
- Exterior Coating (Fair): Isolated areas of delamination; moderate degree of biogrowth (aesthetic). Tank coating should continue to protect steel substrate for another 3 – 4 years before next paint cycle.

Tank No. 4 – Grahamville/Bees Creek EST (December 2019 Inspection)	
Overall Facility Probability of Failure Score:	**2.0**

Deficiencies/Recommendations:

- Interior Coating (Good): No steel substrate is exposed; should continue to protect steel substrate for many more years.
- Exterior Coating (Good): Moderate degree of biogrowth (aesthetic). Tank coating should continue to protect steel substrate for many more years. Recommend pressure wash exterior in next 1 – 2 years.

Tank No. 5 – Prison EST (January 2020 Inspection)	
Overall Facility Probability of Failure Score:	**2.0**
Deficiencies/Recommendations: • Catwalk Floor: Recommended to tool clean, spot prime, and paint rusted areas on catwalk floor. • Interior Coating (Good): Interior epoxy coating system is in good condition and is protecting the steel substrate as intended. • Exterior Coating (Good): Coatings system on exterior of tank found to be in good condition. There are a few minor areas of rust/corrosion visible on the catwalk floor and should be touched up to prevent further corrosion.	

Tank No. 6 – Cypress Ridge EST (December 2019 Inspection)	
Overall Facility Probability of Failure Score:	**2.0**
Deficiencies/Recommendations: • Interior Coating (Good): Interior epoxy coating system is in good condition and the coating should continue to protect the substrate for many more years. • Exterior Coating (Good): Coatings system on exterior of tank found to be in good condition. There was a moderate degree of biogrowth observed (aesthetic) which can impact life of coatings if not addressed.	

3.1.3 TOWN WATER DISTRIBUTION SYSTEM

As presented in Section 2.1.4, the Major Water Transmission System (MWTS) includes approximately 39.5 miles of water mains. Limited information is available on the existing water main materials and is primarily listed on printed maps kept by the Water and Sewer Department or is known directly by operations staff. The Town's Water GIS does not include any information on water main material. Although it can be assumed that much of the Town's water system consists of Polyvinyl Chloride (PVC) and Ductile Iron, the water system in the older areas of Town were installed in the early 1940's and likely consist of other materials such as Transite (Asbestos Cement), Cast Iron, Galvanized Steel, and possibly concrete. Based on typical industry standards, the older water main and associated joint materials are nearing the end of the design useful life. The useful life of water main varies by material and is impacted by multiple factors including physical conditions of the installation – pipe bedding, pipe wall thickness, type of joint, inadequate thrust restraint, poor installation practices; environmental conditions – corrosive soils or aggressive groundwater, stray currents causing electrolytic corrosion; or operational conditions such as changes in water pressure, leakage which undermines bedding, or low velocity or dead-end water mains.

Common failure modes for Transite pipe include circumferential breaks, longitudinal splits, and pipe degradation in aggressive groundwater; Cast Iron pipe failure modes include corrosion through holes, circumferential breaks, and longitudinal breaks; and Steel pipe failure is typically related to corrosion through holes.

4Waters recommends that the Town develop a water main rehabilitation program with an initial goal to capture available information on water main materials and water main breaks from operations staff knowledge and paper maps into the Town's Water GIS. Based on the findings, an implementation plan for water main replacement and potential upsizing can be developed to focus on improving reliability, pressure, and fire flow capabilities. An initial focus on replacement of undersized and Transite water main pipes is recommended. Although much of the undersized water mains are assumed to be 2-inch

Galvanized, there are also backbone areas of the water distribution system which are undersized and unable to provide the necessary flow and pressure levels of service desired. These undersized backbone areas are identified in Section 5.0 Water System Hydraulic Model of the Master Plan. Town operations staff have previously identified Transite water main around Well No. 3 site.

Rehabilitation of the older water main materials will not only improve the operational conditions for the customers but will free up Town operations staff and resources to conduct maintenance and operation efforts which benefit the entire water system, not just isolated areas. Two water main replacement program items have been included in the CIP as noted below.

Small Diameter/Galvanized Water Main Replacement Program (FY2027 +)	Probability of Failure Score	3.0
• Identify areas of undersized and known/assumed Galvanized water main • Develop project areas for annual program based on overall improvement to water system operations		

Water Main Replacement (Transite (AC)/CIP Pipe) Program (FY2031+)	Probability of Failure Score	3.5
• Identify areas of CIP and Transite water mains • Develop project areas for annual program based on overall improvement to water system operations		

3.1.3.1 TOWN WATER METERS

In addition to the Water Main Rehabilitation program, the Town is implementing a Water Meter Replacement program to assist with reducing non-revenue water within the water systems. The water meter replacement program will assist with changing out aging waters meters which are prone to operating more slowly and may not measure all the water passing through the meter which results in reduced revenues. As the Town's water meters are primarily more than 20 years old, it is anticipated many are operating outside of the American Water Works Association's (AWWA) recommended accuracy standards and therefore recording lower than actual water consumption which in turn results in an ineffective and reduced recovery of revenue by the Town. The new water meters will have automated meter reading (AMR) capabilities which provide increased customer service by removing human error from visual meter readings, provide a more predictable meter reading schedule, allow instantaneous download of consumption data to the billing software, and allow for proactive notification of leaks or increased consumption patterns consequently also leading to water conservation improvements in the water system. It is anticipated that the use of AMR meters will save roughly 48 days of labor costs per year for two men, as well as significant wear and tear on two vehicles.

In 2022, the Town applied for a South Carolina Infrastructure Investment Program grant to assist with the AMR Water Meter Replacement project. The Town was awarded a grant for ~$670,000 (based on a 2022 turnkey installation quote from Core & Main for 1700 5/8" meters and 100 1" meters) for the AMR Water Meter Replacement project in 2023. The grant requires a 15% match by the Town and the funds must be expended and the grant closed out by December 31, 2026, although the Town's goal is to initiate construction as soon as possible based on RIS approvals and complete construction within a year.

Water Meter Replacement Program (FY2024+)	Probability of Failure Score	3.0
• Replace all 5/8" (1700) and 1" (100) water meters in system with new Neptune AMR capable meters • Purchase equipment for drive-by meter reading • Gather data of service lines to inform Lead Service Line Inventory as possible.		

3.1.3.2 TOWN LEAD SERVICE LINES

In December 2020, the US Environmental Protection Agency (EPA) issued revisions to the Lead and Copper Rule (LCR) which requires all public water systems, whether large or small, to develop a service line inventory unless they can demonstrate that they have no lead service lines (LSLs). Subsequent revisions extended the deadline for the development of the inventory to October 16, 2024. The goal of the rule revisions is to reduce lead in drinking water. According to a DHEC press release, EPA directed states and systems to prioritize developing lead service line inventories. DHEC has partnered with the consulting firm, TruePani, to provide service line inventory assistance at no cost to small water systems. DHEC notes that TruePani is a trusted subject-matter expert in lead in drinking water and has completed service line inventory projects across the nation for both state and local clients.

TruePani is currently coordinating with the Town and 4Waters to gather the available, relevant information on the Town's water system to develop the inventory. Their approach to completing the inventory relies on past experience while incorporating recommendations from EPA's Service Line Inventory Guidance document and DHEC's State specific guidance, specifically the inventory template spreadsheets. The inventory will result in identification of each service line as either: lead, galvanized requiring replacement, non-lead, or lead status unknown. It is anticipated that data gathered during the AMR Water Meter Replacement project can assist in developing the inventory and identifying service laterals which require replacement.

Lead Service Line Identification Program (FY2024 +)	Probability of Failure Score	3.0
• Investigate water service laterals which could not be determined as "non-lead" during the inventory. • Anticipated to require excavation/test hole exploration on both public and private side of the water meter.		

Lead Service Line Replacement Program (FY2027+)	Probability of Failure Score	3.0
• Complete replacement for water service lines identified as lead or galvanized requiring replacement. Replacement required on both sides of the water meter. • State funding with significant principal forgiveness is ancticipated.; Town will apply after completion of inventory.		

3.2 TOWN SEWER SYSTEM COMPONENTS

The following sections summarize the assessments of the physical condition and capacity of the water reclamation facility (WRF) and the pump stations (PS) in the major sewer transmission systems. Section 3.4 addresses Inflow and Infiltration of the existing gravity sewer system and recommended rehabilitation efforts. The SewerGEMs hydraulic model of the sewer system as described in Section 6.0 provides additional information on the hydraulic condition of the systems and the capability of the sewer systems to meet the flowrate requirements. Recommendations for rehabilitation capital improvements encompassing all of the noted physical and hydraulic deficiencies are provided in Section 7.0 Master Plan Implementation.

3.2.1 JIMMY MIXSON WATER RECLAMATION FACILITY

The Jimmy Mixson WRF is a secondary treatment facility with dual effluent discharge options including a land application system (LAS) on the Nimmer Sod Farm southwest of the Town and surface water discharge to Captain Bill Creek which is located approximately 200 feet from the WRF site.

In April 2021, the upgrades to the WRF were completed and approved for operation by DHEC. The upgrades transformed the WRF from a simple 0.8 MGD dual aerated lagoon facility with chlorination disinfection and land application system (LAS) discharge to a 1.6 MGD state of the art facility capable of meeting stringent discharge limits. The upgraded facility was constructed at the site of the existing WRF and utilized the area of one lagoon. The upgrades include: influent pump station, headworks facility with fine screen, grit removal, and conveyor assembly, Intermittent Cycle Extended Air System (ICEAS) biological treatment system with blowers and sludge pumps, post-equalization basin with aeration, effluent pump station, effluent filtration, UV disinfection system with channel, split effluent outfall channel to creek or back to LAS pump station, upgraded vertical turbine LAS pump station, WRF SCADA system, and operator building. Due to funding restrictions, the residuals management facilities were not upgraded and the waste sludge is discharged from the ICEAS to the remaining aerated lagoon and sludge is removed, dried, processed and disposed of by a separate contractor

Based on regular discussions with the Town's WRF operations staff and assessments of the facility, the following deficiencies and recommendations were noted for the Jimmy Mixson WRF:

Power Quality:
Since completion of the WRF upgrades, operations staff have noted issues with outages and fluctuations in the power system (Dominion Energy) which impact equipment operations. These outages and fluctuations are often minor in nature but cause equipment to shut down without triggering operation of the generator. The equipment cannot be reset through the SCADA system and requires manual reset. The ICEAS equipment and UV equipment are typically impacted. The Town has coordinated with Dominion Energy and while Dominion Energy is monitoring their operations, their recommendation is to install uninterrupted power supply (UPS) devices within the WRF to serve the various equipment components. The Town is currently coordinating with the WRF equipment manufacturers for recommended UPS sizing. As this issue is currently being resolved, it has not been included in a CIP.

Sludge Lagoon Floating Aerators
As noted, during the WRF upgrades one of the aerated lagoons was repurposed into a sludge holding pond and utilized four existing floating aerators to maintain oxygen levels and eliminate algae, duckweed, etc. from accumulating on the surface. The aerators were over 30 years old and all failed in 2022. Replacing the floating aerators is vital to prevent the sludge holding lagoon from becoming anaerobic which would lead to odor problems and potential violations of the WRF's DHEC operating permit.

In 2022, the Town applied for a South Carolina Infrastructure Investment Program grant to assist with the WRF Floating Aerator project. The Town was awarded a grant for ~$317,500 for replacement of the

aerators with four 25 Hp floating aerators and installation of control panels (based on a 2022 quote). The grant requires a 15% match by the Town and the funds must be expended and the grant closed out by December 31, 2026.

Sludge Lagoon Liner

In July 2023, WRF operations staff noted issues with areas of the sludge lagoon liner rising up and floating when the water levels are high in the sludge lagoon. The liner is the original liner installed in the aerated lagoon/sludge lagoon in 1991. It is anticipated that areas of the liner have deteriorated and ripped allowing water behind the liner which causes it to float. The liner is 30+ years old and at the end of useful life and is recommended for replacement. As there is a single sludge lagoon, a temporary tank and pumps may be needed to store waste sludge during the replacement.

Overall facility Probability of Failure Score is a 1.5

JIMMY MIXSON WRF (0 -5 YR)	*Probability of Failure Score*
Sludge Lagoon Floating Aerators (Four 25 Hp Aerators) Replacement	5.0
Sludge Lagoon Liner Replacement	4.0

3.2.1.1 TOWN WRF TREATMENT PROCESS ASSESMENT

As noted in Section 3.2.1, the Jimmy Mixson WRF is a 1.6 MGD secondary treatment facility which can discharge to the Nimmer Sod Farm LAS (Discharge 001) or to the nearby Captain Bill Creek (Discharge 002). The facility provides primary screening, grit removal, aeration, clarification, filtration, UV disinfection, and reaeration. Based on discharge monitoring reports for the 18-month period from June 2021 through December 2022, the facility appears to consistently meet all permit requirements for discharge to the LAS. This 18-month period was selected as the WRF upgrades were being brought online beginning in January 2021 and the DHEC operating permit was issued in May 2021. Table 3.3 provides a summary of treatment levels for the LAS discharge (Discharge 001) during the noted 18-month period.

Table 3.4 provides a summary of the treatment levels for the Captain Bill Creek discharge (Discharge 002) during the 18-month period. The facility consistently met permit parameters during that period except for June 2022 when there were exceedances for both 5-Day Biological Oxygen Demand (BOD-5) and Ultimate Oxygen Demand (UOD). In June 2022, the equalization basin was taken offline for maintenance and flow discharged directly from the ICEAS to the filtration and UV disinfection systems. The filter was not designed for the unbuffered flow from the ICEAS and accordingly some duckweed solids were not filtered out and resulted in the high BOD-5 and UOD levels. Once the equalization basin was put back online, the levels were in compliance.

It is noted Tables 3.3 and 3.4 are based on the draft permit issued by DHEC in April 2022. The Town is awaiting issue of the final permit for the WRF operations from DHEC.

Table 3.3 Jimmy Mixson WRF Treatment Levels
Discharge 001 – Nimmer Sod Farm LAS

Date (MO-YR)	$CBOD_5$ (mg/L)		TSS (mg/L)		Ammonia Nitrogen (as N) (mg/L)		DO (mg/L)	pH	
	Monthly Average	Weekly Average	Monthly Average	Weekly Average	Monthly Average	Weekly Average		Min	Max
Jun-21	5.10	5.60	2.20	5.00	0.13	0.16	7.33	7.22	8.13
Jul-21	5.50	10.80	3.20	7.30	0.15	0.18	6.87	7.21	8.18
Aug-21	4.70	6.00	2.40	3.80	0.12	0.14	6.67	7.21	8.00
Sep-21	5.20	7.50	2.90	7.50	0.10	0.11	8.16	7.13	8.07
Oct-21	4.20	5.30	2.10	2.80	0.12	0.16	8.13	7.01	7.69
Nov-21	5.40	7.40	5.40	12.40	0.29	0.45	7.00	6.90	7.40
Dec-21	6.70	6.70	2.00	2.40	0.19	0.29	6.49	6.95	7.08
Jan-22	7.10	13.20	3.90	5.70	0.19	0.33	7.00	6.70	7.06
Feb-22	6.00	8.00	3.60	6.50	0.15	0.26	8.65	6.93	7.05
Mar-22	8.15	9.80	3.40	6.40	0.21	3.20	7.00	6.93	7.19
Apr-22	6.60	9.00	3.40	5.00	0.53	1.40	6.67	6.90	7.10
May-22	10.70	12.90	7.10	9.50	0.03	0.10	6.70	6.90	7.60
Jun-22	15.40	27.90	5.90	10.80	0.15	0.60	6.80	7.10	7.30
Jul-22	7.60	9.10	3.40	4.00	0.03	0.10	6.72	7.10	7.90
Aug-22	4.60	7.20	2.90	3.20	0.03	0.10	7.01	7.20	7.80
Sep-22	4.17	4.90	1.60	2.40	0.10	0.11	8.20	7.11	7.78
Oct-22	4.23	5.30	1.13	1.50	0.16	0.31	9.00	7.30	7.90
Nov-22	4.25	7.80	1.75	3.00	0.14	0.23	8.24	7.00	7.80
Dec-22	3.70	4.60	4.10	5.70	0.17	0.31	9.30	7.02	7.70
Permit Limits	25.0 mg/L	40.0 mg/L	90.0 mg/L	135.0 mg/L	MR	MR	min. 1.0 mg/L	6.0	8.5

Table 3.4 Jimmy Mixson WRF Treatment Levels
Discharge 002 – Captain Bill Creek Surface Water Discharge

Date (MO-YR)	DO (mg/L)	Effluent BOD-5 Day (20 Degrees C) (mg/L)		Effluent pH		Effluent TSS (mg/L)		Effluent Ammonia Nitrogen (as N) (mg/L)		Ultimate Oxygen Demand (mg/L)		E. coli (MPN/100 ml)	
		Monthly Average	Weekly Average	Min	Max	Monthly Average	Weekly Average	Monthly Average	Weekly Average	Monthly Average	Weekly Average	Monthly Average	Daily Maximum
Jun-21	7.33	5.10	5.60	7.22	8.13	2.20	5.00	0.129	0.159	8.19	9.08	2.00	11.00
Jul-21	6.87	5.50	10.80	7.21	8.18	3.20	7.30	0.146	0.182	8.89	17.03	10.00	69.10
Aug-21	6.67	4.70	6.00	7.21	8.00	2.40	3.80	0.118	0.138	2.40	9.50	1.00	1.00
Sep-21	8.16	5.20	7.50	7.13	8.07	2.90	7.50	0.104	0.114	11.80	8.30	3.00	31.60
Oct-21	8.13	4.20	5.30	7.01	7.69	2.10	2.80	0.116	0.161	6.91	8.74	3.00	9.60
Nov-21	7.00	5.40	7.40	6.90	7.04	5.40	12.40	0.289	0.448	9.40	12.00	2.00	9.70
Dec-21	6.49	6.10	6.70	6.95	7.08	2.00	2.40	0.188	0.288	9.90	10.70	1.00	1.00
Jan-22	7.00	7.10	13.20	6.70	7.06	3.90	5.70	0.192	0.329	11.50	21.30	1.00	1.00
Feb-22	8.65	6.00	8.00	6.93	7.05	3.60	6.50	0.145	0.261	9.66	12.46	2.00	9.80
Mar-22	7.00	8.15	9.80	6.93	7.19	3.40	6.40	0.210	3.200	17.00	25.00	2.00	3.80
Apr-22	6.67	6.60	9.00	6.90	7.10	3.40	5.00	0.527	1.400	12.30	14.60	49.60	2.00
May-22	6.70	10.70	12.90	6.90	7.60	7.10	9.50	0.025	0.100	16.50	19.80	2.00	21.60
Jun-22	6.80	15.40	27.90	7.10	7.30	5.90	10.80	0.150	0.600	24.10	44.60	2.00	3.10
Jul-22	6.72	7.60	9.10	7.10	7.90	3.40	4.00	0.025	0.100	11.90	14.10	2.00	67.00
Aug-22	7.01	4.60	7.20	7.20	7.80	2.90	3.20	0.025	0.100	7.30	11.30	2.00	29.50
Sep-22	8.20	4.17	4.90	7.11	7.78	1.60	2.40	0.103	0.113	6.73	7.81	2.00	61.60
Oct-22	9.00	4.23	5.30	7.30	7.90	1.13	1.50	0.160	0.310	7.10	9.30	2.00	8.40
Nov-22	8.24	4.25	7.80	7.00	7.80	1.75	3.00	0.135	0.230	6.98	12.60	2.00	9.80
Dec-22	9.30	3.70	4.60	7.02	7.70	4.10	5.70	0.170	0.310	6.27	8.18	2.00	26.60
Permit Limits (Mar - Oct)	min. 6.0	8.0	12.0	6.0	8.5	30.0	45.0	1.0	1.5	17.0	25.5	126.0	349.0
Permit Limits (Nov - Feb)	min. 6.0	8.0	12.0	6.0	8.5	30.0	45.0	3.3	4.9	34.4	51.6	126.0	349.0

Notes:
Permit Limits indicated are based on flow of 1.6 MGD; for flows less than 1.6 MGD, the limit varies proportionally.
Permit exceedances are highlighted in red.
Entries highlighted in blue are not exceedances based on a flow less than 1.6 MGD during the noted month.

3.2.1.2 TOWN WRF AVAILABLE CAPACITY

Section 2.2.7 provided an analysis of the historic sewer generation rates for the sewer system. Table 3.5 provides an analysis of the historic metered effluent flows through the Jimmy Mixson WRF over the 18-month period from June 2021 through December 2022. The period from January through May 2021 was not included in the analysis as the upgraded WRF was being brought online during that period and the flows and operations were in flux. The analysis includes an evaluation of the monthly average daily flow (ADF) in comparison to the permit limits for both of the discharge outfalls and the total flow.

Table 3.5 Historic and Permitted Monthly Effluent ADF Comparison for WRF

DATE	MONTHLY ADF		
	OUTFALL 001 SOD FARM LAS (MGD)	OUTFALL 002 CAPT BILL CREEK DISCHARGE (MGD)	TOTAL ALL OUTFALLS (MGD)
Jun-21	0.272	0.321	0.593
Jul-21	0.011	0.591	0.602
Aug-21	0.089	0.485	0.573
Sep-21	0.185	0.437	0.621
Oct-21	0.184	0.394	0.578
Nov-21	0.045	0.495	0.540
Dec-21	0.092	0.503	0.595
Jan-22	0.004	0.539	0.543
Feb-22	0.007	0.548	0.555
Mar-22	0.109	0.436	0.545
Apr-22	0.180	0.440	0.620
May-22	0.298	0.339	0.637
Jun-22	0.220	0.315	0.535
Jul-22	0.144	0.406	0.550
Aug-22	0.020	0.543	0.563
Sep-22	0.000	0.614	0.614
Oct-22	0.172	0.314	0.486
Nov-22	0.000	0.481	0.481
Dec-22	0.000	0.516	0.516
Average (MGD)	**0.107**	**0.459**	**0.566**
Maximum (MGD)	**0.298**	**0.614**	**0.637**
Monthly ADF Permit Limits (MGD)	0.8	1.6	1.6

Based on the historic monthly average daily flows for both discharge outfalls over the noted 18-month period, the Jimmy Mixson WRF is currently operating at 35% of permitted capacity. The maximum monthly average daily flow over the 18-month period is 40% of permitted capacity. The Jimmy Mixson WRF has sufficient capacity available for the current customer base population and has not had exceedances of either of the permitted monthly ADF values during the evaluation period. The WRF has significant treatment capacity available with the existing infrastructure to provide service for future growth and development. The WRF and sewer collection system do experience increased flows due to inflow & infiltration which is described in Section 3.4. An evaluation of the available capacity of the pump stations and the collection systems is provided in Section 6.0 Sewer Hydraulic Model.

3.2.2 TOWN PUMPING AND FORCEMAIN SYSTEMS

4Waters with Town Water & Sewer Department staff conducted field inspections of nine sewer pump station facilities in September 2022. The assessments evaluated the pumps, piping, controls, instrumentation, wet well and other structures, and overall site civil condition at the facilities. A summary of the noted deficiencies is provided below by individual pump station. As noted in Section 3.0, field inspections were not conducted at all pump station facilities for the Master Plan, but the information gathered from inspected facilities was utilized along with data from prior recent assessments associated with ongoing design projects and grant evaluations and from Town staff to extrapolate the findings to update the other facilities prior assessments.

Overall the pump station facilities which were visited were generally secure, pumps and equipment were operational, and the sites were neat and clear. It appears that good housekeeping measures are maintained along with important routine maintenance efforts such as regular removal of grease from wet wells. Issues of concern are also identified during operational visits and are presented to Water and Sewer Department leadership for processing and followup.

PS1 (September 2022 Site Visit)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	2.0	**3.0**

Civil/Mechanical

- Pumps are 10 years old; replace at 15 years.
- Ductile iron piping and fittings in wet well coated - some corrosion; above grade bypass piping – paint peeling; worn.
- Wetwell coating is worn off - poor condition.
- Wet Well Wizard hose goes through top of hatch; trip hazard.

Electrical

- The service bonding is not correct.
- The surge protection device has two failed phases. The surge protection in the pump control panel has two failed phases.
- There is a single junction box below the control panel with seal-off fittings between the junction box and control panel.
- The ground from the generator is not terminated correctly in the disconnect switch between the generator and ATS.
- The flood light has failed.
- The SCADA system is not compliant with the new specification.
- The wet well does not have cable grips for the motor or float cables.

PS2 (September 2022 Site Visit)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	2.0	**2.5**

Civil/Mechanical

- Pumps are 7 years old; Replace pumps at 15 years of age.
- Ductile iron piping in wetwell is painted/coated but is corroding .
- Ductile iron piping and valves in valve vault and bypass is painted but worn off and some corrosion.
- Wetwell coating is worn off and buckling in some areas .
- No wet well wizard.

Electrical

- The service bonding is not correct.
- The surge protection device has failed phases. The surge protection in the pump control panel has failed phases.
- There is a single junction box adjacent to the control panel with seal-off fittings between the junction box and control panel.

- The ground from the generator is not terminated correctly in the disconnect switch between the generator and ATS.
- The SCADA system is not compliant with the new specification.
- The wet well does not have cable grips for the motor or float cables.

PS3 (2023 EDA Design)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	4.0	**4.0**

PS3 is part of the 2023 Water and Sewer Resiliency Improvements project funded in part by the EDA grant. The project is scheduled to begin construction in late summer or fall 2023. This pump station repumps 7 other system pump stations including the flow from the Ridgeland Correctional Institution and handles more than half of the sewer system flow. In addition to the deficiencies noted below, the pumps are hydraulically inadequate for the current flows. The pump station upgrades include a complete replacement of the pump station including new wet well, generator, manhole rerouting and stub-outs for future expansion of the pump station, and access road and elevation improvements. The project will provide an increase in hydraulic capacity from approximately 600 gpm (estimated with 2 pumps operating) to 900 gpm.

Civil/Mechanical

- Ductile iron pipes in wet well and valve vault are corroded.
- There is a lot of debris on top of pipes, indicates surcharges in wet well.
- Site is very low and surrounded by wet/swampy areas.
- Access road is dirt/grass and low in some areas - impassable during some storm events.
- Pump station has had pump failures of the current pumps.

Electrical

- No generator or receptacle.
- No junction boxes between the wet well and the control panel or conduit seal on the electrical conduits below the control panel; no protection from corrosive gases.
- The SCADA system is not compliant with the new specification.

PS4 (2023 EDA Design)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	4.0	**4.0**

PS4 is part of the 2023 Water and Sewer Resiliency Improvements project funded in part by the EDA grant. The project is scheduled to begin construction in late summer or fall 2023. This pump station pumps the commercial corridor around and upstream of Exit 21 of I-95 and residential areas and subdivisions along Bees Creek Road. In addition to the deficiencies noted below, the pumps are hydraulically inadequate for the current flows. The pump station upgrades include a complete replacement of the pump station including new wet well, generator, manhole rerouting and forcemain stub-out for future upgrades to the existing forcemain. The project will provide an increase in hydraulic capacity from approximately 78 gpm to 350 gpm.

Civil/Mechanical

- Areas around wet well hatch are rusted and corroded.
- Corroded Ductile Iron piping in wet well.
- Corroded guide rails.
- Wet well condition - no coating – fair.
- Valve vault is bolted closed and inaccessible - piping and valves assumed in poor condition.
- Discharge bypass condition is unknown - may be in valve vault.

Electrical

- No generator.
- Control panel is beyond its useful life and needs to be replaced.
- Existing control panel support rack is wooded and needs to be replaced.
- The SCADA system is not compliant with the new specification.

PS5 (2023 EDA Design)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	3.0	**3.0**

PS5 is part of the 2023 Water and Sewer Resiliency Improvements project design; however funding was insufficient to cover the bid received for the entire project scope with the EDA grant and Town funding. PS5 was not considered as critical a priority and was removed from the construction scope of work; the Town is applying for additional grants to fund the project.

This pump station is a grinder pump station which primarily serves the Health Complex.

Civil/Mechanical

- Pumps and guiderails need to be replaced. Guidebars corroded at top..
- No wet well wizard.
- No bypass connection.
- No safety grating on wet well.
- Lot of debris on top of the pipes (indicates pump outage/rising water)
- Vent corroded and peeling off.

Electrical

- No SCADA system.
- No local generator (generator at health complex may serve PS5 but construction unknown).
- Control panel is beyond its useful life and needs to be replaced.
- Junction boxes are recommended between wet well and control panel.
- Conduit seal recommended on electrical conduits below control panel to protect from corrosive gases.

PS6 (2023 EDA Design)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	4.0	**4.0**

PS6 is part of the 2023 Water and Sewer Resiliency Improvements project funded in part by the EDA grant. The project is scheduled to begin construction in late summer or fall 2023. This is a duplex pump station which serves the South Carolina Department of Corrections Ridgeland Correctional Institution (RCI). The pump station also has a mechanical and manual screen system which is owned and operated by the RCI. The Town owns and operates the pump station. In addition to the deficiencies noted below, the pumps are hydraulically inadequate for the current flows and according to the pump supplier (Pete Duty & Associates) have to be replaced approximately every 5 years. The pump station upgrades include replacement of the pumps, piping, control panel, flow meter, and installation of a local generator. The project will provide a slight increase in hydraulic capacity, but more importantly a more robust pump with higher horsepower rating to accommodate the heavy flows and debris.

Civil/Mechanical

- Station has had pump failures (at time of site visit only one pump operational).
- Wet well does not have a coating and is deteriorating.
- Wet well hatch is kept open to accommodate conduit for pumps; trip hazard and allows inflow into wet well.
- Ductile Iron piping in wet well and valve vault is corroded and rusted.
- Debris in wet well on top of pump indicates previous flooding;
- Site drainage issues – wet well top slab needs to be raised.
- Discharge bypass in valve vault is undersized.
- No safety grating on wet well.

Electrical

- Steel conduit for pump motor cables in the wet well is severely corroded.
- Junction boxes recommended between wet well and control panel and conduit seal on electrical conduits below control panel to protect panel from corrosive gases.
- No local generator (generator at RCI may serve PS6 but construction unknown).
- The SCADA system is not compliant with the new specification.

PS7 (September 2022 Site Visit)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	2.5	**3.0**

Civil/Mechanical

- No coating in wet well.
- Ductile iron discharge piping very corroded in wet well.
- Ductile iron piping and valves corroded in valve vault.
- No backflow preventer on water line.
- No safety grating.
- Wet well wizard hose goes through vent pipe - trip hazard.

Electrical

- The fence location does not provide the required working clearance in front of the meter, service disconnect, automatic transfer switch or the SCADA panel.
- The service bonding is not correct.
- The surge protection device in the control panel is a minimal device and should be replaced or supplemented.
- There is no junction box between the control panel and the wet well; the pump and float cables extend to the control panel with seal-off fittings just below the control panel.
- The ground from the generator is not terminated correctly in the disconnect switch between the generator and ATS.
- The ground rod connection utilizes a single acorn nut with multiple conductors terminating to the rod adjacent to the panel.
- The SCADA system is not compliant with the new specification.
- The wet well does not have cable grips for the motor or float cables.
- There is no yard light.

PS8 (2023 EDA Design)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	3.5	**3.5**

PS8 is part of the 2023 Water and Sewer Resiliency Improvements project design; however funding was insufficient to cover the bid received for the entire project scope with the EDA grant and Town funding. PS8 was not considered as critical a priority and was removed from the construction scope of work; the Town is applying for additional grants to fund the project.

This pump station is a duplex pump station which serves the Cypress Ridge Industrial Park.

Civil/Mechanical

- Ductile Iron piping and fittings in wet well are extremely corroded.
- Ductile Iron piping in valve vault has some corrosion.
- Vent piping is very corroded (Ductile Iron).
- No safety grating on wet well.
- No visible RPZ/hose bibb.
- No wet well coating.

Electrical

- SCADA was not working at time of site visit; SCADA does not comply with new standard specifications.
- Fencing is too close to electrical equipment; not in compliance with regulating codes.
- Junction boxes are recommended between wet well and control panel and conduit seal on electrical conduits below panel to protect from corrosive gases and improve future rehabilitation work.
- No generator.

PS9 (2023 EDA Design)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	4.0	**4.0**

PS9 is part of the 2023 Water and Sewer Resiliency Improvements project design; however funding was insufficient to cover the bid received for the entire project scope with the EDA grant and Town funding. PS9 was not considered as critical a priority and was removed from the construction scope of work; the Town is applying for additional grants to fund the project.

This pump station is a duplex pump station which serves the High School complex and airport.

Civil/Mechanical

- Discharge ductile iron piping in wet well and valve vault very corroded.
- Ductile iron vent piping has some corrosion.
- No coating on wet well.
- Issues with the road - low areas; dirt road.
- Site is low and prone to flooding.
- Manhole outside of site is low and often covered with standing water.
- No safety grating on wet well access hatch.
- No water service.
- No Wet Well Wizard.

Electrical

- Junction boxes are recommended between wetwell and control panel.
- Conduit seal recommended on electrical conduits below panel (protect from gases and ease future rehab).
- SCADA does not comply with new standard specifications.
- No site lighting.

PS10 (September 2022 Site Visit)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	3.0	**3.0**

Civil/Mechanical

- Pumps are 20 years old; need to plan for replacement in next 5 years.
- No lighting at site.
- Wet well coal tar coating needs to be replaced with new coating.
- No wet well wizard.
- No safety grating on wet well.
- Ductile iron discharge piping in wet well is very corroded.
- Check valves need to be repaired or replaced.

Electrical

- The service disconnect does not provide overcurrent protection, NEC Neutral bonding, bonding jumper or service rating.

- The automatic transfer switch is a NEMA 3R enclosure (not 4X SS) and is showing surface corrosion.
- The surge protection device in the control panel is a minimal device and should be replaced or supplemented.
- The station level control system does not conform to the new requirements: the station utilizes float control.
- There is no junction box between the control panel and the wet well; the pump and float cables extend to the control panel with seal-off fittings just below the control panel.
- There is extensive use of seal-tight flex between the control panel and other enclosures.
- The SCADA system is not compliant with the new specification.
- The wet well does not have cable grips for the motor or float cables.
- There is no yard light.

PS11 (September 2022 Site Visit)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	3.5	**3.5**

Civil/Mechanical

- Pumps are 18 years old; need to plan for replacement in next 5 years.
- One of guide rails is not connected to wet well; missing top of guide rail.
- Wet well coal tar coating needs to be replaced with new coating system.
- No wet well wizard - lot of corrosion and strong odors at site.
- No safety grating on wet well.
- Ductile iron discharge piping in wet well is extremely corroded.
- No backflow preventer on water service.

Electrical

- The service bonding is not correct; the neutral is bonded in the utility meter.
- The station probably does not have a grounding delta, but a single ground rod for the utility meter.
- The surge protection device in the control panel is a minimal device and should be replaced or supplemented.
- There are three junction boxes between the control panel and the wet well with seal-off fittings; a fourth junction box and sealing fitting is needed for a transducer cable.
- The ATS is very old (Dayton), in a NEMA 3R enclosure that is starting to show corrosion.
- The generator is old (2004) and has three warning lights/is in alarm.
- The SCADA system is not compliant with the new specification.
- The wet well does not have cable grips for the motor or float cables.
- There yard light is mounted on the utility pole; it is probably served by the utility and not part of the station.

PS12 (2023 EDA Design)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	4.0	**4.0**

PS12 is part of the 2023 Water and Sewer Resiliency Improvements project funded in part by the EDA grant. The project is scheduled to begin construction in late summer or fall 2023. This is a duplex pump station which serves the Jasper County Detention Center. The pump station also has a mechanical and manual screen system which is owned and operated by the Detention Center. The Town owns and operates the pump station. The pump station upgrades include replacement of the pumps, piping, control panel, and installation of a local generator.

Civil/Mechanical

- Pump station has had issues with pumps underperforming - could indicate worn impellers.
- Guide rails corroded at top.
- Ductile Iron piping and fittings badly corroded in wet well and in valve vault.
- Wet well and valve vault bricked up - flooding issues at site.
- Cable rack, guide rails - poor condition; corroded, particularly at connectors to wet well/hatch.
- Valves in valve vault - some rust/corrosion (likley from groundwater in vault).
- No pump chains visible at time of site visit.
- Vent pipe - some corrosion; paint peeling.
- No wet well wizard.
- No safety grating on wet well.
- Corrosion around wet well hatch.

Electrical

- No local generator (generator at Detention Center may serve PS12 but construction unknown).
- SCADA system does not comply with new standard specifications.
- Concern regarding age of motor controls/control panel - difficult to get parts.
- Junction boxes recommended between the wet well and control panel and conduit seal on electrical conduits below control panel to protect control panel from corrosive gases and improve ease of future rehabilitation work.

PS13 (September 2022 Site Visit)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	3.0	**4.0**

Civil/Mechanical

- Pumps are 19 years old; need to plan for replacement in next 5 years.
- Guide rails corroded at top; chain missing on one pump.
- Wet well coal tar coating needs to be replaced with new coating system.
- Ductile iron pipe corroded in wet well - needs to be replaced.
- Wet well wizard hose installed through notch in hatch - trip hazard.
- Flooding concerns - need to raise wet well and valve vault tops (existing has bricks built up).
- Lift rings on top wet well - trip hazard.
- No safety grating on wet well.

- No backflow preventer on water service.
- Odors strong at site.

Electrical

- The fence location does not provide the required working clearance in front of the meter, service disconnect or the SCADA panel.
- The service disconnect does not provide overcurrent protection, NEC Neutral bonding, bonding jumper or service rating.
- The automatic transfer switch has a NEMA 3R enclosure; it is in poor condition and is showing surface corrosion and the mechanical lugs are also corroding due to the high moisture level within the enclosure.
- The generator is old (2005) and has two warning lights/is in alarm.
- The LP fuel tank is rusty and should be replaced.
- The surge protection device in the control panel is a minimal device and should be replaced or supplemented.
- The station level control system does not conform to the new requirements: the station utilizes float control.
- There is no junction box between the control panel and the wet well; the pump and float cables extend to the control panel with seal-off fittings just below the control panel.
- There is extensive use of seal-tight flex between the control panel and other enclosures.
- System grounding is deficient in method and installation.
- The SCADA system is not compliant with the new specification.
- The wet well does not have cable grips for the motor or float cables.
- There is no yard light.

PS14 (September 2022 Site Visit)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	3.0	**3.5**

Civil/Mechanical

- Pumps are 18 years old; approaching end of life - need to plan for replacement in next 5 years.
- Wet well needs to be coated (currently no coating).
- Ductile iron piping in wet well is corroded - need to replace.
- Other ductile iron piping/valves have some corrosion - need to be repainted.
- No wet well wizard is installed.
- There are hooks on the top of the wet well slab - trip hazard - need to be cut/removed.
- No safety grating.
- No backflow preventer on water service.

Electrical

- The service disconnect does not provide overcurrent protection, NEC Neutral bonding, bonding jumper or service rating.
- The automatic transfer switch has a NEMA 3R enclosure; it is relatively new but is a replacement (Cummins) for the original transfer switch (Caterpillar).
- The generator is old (2006) and has much surface corrosion and fungi growth on the exterior.
- The LP fuel tank is not on a support pad.

- The surge protection device in the control panel is a minimal device with two failed phases and should be replaced or supplemented.
- The station level control system does not conform to the new requirements: the station utilizes float control.
- The junction boxes between the control panel and the wet well are fiberglass; the pump and float cables extend to the control panel with seal-off fittings just below the control panel.
- System grounding is deficient in method and installation.
- The SCADA system is not compliant with the new specification.
- The wet well does not have cable grips for the motor or float cables.
- The yard light is HID and should be replaced with an LED type conforming to the new standards.

PS15 (September 2022 Site Visit)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	2.5	**3.0**

Civil/Mechanical

- Pumps are 16 years old; approaching end of life - need to plan for replacement in next 5 years.
- Wet well needs to be coated (currently no coating).
- Ductile iron piping in wet well is corroded - need to replace.
- Other ductile iron piping/valves have some corrosion - need to be repainted.
- No wet well wizard is installed.
- No safety grating.

Electrical

- The service bonding is not correct; the grounding electrode conductor conduit is rigid galvanized steel, but it does not have bonding bushings.
- The installation of a grounding delta can not be confirmed.
- The surge protection device in the control panel has failed along with the surge protection at the main disconnect.
- The pump control panel shows signs of water accumulation as the threaded hubs in the bottom are corroded.
- The control panel utilizes float control, it does not conform to the new requirements.
- There are three fiberglass junction boxes between the control panel and the wet well with seal-off fittings; a fourth junction box and sealing fitting is needed for a transducer cable.
- The door gasket on the ATS does not seal and water has accumulated in the bottom of the enclosure; the mechanical lugs mounted to the bottom are corroding.
- The SCADA system is not compliant with the new specification and the enclosure is badly corroded.
- The wet well does not have cable grips for the motor or float cables.
- The yard light is a quartz floodlight mounted on a 4X4 post; it does not work.

PS16 (September 2022 Site Visit)		
Overall Facility Probability of Failure Score:	**Civil/Mechanical**	**Electrical**
	1.5	**2.5**

Civil/Mechanical

- Pump station constructed in 2021 - new standards were being developed. Some issues to be resolved.
- Need pump station sign and emergency information.
- No backflow preventer on water service.

Electrical

- The service bonding is not correct; the neutral is bonded in the utility meter.
- The station probably does not have a grounding delta, but a single ground rod for the utility meter.
- There is no surge protection device in the control panel or at the service disconnect
- There are no junction boxes or sealing fittings between the control panel and the wet well.
- The SCADA system is not compliant with the new specification.
- The wet well does not have cable grips for the motor or float cables.
- There is no yard light.

The Town has limited information available in GIS data or as-built records regarding forcemain materials in the system; accordingly it is unknown at this time whether there are existing Cast or Ductile Iron forcemains. Forcemains are exposed internally to the corrosive nature of gases such as hydrogen sulfide which develop from sewage, particularly in pipes that do not remain full and can deteriorate rapidly at locations where internal coatings have been compromised. If existing Cast or Ductile Iron forcemains are identified in the Town's sewer system, a programmatic approach for replacement should be developed.

3.3 TOWN OVERALL ELECTRICAL ASSESSMENTS

The electrical deficiencies noted at the water production facilities and pump station facilities have been listed in the sections above. However, there were several common and repetitive findings observed by Chatham Engineering for the facilities which the Town should be cognizant of for future electrical design and upgrade projects.

Water Production Facilities – Overall Electrical Assessment

The Town's Well/Water Production Facilities are typically older facilities with only Well No. 1 having had recent improvements. Wells No. 2 and No. 3 are scheduled for rehabilitation improvements. The improvements at Well No. 2 are associated with the 2023 Water and Sewer Resiliency Improvements project and include a complete revamping of the electrical components including a new electric service, an emergency generator, new controls and SCADA. The improvements at Well No. 3 are funded by a 2022 CDBG grant and are scheduled to go out for bid and construction in the fall of 2023. The Well No. 3 improvements include replacement of the well pump, new electric service, grounding system, main breaker, automatic transfer switch, new controls and SCADA.

- Typical Well/WPF: The electrical systems are functional but Wells No. 2 and No. 3 systems and controls are at the end of life and many components are obsolete and difficult for the Town to secure parts. Two of the three facilities have emergency generators capable of operating the facility during a loss of utility power. Most of the Wells/WPFs do, however, have issues with:

    - service disconnect,
    - service grounding, and
    - a lack of surge protection.

    The surge protection can be easily corrected by adding surge protection to the system. The service disconnect and service grounding issues at some locations need more invasive solutions, essentially a new service disconnect with overcurrent protection.

Pump Stations – Overall Electrical Assessment

The Town's pump stations condition range from brand new to systems that are about to fail due to corrosion and equipment reaching the end of useful life. Most of the pump stations fall into a middle category in that there is a need to some degree for improvement, but it is not immediately necessary.

The pump stations are all conventional submersible stations. Of the 16 pump stations, only three do not have generators; additionally there are three which are understood to have emergency backup power provided from an adjacent facility (health complex, Ridgeland Correctional Institution, and Jasper Co. Juvenile Detention Center/Sheriff's Complex). Most of the pump stations would benefit from replacement or the provision of a surge protective device in the panel.

There are six pump stations which received a Poor (4.0) score in the assessments for electrical condition. Four of these stations (PS3, PS4, PS6, PS12) are scheduled for rehabilitation as part of the 2023 Water and Sewer Resiliency Improvements project and include a complete revamping of the electrical components including new emergency generators. Overall, the other pump stations are functional and will serve for the next several years.

There are several common issues of note observed at the pump stations. The majority of the pump stations do not have:

- Correct service disconnecting means, or
- Proper service grounding, or both.

- Surge protection
- Sufficient conduit seals/terminal boxes

Several pump stations were observed with non-fusible disconnect switches utilized as the service disconnect. These lacked the required over-current protection, the insulated neutral with grounding electrode conductor, and bonding jumper.

Electrical Design Standards

Important electrical design standards that were reviewed are described below.

As defined by the National Fire Protection Association (NFPA) a Classified Area is a space where a flammable gas, flammable liquid-produced vapor, combustible liquid produced vapors, combustible dusts, or combustible fibers could be present, and the likelihood that a flammable or combustible concentration or quantity is present. NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities, indicates that the envelope within 18 inches above the wet well top slab, and within 3 ft of the outside edge of the hatch, is designated as a Division 2 Classified Location. The classified area also extends for a 5 ft radius from the end of the wet well vent. Pump station electrical equipment should not be permitted within the classified area.

Electrical equipment should be protected by National Electrical Code (NEC) approved conduit sealing fittings to prevent the atmosphere or the wet well from gaining access to the electrical equipment. Additionally, wet well electrical equipment including the pump motors, float switches, and level sensor, should be able to be disconnected and removed without disturbing the conduit sealing fittings. To meet these requirements the Town's new standard pump station design requires use of explosion protected wet well terminal boxes between the wet well and the pump control panel, with cable seals on the wet well conduits, and explosion proof conduit sealing fittings on the control panel conduits.

The Town's new standard pump station control panel also requires a dead front inner door to allow the operator to have access to the pump controller and circuit breaker operating handles without being exposed to live electrical parts. The standard pump station electrical service surge protection equipment is required to have status indication lights that are only operational when the equipment is energized. This equipment should also be installed so that the status indication lights are visible from outside the dead front inner door, or through a view window.

3.3.1 TOWN SCADA SYSTEMS

The Town maintains two existing Supervisory Control and Data Acquisition (SCADA) systems; one for the Jimmy Mixson WRF and another for the water distribution and sewer collection systems. The SCADA system for the WRF was installed as part of the WRF upgrades and was put online in 2021. The WRF SCADA system uses a VTScada application and integration was provided by Lord & Company. The WRF SCADA system operates well although because it is internet based, there have been issues when the internet service at the WRF is out. The Town is currently coordinating with Lord & Company to have a local cellular modem installed as a backup for SCADA operations when the internet is out.

The current SCADA system used to monitor the water wells and sewer pump systems is outdated and difficult to maintain. The SCADA system provides only monitoring capabilities for the pump stations and limited monitoring and controls capability for the water system. A new SCADA system similar to and compatible with the WRF SCADA system has been designed/specified for the water distribution system and sewer collection system and is included as part of the 2023 Water and Sewer Resiliency Improvements project funded in part by the EDA grant. The new SCADA system will provide improved monitoring capabilities and also remote-control capabilities for controlling pumps (sewer and wells). Each remote terminal unit shall include a cellular modem. The new SCADA system will also provide

capabilities for monitoring tank levels in all ESTs, and accordingly will allow operation of wells from any of the ESTs which is anticipated to improve tank turnover and operations.

WATER DISTRIBUTION AND SEWER COLLECTION SCADA	*Probability of Failure Score*
New SCADA System (3 Wells, 16 Pump Stations, 5 ESTs)	4.5

3.4 TOWN INFLOW AND INFILTRATION EVALUATION

3.4.1 INTRODUCTION AND METHODOLOGY

The Town of Ridgeland's sewer collection system was primarily installed in the early 1940's and consists of clay pipes with brick manholes in the older sections and PVC with precast manholes in the newer sections. There is some cast/ductile iron pipe in the system, particularly under primary South Carolina Department of Transportation (SCDOT) roads and railroads. The nearly 21 miles of gravity sewer mains, which vary in size from 6-inches to 12-inches in diameter, and 524 manholes are divided into 16 different sub-basins with each sub-basin collecting flow from a given area or neighborhood and conveying sewage via a trunk main and/or pump station until it reaches the Jimmy Mixson Water Reclamation Facility (WRF).

The sanitary sewer system and manholes in some sub-basins are approaching 80 years old, and up until 2019, no major rehabilitation of the system had been performed. The Town has recognized significant increases in rainfall derived inflow and infiltration (I&I) at the WRF, on average approximately 200,000 gallons per day during even typical low intensity storm events. The Town has realized that without repairs to the system, the I&I flows will continue to increase and will threaten structural integrity of the sewer system and pose increased risk to public health concern and safety from additional sewer system overflows and potential roadway collapse from failing sewers.

In 2017 the Town hired Weston & Sampson and Four Waters Engineering firms to assess the general condition of the sewer system, identify the primary areas of the sewer system contributing I&I, and begin prioritizing sewer sub-basins for repairs. These studies have included flow monitoring at pump stations and within the gravity sewer system, smoke testing, television inspection of sample areas (CCTV), and efforts to reopen tuberculated cast/ductile iron pipe segments to restore the flow line and allow further investigation of I&I sources. The analysis of these efforts has allowed the Town to develop an understanding of the I&I sources and to prioritize repairs and rehabilitation which will provide the most cost-effective reduction in I&I.

For the Water and Sewer Master Plan, the findings of the 2017 I&I studies have been utilized and updated for sewer rehabilitation efforts completed since. This represents the most accurate information on sewer sub-basin I&I flows as more granular information like pump run times and drawdown testing is not available. The following sections provide information on the estimated overall I&I flows in the system and at the WRF and the prioritization of the sewer sub-basins for rehabilitation efforts.

3.4.2 OVERALL INFLOW & INFILTRATION IN JIMMY MIXSON WRF SYSTEM

The typical overall I&I entering the Jimmy Mixson WRF sanitary sewer collection system was determined by performing an overall evaluation of the system based on monthly rainfall totals for the service area and the average daily and maximum daily flowrates recorded at the WRF. The analysis was conducted from June 2021 through May 2023. Rain events during winter months from December to March often cover large areas draining to the WRF and might be expected to produce higher flows, whereas summer events during April to November may be associated with more localized storm cells that do not cover large areas of the system and may result in lower flows at the WRF. This evaluation does not specifically account for seasonal variations in flow, however, the Average Dry Weather Flow (ADWF) determination incorporates flow data from periods throughout the year and tends to dampen the impact from seasonal variations.

Months during the study period with the lowest total rainfall were used to approximate the Base Flow or Average Dry Weather Flow for the sewer system. For the Jimmy Mixson WRF sewer system, there were no months with total rainfall less than one inch, accordingly months with total rainfall between one and two inches was used to calculate the Base Flow/ADWF. The estimated Average Dry Weather Flow for the Jimmy Mixson WRF system is 0.58 MGD as presented in Table 3.6.

The monthly data was then divided according to total rainfall in increments of one inch (1") up through six inches (6") of total rainfall. All months with total rainfall over six inches (6") were placed in one category. As there were no months during the evaluation period with total rainfall less than one inch, individual storms of approximately 0.3 to 0.6 inches were identified which had no precipitation in the several days period before and after the rainfall event. The sewer flows measured at the WRF on the day of the rainfall event or the following day, whichever was greater, were used to determine I&I levels for rainfall events less than one inch. The Average Dry Weather Flow calculated for the system was compared with the Maximum Daily Flow recorded in each month (or day for storms less than one inch) to determine the approximate I&I in the system for each month of the study.

The evaluation resulted in a determination of the average I&I for the system by categories of total monthly rainfall. Table 3.6 presents the calculated average I&I for the Jimmy Mixson WRF system.

Table 3.6 Average I&I in the Jimmy Mixson WRF Sewer System

Total Monthly Rainfall (inches)	I&I Increase over Average Dry Weather Flow (%)
ADWF (MGD)	0.58
1	19%
2	32%
3	32%
4	28%
5	29%
6+	71%

This information was utilized to develop a linear regression of the percent flow increase at varying rainfall amounts for each system. Based on these equations, for a one inch (1") storm event, an increase of 100,170 gallons (17.3%) is anticipated at the Jimmy Mixson WRF.

These rates of I&I represent a loss of capacity in the transmission and treatment systems which can limit the capacity available for growth and development of the service areas. Additionally there is an unnecessary operational cost to the Town associated with treating and disposing of non-sanitary sewer flows. The above estimate of Inflow & Infiltration is for a one inch (1") storm which is very common for this region of South Carolina. As indicated in Table 3.6, as the number of storms and volume (inches) of rainfall increases, the I&I rate also increases and can lead to excessive peak flow conditions at the WRF and potential permit flow exceedances. For example, during and after more extreme events such as Hurricane Irma in 2017, I&I flows at the WRF exceeded the capacity of the flow monitoring and indicated at least 350,000 gallons per day and resulted in sanitary sewer overflows (SSOs) from manholes in some locations. Hurricane Idalia which passed in proximity to the Town on August 30, 2023 dropped 6-inches of rainfall and resulted in a peak flow at the WRF of 1.1 MGD, almost double the typical dry weather flows at the WRF.

3.4.3 SUB-BASIN DELINEATIONS

The Jimmy Mixson WRF sewer system has 17 sub-basins. Sub-basins are typically delineated around pump stations or to encompass no more than approximately 10,000 linear feet of gravity sewer to improve the assessment value of flow monitoring data. Within the Jimmy Mixson WRF sewer system, the pump stations are primarily located within subdivisions or isolated areas such as Cypress Ridge Industrial Park or the High School Complex. Accordingly, the majority of the sub-basins are the gravity sewer associated with the individual pump stations. The only exception is the older area of the Town, the WRF sub-basin, which includes 35,720 linear feet of gravity sewer. Multiple pump stations/sub-basins discharge into the WRF sub-basin which discharges directly to the Jimmy Mixson WRF.

Figure 3.2 depicts the sub-basins, the pump stations within the sub-basin, and the existing gravity sewer. Table 3.7 summarizes each delineated sub-basin with the length and size of gravity sewer pipe and the number of manholes contained in each sub-basin. Reliable pipe material information is not available for the sub-basins.

Table 3.7 I&I Sub-Basin Delineation Information

Sub-Basin	Total Gravity Sewer within Sub-Basin (LF)	Gravity Sewer Pipe Size					Manholes
		6-inch (LF)	8-inch (LF)	10-inch (LF)	12-inch (LF)	Unknown	
WRF	35,717	13,256	15,876	5,371	1,214	0	128
PS 1	10,900	1,399	9,501	0	0	0	58
PS 2	6,577	516	6,060	0	0	0	27
PS 3	15,187	2,889	12,299	0	0	0	64
PS 4	11,028	0	4,998	6,030	0	0	57
PS 5	Unknown - Health Center						
PS 6	Unknown - Ridgeland Correctional Institution						
PS 7	5,794	0	5,794	0	0	0	28
PS 8	4,807	0	4,807	0	0	0	22
PS 9	4,330	4,330	0	0	0	0	19
PS 10	7,088	0	7,088	0	0	0	56
PS 11	990	0	0	0	0	990	8
PS 12	Unknown - Jasper County Juvenile Detention Center						
PS 13	3,905	3,905	0	0	0	0	18
PS 14	3,556	0	0	0	0	3,556	18
PS 15	1,360	0	1,360	0	0	0	9
PS 16	517	0	517	0	0	0	3

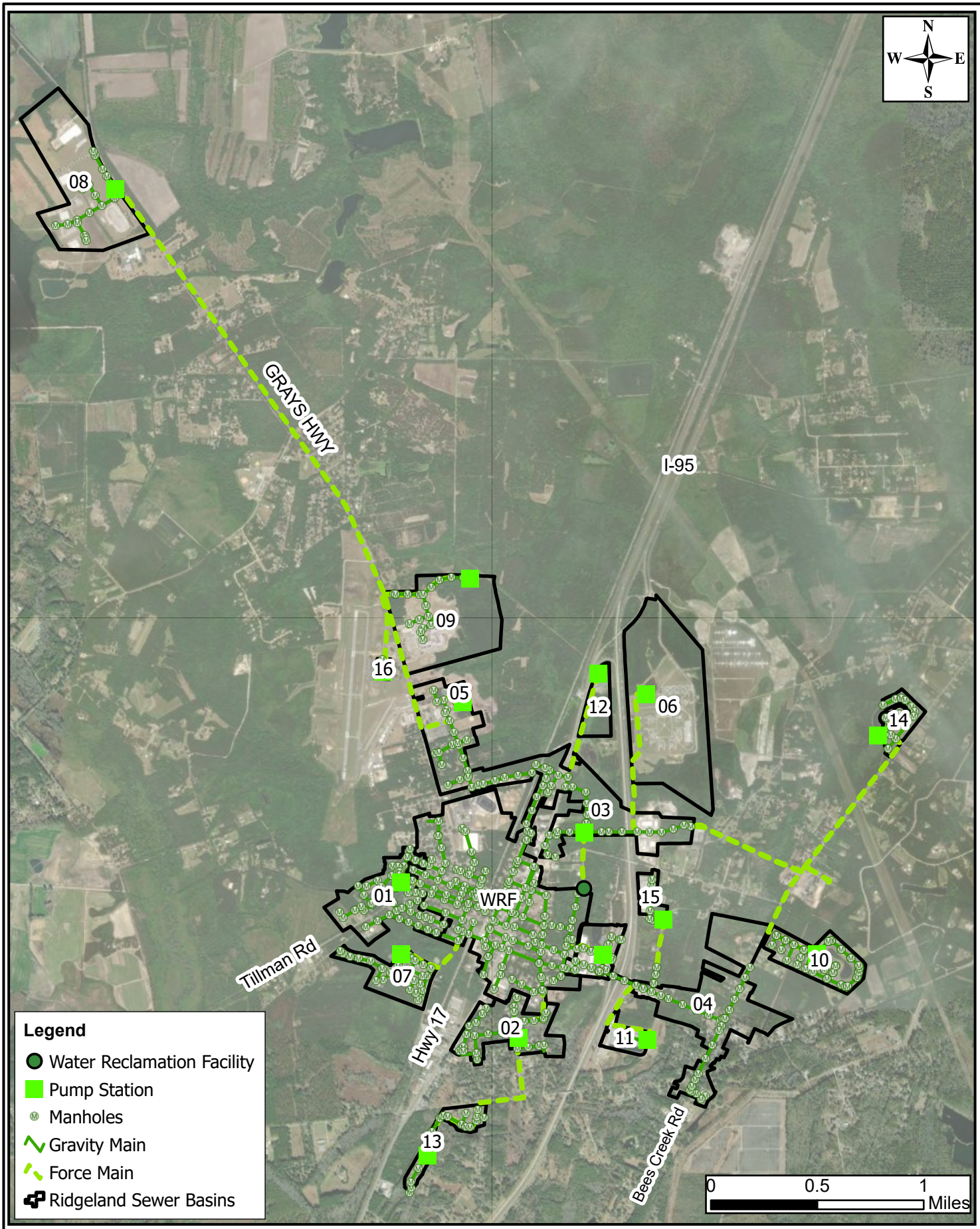


Figure 3.2 : Ridgeland Sewer System Sub-Basin Delineations

Ridgeland, SC

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3.4.4 INFLOW & INFILTRATION PER SUB-BASIN

The 2017 I&I analysis work resulted in the November 2017 *Inflow and Infiltration Abatement Analysis* prepared by Four Waters Engineering. Based on the findings of the studies, sewer sub-basins 1, 2, 3 (northern leg), 4, 9, 10, and WRF have the greatest rates of I&I in the system, as indicated in Table 3.8, I&I Analysis Priority Rankings by Sub-Basins. The table provides the identified prioritization of the sewer sub-basins, the estimated background groundwater infiltration, and the wet weather induced I&I from the study. It is noted that sub-basins for pump stations 5, 6, and 12 are not included in the table as the location of the gravity sewer is unknown and is anticipated to be minimal as these are isolated facilities serving the health complex, Ridgeland Correctional Institution, and Jasper County Juvenile Detention Center, respectively.

The prioritization scoring is similar to the scoring utilized for the component assessment with a score of 1 representing negligible I&I and an Excellent condition and a score of 5 representing critical I&I and a potential Catastrophic condition. The prioritization scoring is based solely on the identified wet weather induced I&I from the study; further evaluation such as smoke testing and CCTV reporting is needed within the sewer sub-basins to localize the cause of the I&I and the most cost-effective approach to resolve.

The prioritized sewer sub-basins are depicted in Figure 3.3.

Table 3.8: I&I Analysis Priority Rankings by Sub-Basin

Sewer Sub-Basin/Pump Station	Priority	Priority Scoring	Estimated Groundwater Infiltration (Difference between Dry Weather ADF and Estimated Base Wastewater Customer Flow (Gallons))	Gallon Increase Range over Daily Dry Flow During 3 Different Storm Events (Gallons)
1	High	4	1,512	1,492 to 18,262
2	High	4	12,855	0 to 19,770
3[1]	Low	2	99,799	0
3[2]	High (2 Sinkholes w/in Basin)	4		8,578 to 58,280
4	Medium (1 Sinkhole w/in Basin)	3	8,763	2,561 to 20,291
7	Low (1 Sinkhole w/in Basin)	2	3,604	0 to 1,953
8	Low	2	5,964	0 to 359
9	High	4	13,893	0 to 16,669
10	High	4	3,903	0 to 8,003
11	Low	2	810	456 to 1,184
13	Medium	3	9,157	0 to 4,321
14	Medium	3	8,905	0 to 6,263
15	Low	2	2,805	0 to 1,782
16	Negligible	1	N/A[3]	N/A[3]
WRF	High (1 Sinkhole w/in Basin)	4	103,440	4,977 to 71,505

3[1] Flow monitored from Eastern Leg of gravity sewer coming into PS3

3[2] Flow monitored from Northern Leg of gravity sewer coming into PS3

NA[3] Pump Station 16 was not in operation at the time of the 2017 analysis; new construction; Negligible I&I priority

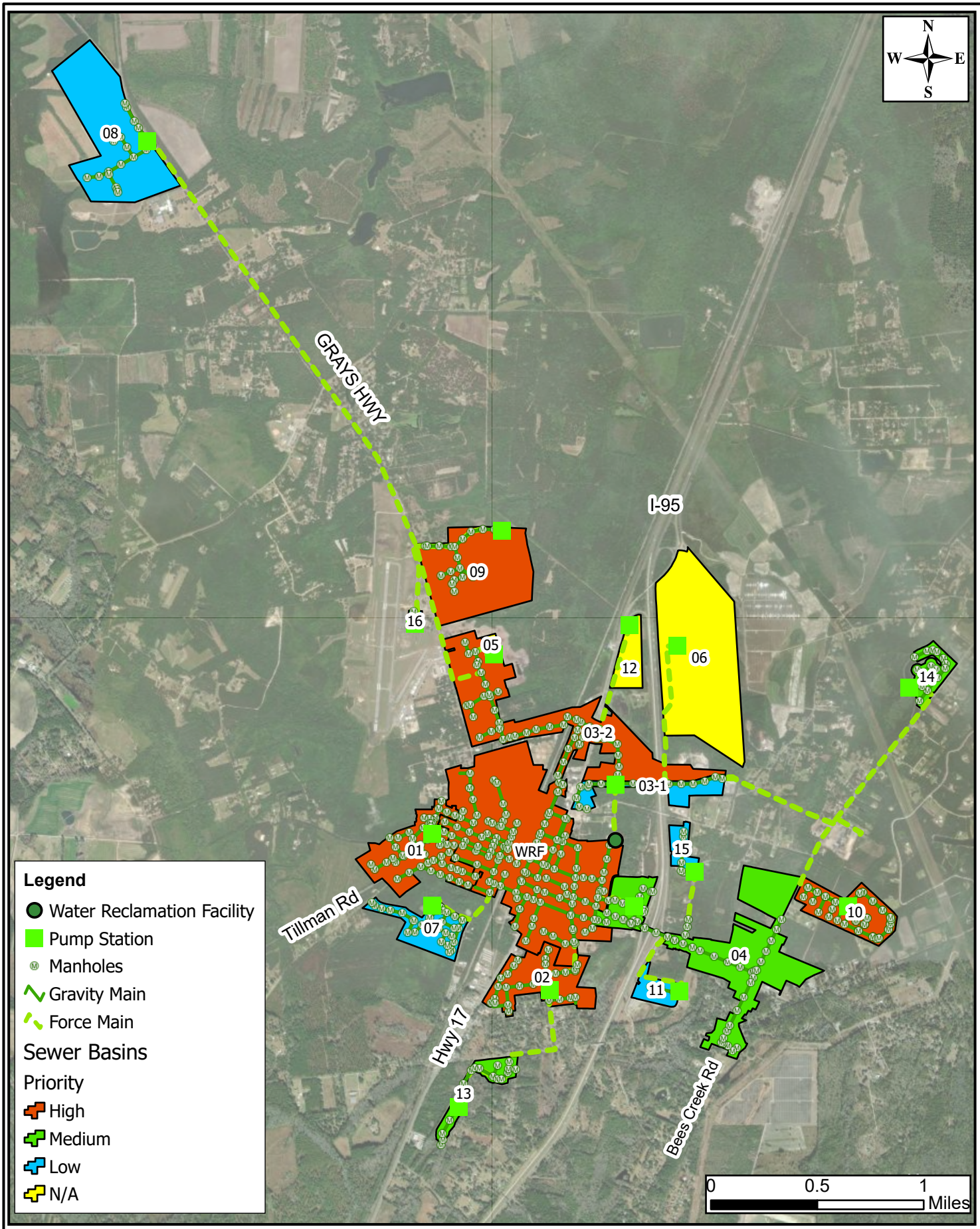

Figure 3.3 : Ridgeland Sewer System
Sub-Basins Prioritized by I&I Contributions

Ridgeland, SC

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These sub-basins vary significantly in size, and in some cases the primary cause of the I&I has already been identified by operations staff and the smoke testing results. For example, the sinkholes noted in the table were considered a priority and have been repaired. Additionally a sewer rehabilitation project in sub-basin WRF funded by the CDBG program was completed in 2021 and included sewer main rehabilitation of 8,000 LF of gravity sewer with trenchless repair methods Cured-In-Place-Pipe (CIPP) and pipebursting and manhole coating and raising for 33 manholes. Even though rehabilitation efforts have been made in the sub-basin, given the high I&I measured within the WRF sub-basin and extensive size of the sub-basin, the High priority scoring is maintained.

A plan for further study, analysis, sewer rehabilitation project identification and prioritization is provided in the *Inflow and Infiltration Abatement Analysis*. Several of the recommended projects have been completed including July 2019 smoke testing study of PS/Sewer Sub-Basin No. 3 – along the eastern leg which accepts the sewer flows from the Ridgeland Correctional Institution and the northern leg which accepts sewer flows from Cypress Ridge Industrial Park, sewer rehabilitation along East Adams Street as part of the CDBG project completed in 2021, and CCTV evaluation within sub-basin 3 (PS3) along the eastern leg where manholes around Captain Bill Creek were identified as a primary source of inflow to the sewer system..

Several areas of the sewer system have been pinpointed for repair based on the findings of the I&I study, the smoke testing, other repair work which has been completed, and the findings of the July 2019 smoke testing and subsequent CCTV. These particular areas are primary to the sewer system and part of the backbone of the system directing flow to the WRF. These areas also serve a significant portion of the commercial and industrial sewer introduced into the sewer system from the Cypress Ridge Industrial Park, the Ridgeland Correctional Institution, the commercial area around I-95 Exit 21, and the core commercial areas and Town and County government facilities in the Town center. The associated sewer sub-basins are PS 3, PS 4, and WRF. Sewer rehabilitation design was developed for these areas including sewer pipe cleaning and CCTV and identification of required sewer pipe and manhole rehabilitation. This design was incorporated into the 2023 Water and Sewer Resiliency Improvements project to be funded in part by the EDA grant. However, because bids for the project were in excess of available EDA grant and Town funds, the project was scaled back and for sewer rehabilitation only includes the manholes north and east of PS3. The remaining portion of the design will be packaged up for future grant funding initiatives.

Where possible, the Town is working on repairs in-house to address “find and fix” type inflow items identified from smoke testing, such as missing sewer cleanout caps and manhole sealing, but understand that a programmatic approach is necessary to reduce the infiltration levels in the overall sewer system. The recommended approach to the Inflow and Infiltration Reduction Program is provided below.

Inflow and Infiltration Reduction Program	Probability of Failure Score	5.0
• Priority #1: Smoke Testing of remaining portion of sewer system (~39,500 LF); • Priority #2: CCTV Inspection and Cleaning of (assume needed for 50% of remaining portion of sewer system ~32,750 LF)		

Inflow and Infiltration Reduction Program	Probability of Failure Score	Varies (4.0 to 3.0)
• Priority #3: Sewer Main Rehabilitation Program – identify project areas by prioritization and results of smoke testing and CCTV; develop annual packages of $250,000 (FY2026+); estimate 1/2+ mile per year		

Establishing an acceptable level of I&I in a gravity sewer system is a complex issue especially where the age of the system is more than 60 years old and was installed at a time when the industry standard for

exfiltration or infiltration was much greater than the 100 gallons per inch of pipe diameter per mile per day standard (*Recommended Standards for Wastewater Facilities*, also known in the industry as the *Ten State Standards*, published by the Great Lakes-Upper Michigan River Board of State and Provincial Public Health and Environmental Managers) used today. While it is always desirable to minimize the I&I in a system as much as possible, there is a break even point where spending additional capital funds toward I&I rehabilitation begins to provide diminishing returns. The rate of allowable I&I is subjective and to some extent is impacted by the excess hydraulic capacity in the collection and transmission systems and also the excess treatment and hydraulic capacity at the WRF.

To this end, the Town will need to continue evaluation of I&I within the sewer system sub-basins in consideration of the piping material and age of the system. It is anticipated differing levels of acceptable I&I will vary by sub-basin.

Developing Sewer Main Rehabilitation Program

Typically a series of CIPs would be developed for sewer rehabilitation within the Critical to Low sewer sub-basins based on information on pipe and manhole material and pipe size and depth. Such information is not available for the Town's sewer system and accordingly, estimated I&I reduction CIPs have not been developed by sub-basin. CCTV reporting will provide the information necessary to develop accurate CIPs and cost estimates. I&I problems in the gravity sewer mains can typically be resolved with trenchless technologies such as cured-in-place-pipe (CIPP) and/or pipebursting so as to minimize damage to the existing infrastructure including roads and to reduce the disruption to the community caused by open trench construction. While trenchless technologies can reduce I&I and provide improvement in structural conditions, it will not alter slopes of pipes. Therefore, if upon further evaluation of the sub-basins it is determined that there are negative slopes or sags in the pipes, open trench construction may be necessary. Table 3.9 provides a summary of the typical recommendation of pipe rehabilitation methods based on pipe materials, condition of pipe slope, amount of pipe which sags between manholes, diameter, and previous pipe point repairs.

Table 3.9 Typical Recommendation of Pipe Rehabilitation

Recommended Pipe Rehabilitation Method	Pipe Conditions					
	Sags as Percent of Pipe Diameter	Structual Condition	Depth of Pipe	Pipe Diameter	Pipe Material	Pipe Slope
Pipe Bursting	< 50%	3 or Less Point Repairs	< 12 FT	< 18-Inch	VCP	Adequate
CIPP	< 50%	No Structural Defects; Joint offsets < 2-inches	Unrestricted	Unrestricted	DIP/CIP/ VCP	Adequate
Open Trench Replacement	> 50%	Multiple Structural Defects	Unrestricted	Required More Than 2 Sizes > Existing	Unrestricted	Negative or Less than Adquate

3.4.5 IMPACT ON WATER RECLAMATION FACILITY CAPACITY

Inflow & Infiltration has an impact not only on the capacity available in the sewer collection systems but also on the water reclamation facility. As concluded in Section 3.4.2 above, during a 1-inch storm event, an estimated additional 100,170 gallons must be treated at the Jimmy Mixson WRF. As an example of

the financial impact, it is noted that during the one-year study period from July 2021 through June 2022 there were approximately 44.7 inches of rainfall measured at the WRF. Using the calculated I&I for a 1-inch storm event as a standard, approximately 4.48 million gallons of I&I were unnecessarily treated at the WRF. Based on actual fiscal year 2022 sewer system operating expenses, it costs approximately $0.02 per gallon for treatment at the Jimmy Mixson WRF. Accordingly, I&I at the WRF cost the Town approximately $90,000 during the study period. This estimate is at the low end of the I&I costs as many of the storm events were greater than 1-inch and therefore generated more I&I than multiple 1-inch storms would. Additionally, this does not include the associated unnecessary operational wear and tear and maintenance costs associated with the operation of pump stations and treatment equipment due to the I&I. The peak flows from I&I can also exceed the hydraulic capabilities of the WRF and the pumping and transmission systems.

3.4.6 OVERALL IMPLICATIONS OF TOWN INFLOW & INFILTRATION

As described in Sections 3.4.4 and 3.4.5, I&I has a significant impact on the available hydraulic capacity of both the Town's sewer collection and transmission systems and also on the WRF. There is also a considerable associated cost to the Town for unnecessary treatment; at least $90,000 at the Jimmy Mixson WRF during the one year study period alone. The transmission and treatment of the I&I flows also causes excessive wear and tear on the plant equipment and the pumping systems and thereby shortens the anticipated life span.

Significant development is anticipated in Ridgeland over the next 20 years. I&I in the system reduces the available capacity for growth and development particularly when considering that there is not sufficient capacity available for even just the anticipated development to the west, central, and the infill growth, as noted in Section 4. The noted I&I concerns need to be addressed not only to recapture capacity in the system, but also to reduce the potential for structural failures, further increasing I&I flows, sewer system overflows, and increased operational costs.

4.0 – GROWTH – REGIONAL COORDINATION & PLANNING

The purpose of Section 4 of the 2023 Regional Water & Sewer Master Plan is to present anticipated growth, development trends, and projected population and water capacity/sewer generation rates for the service areas over the 20year study period. The BJWSA Water & Wastewater 2022 Master Plan Update, specifically Technical Memorandum No. 1 (TM 1): Population Projections, Water System Demand Projections, Wastewater System Flow Projections, presents the BJWSA's anticipated growth trends and water and sewer flows for their service areas.

In 2017, the Town of Ridgeland updated their 2007 Comprehensive Plan. The 2007 Comprehensive Plan was written during a period of rapid growth for the entire region and accordingly included accommodations for aggressive commercial and residential development. Unfortunately, due to the housing market crash of 2009, this growth stagnated for many years. The 2017 Comprehensive Plan states that the metrics for community health and vitality have since stabilized.

The 2017 Comprehensive Plan and other Town provided documents were used as reliable sources of past and projected population data for the Regional Water and Sewer Master Plan. The following sections discuss the projected land use and anticipated development trends that were used to develop the projected population numbers and corresponding water usage and sewer generation rates for the Town service area. This section does not present data on the current BJWSA service areas, other than discussions of overall available water and sewer system capacity and opportunities for regional cooperation.

4.1 TOWN PROJECTED LAND USE

In 2010, the Town of Ridgeland adopted the SmartCode to promote infill of the existing development as well as development of compact, walkable neighborhoods. As such, with the exception of industrial land uses, the goal is to encourage mixed use development and sustainable growth. By reducing sprawl, the Town is able to focus on maintaining and improving existing infrastructure such as the water and sewer distribution, collection and treatment systems. As more people can connect to centralized water and sewer systems, the utilization of private wells and septic systems will be reduced and should result in a corresponding improvement in environmental concerns which will address a primary goal for adopting the SmartCode.

The Town of Ridgeland has three large areas that are currently under PDD, or Planned Development District, with developers. These three regions all fall on the eastern side of I-95 and are primarily forested lands which are to be developed with residential (both single- and multi-family), commercial, and light industrial uses. These PDDs also have included provisions for both environmental and historical protections.

4.2 TOWN ANTICIPATED DEVELOPMENT TRENDS

The Town of Ridgeland utilizes the SmartCode and does not break down its land areas by the traditional land uses. However, some information can be derived from the 2017 Comprehensive Plan on the current state and predicted development. This information is summarized briefly below and is presented as it guides a foundation for the development of population projections and the water and sewer generation projections for the 20-year Master Plan study period from 2023 – 2042.

4.2.1 RESIDENTIAL

According to the Town of Ridgeland's Comprehensive Plan, in 2017 there were a total of 1,352 housing units (made up of utility customers and private users). As was mentioned in Section 1.3, approximately 78% of the housing stock is made up of single-family and mobile homes, and the remaining 22% are multi-family units. The occupancy rate of the housing units breaks down into:

- Occupied – 92.3%
- Vacant – 7.7%

The high occupancy rate is considered to be a sign of market health and stability. Approximately 66% of the Town's housing stock was constructed between 1980 to 2009 with minimal constructed in the last decade. Additional housing construction would be needed to support a growing community and replace aged structures. With the proposed construction that should come along with the PDDs, there should be sufficient units to meet any future needs of the community.

4.2.2 COMMERCIAL/INDUSTRIAL

According to the Town of Ridgeland's 2017 Comprehensive Plan, there are several industrial areas that are located in and near the Town limits. The businesses occupying these areas include Tico Manufacturing, Be Green Packaging, Ohio Grating, Gretsch Drums, Nimmer Turf Farm, and Daniel Defense. Three emerging opportunities highlighted are the Jasper Ocean Terminal, the developing green industry/energy field, and food systems development. The Comprehensive Plan also provides some information on job growth in Jasper County that can be used as illustrative for industry changes in Ridgeland. Jasper County has seen growth in the fields of "Distribution and Electronic Commerce", "Business Services", and "Construction Products" but has seen the largest reduction in "Hospitality and Tourism".

4.3 PROJECTED POPULATION FOR TOWN SERVICE AREAS

4.3.1 METHODOLOGY

The following sections describe the general methodology used to develop the population projections for the Town's water and sewer system service areas for the 20 year planning period. The complete accounting of the population projections is provided in Appendix A.

Several types of information were gathered to develop a thorough method of projecting the future development growth areas and associated populations for the water and sewer service areas. The beginning foundation for all the projections was the Town, Jasper County and Beaufort County Comprehensive Plans. 4Waters additionally corresponded with several stakeholders in the community, as listed below, to develop an understanding of the anticipated growth between the Town and BJWSA service areas.

- Dennis Averkin, Town Administrator, Town of Ridgeland
- Heather Spade, Director of Planning & Community Development, Town of Ridgeland
- Rebecca Bower, P.E., Former Director of Engineering, Beaufort-Jasper Water Sewer Authority
- Ed Saxon, Former General Manager, Beaufort-Jasper Water Sewer Authority
- James Clardy, Program Manager, Beaufort-Jasper Water Sewer Authority

Based on discussions with the above stake holders it was determined that the Comprehensive Plans represent the most reliable source of published population data that was used for the 2023 Regional Water and Sewer Master Plan. Other sources of information that were used included the 2020-2025 Fiscal Projection for Jasper County, SC Including County, School District, Hardeeville and Ridgeland which was prepare by the Regional Economic Analysis Laboratory, Clemson University, the PDDs, the Town and County GIS databases and discussions with staff. The 2022 BJWSA Water & Wastewater Master Plan Update, TM1: Population Projections, Water System Demand Projections & Wastewater System Flow Projections references use of the draft Traffic Analysis Zone (TAZ) data for Beaufort and Jasper Counties as a source of population and household estimates for 2019, 2030, 2040, and 2045. A linear projection was applied to the overall TAZ data in TM1 for the BJWSA service areas.

For the Regional Water & Sewer Master Plan, the Comprehensive Plans along with the PDDs, development planning applications, and other information from developers and associated engineering firms was utilized to provide a localized view of population growth within the Town's service area. All of

this information was compiled and evaluated to determine the population projections for the 20 year study period. The population projections for each 5 year planning window were developed by using a linear interpolation by development area between the 2023 and 2042 time frames.

4.3.2 KEY DEVELOPMENT AREAS

In addition to the Comprehensive Plans, it is important to have an understanding of the key planned future development areas and how they are geographically located throughout the service area. The below sections provide a high-level description of some of the key development corridors, which have been broken down by geographic areas labeled Central, East and West.

4.3.2.1 CENTRAL KEY DEVELOPMENT AREAS

The following provides characteristics of the primary areas in the Central part of the Town that are considered key future development areas:

- The Groves at Bees Creek (Development A)
  - 97 single family households
  - Development timeframe is estimated over the next 20 years
- Bees Creek Plantation - Part 2 (Development O)
  - 60 single family households
  - Development timeframe is estimated over the next 10 years
- RV with Pond (Development R)
  - 60 single family households
  - Development timeframe is estimated over the next 10 years
- Ridgeland Village (Development W)
  - 13 single family households
  - Development timeframe is estimated over the next 10 years
- Single Family (Development B)
  - 38 single family households
  - Development timeframe is estimated over the next 20 years
- Camping World (Development H)
  - 96 RV lots
  - Development timeframe is estimated over the next 10 years
- Captain Johns Graham Subdivision (Development P)
  - 62 single family households
  - Development timeframe is estimated over the next 10 years
- 40 Acres (Development D)
  - Estimated at 130 single family households
  - Development timeframe is estimated over the next 20 years
- Maxfield Plantation (Development Z)
  - Estimated up to 500 single family households
  - Development timeframe is estimated over the next 10 years

4.3.2.2 EAST KEY DEVELOPMENT AREAS

There are four primary areas on the East side of the Town that are considered to be key future development areas: Pittman/Genesis PDD, Graves/Tickton Hall, Moultrie PDD, and Good Hope PDD. The following provides characteristics of these primary key development areas in the East part of the Town:

- Pittman/Genesis PDD (Development M)
  - Approximately 14,860 households (single family and multi-family)
  - 16,000,000 square feet of light industrial

    - Development timeframe is over the next 40 years
- Graves/Tickton Hall (Development N)
    - Approximately 4,800 households (single family and multi-family)
    - 580,000 square feet of commercial/mixed use
    - Development timeframe is estimated over the next 25 years
- Moultrie Tract PDD (Development G)
    - 670 acres (80 acres set aside for nature preserve)
    - 2,600 households (single family and multi-family)
    - 3,000,000 square feet of commercial and industrial
    - Development timeframe is estimated over the next 40 years
- Good Hope PDD (Development Y)
    - 16,000 acres (50% set aside for preservation)
    - 4,200 households (single family and multi-family)
    - 6,300,000 square feet of commercial
    - Development is not projected to start within the next 10 years, however once development starts buildout is anticipated over a 30 year period (per the PDD)

4.3.2.3 WEST KEY DEVELOPMENT AREAS

The following provides characteristics of the primary areas in the West part of the Town that are considered key future development areas:

- Cypress Ridge (Development L)
    - 495,000 square feet of commercial
    - Development timeframe is estimated over the next 10 years
- (Development X)
    - 40 single family households
    - Development timeframe is estimated over the next 20 years
- Thomas Hayward Academy (Development I)
    - 320 single family households
    - Development timeframe is estimated over the next 20 years
- Weathersbee – Mungo (Development C)
    - 90 single family households
    - Development timeframe is estimated over the next 5 years
- Fox Chase (Development F)
    - 183 single family households
    - Development timeframe is estimated over the next 10 years
- Nimmer (Development J)
    - 900 single family households
    - Development timeframe is estimated over the next 10 years
- Tarboro Road (Development S)
    - 30 single family households
    - Development timeframe is estimated over the next 10 years
- Highlands (Development E)
    - 238 single family households
    - Development timeframe is estimated over the next 10 years
- Smart Investment (Development K)
    - 900 single family households
    - Development timeframe is estimated over the next 20 years
- Sisters Ferry (Development Q)
    - 175 single family households
    - Development timeframe is estimated over the next 20 years

Figure 4.1 presents the development areas within the Town and the surrounding area that could develop during the 20-year planning period (and beyond) of this study. These growth projections and development areas form the basis for the water and sewer system expansion capital improvement projects developed in this report.

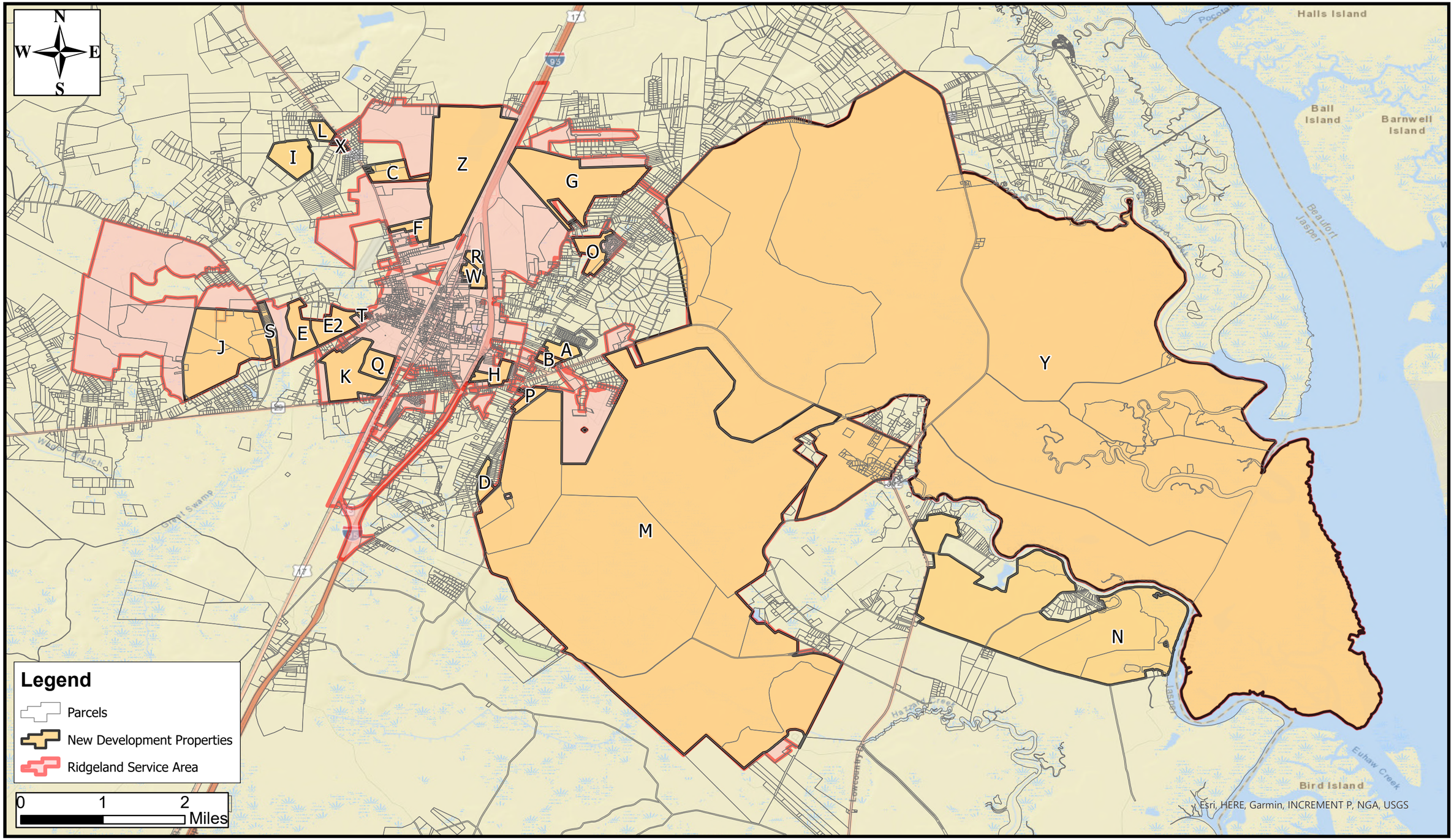

Figure 4.1
Potential Ridgeland Developments

Regional Water and Sewer Master Plan

DISCLAIMER: This map is for reference and discussion purposes only. Data provided are derived from multiple sources with varying levels of accuracy. The information shown hereon is not intended for site specific use or design.

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4.3.3 REGIONAL WATER AND SEWER SERVICE APPROACH

A primary goal of the 2023 Regional Water and Sewer Master Plan was to determine the most efficient and cost-effective manner to improve the reliability and performance of the Town's existing water and sewer infrastructure and to identify the water and sewer system improvements and strategies needed to serve the growth projected to occur in the Town and adjacent areas of Jasper County over the planning period.

At the outset of the Regional Water and Sewer Master Plan effort, there was an understanding that collaboration with the BJWSA would likely be necessary to cost effectively serve portions of the planned developments within the East geographic area which includes a projected 26,460 households and almost 26 million square feet of commercial and light industrial uses.

On March 1, 2023, representatives from the Town, the BJWSA and 4Waters met to discuss the estimated population growth and associated water demand and sewer generation rates for the East area, potential service area delineation (particularly between the areas east of the Town and west of the BJWSA South of Broad (SOB)), and options for water and sewer service.

During the meeting, BJWSA representatives discussed the primary growth corridors within their SOB service area, which include the East Argent development with an anticipated 4,000 residential units and the US17 Corridor developments with an anticipated 15,900 residential units and 41,500 square feet of commercial use. The BJWSA 2022 Water & Wastewater Master Plan Update indicates an estimated water demand of 8.7 mgd and sewer generation rate of 5.2 mgd by 2045 for these two developments alone. These development areas had not been anticipated at the time of the prior BJWSA Water & Wastewater Master Plan in 2017.

As part of the Town's Regional Water and Sewer Master Plan, Raftelis Financial Consultants (Raftelis) has conducted a financial feasibility and revenue sufficiency evaluation of the proposed Rehabilitation and Expansion Capital Improvement Projects for the Town (reference Section 7.3). Based on Raftelis' evaluation of the preliminary estimated Rehabilitation project expenditures and timing and the anticipated growth and Expansion projects, it was determined that it would not be feasible for the Town to undertake the Expansion projects necessary to serve the entire East area developments and maintain a reasonable water and sewer rates. The results of this financial analysis further emphasize the importance of a regional partnership between the Town and the BJWSA to provide water and sewer service to portions of the East area.

The water demand and sewer generation rate projections presented in the following sections have been developed by key development areas – Central, West and East. Based on the findings of the Raftelis analysis, the water and sewer per capita rates for Central and West are based on the Town's averages and the BJWSA's averages were utilized for the East area.

Figure 4.2 presents the potential Ridgeland and BJWSA service boundary.

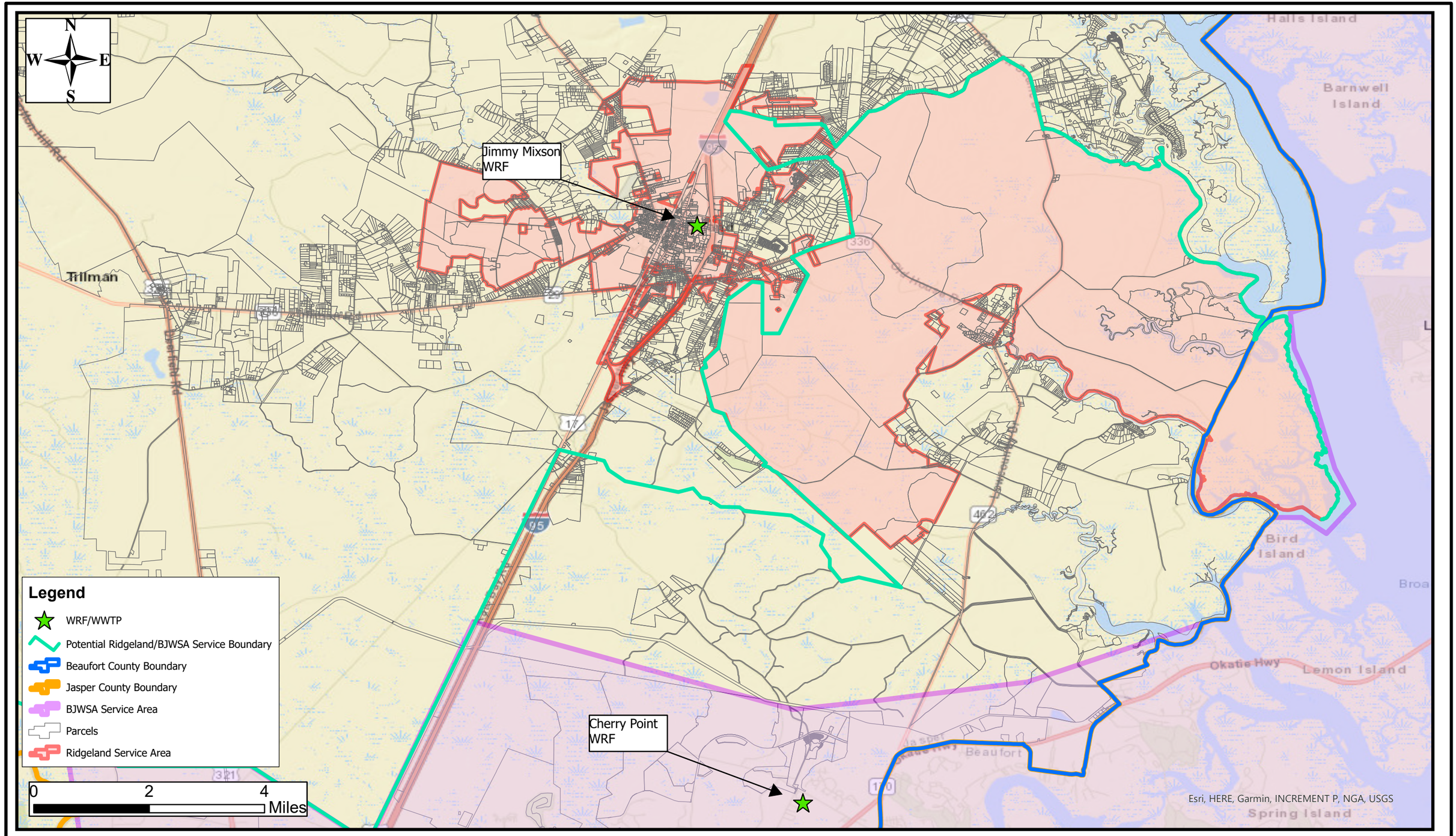

Figure 4.2
Potential Ridgeland/BJWSA Service Boundary

DISCLAIMER: This map is for reference and discussion purposes only. Data provided are derived from multiple sources with varying levels of accuracy. The information shown hereon is not intended for site specific use or design.

FOUR WATERS ENGINEERING

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4.3.3.1 REGIONAL PARTNERSHIP OPPORTUNITIES

The March 2023 meeting between the Town and the BJWSA represents a starting point in the discussion and collaboration to develop a regional solution to serving the anticipated water and sewer development needs of the Town's East area. Estimated impacts to the Town's water and sewer customer base limit the Town's ability to undertake construction and operation of water production and sewer treatment and disposal facilities to serve the anticipated East area developments. Current options to be explored and discussed with the BJWSA for providing timely water and sewer services to the East area include:

- Wholesale Water and Sewer Agreement: The Town would acquire water and wastewater capacity from BJWSA and agree on a point of connection to BJWSA water/sewer infrastructure. The Town will own, operate and maintain the water mains and forcemains and associated infrastructure extended to serve the East area connected to the BJWSA systems.. Under a wholesale agreement, water production and sewer treatment and disposal are provided by the BJWSA and the Town would provide direct customer billing.

- Franchise Water and Sewer Agreement: A Franchise Agreement will be used for the East areas adjacent to existing or future BJWSA infrastructure, BJWSA would maintain and operate the water and sewer infrastructure, provide water production and sewer treatment and disposal, and provide direct customer billing to the Town's customers. The Town will name BJWSA as the sole provider of water and sewer services in these East areas and a Franchise Fee based on a percentage of the water and sewer revenue generated in those areas will be negotiated.

4.3.4 PROJECTED POPULATION FOR WATER SYSTEM SERVICE AREAS

Table 4.1 provides the base 2023 water population in people and the five year increment projected water populations for the Town service area. These will be used to develop the projected water demands for the 20 year study period. It is important to note that these projections are inclusive of the whole Town service area and the large planned PDDs.

Table 4.1 Population Projections for Water Service Areas

Year	Town Population
2023	3,118
2027	14,461
2032	26,833
2037	36,848
2042	44,860

4.3.5 PROJECTED POPULATION FOR SEWER SYSTEM SERVICE AREAS

Table 4.2 provides the base 2023 sewer population in people and the five year increment projected sewer populations for the Town service area. These will be used to develop the projected sewer demands for the 20 year study period. It is important to note that these projections are inclusive of the whole Town service area and the large planned PDDs.

Table 4.2 Population Projections for Sewer Service Areas

Year	Town Population
2023	2,209
2027	14,028
2032	25,872
2037	35,861
2042	43,852

4.4 PROJECTED WATER DEMANDS

The methodology for projecting the water demands for the Town is presented below with an analysis of the remaining available capacity at the Town's existing water production facilities. Any need for expansion of the existing water production facilities or construction of new facilities is also addressed in the following sections.

4.4.1 PROJECTED AVERAGE DAILY WATER DEMAND AND AVAILABLE CAPACITY

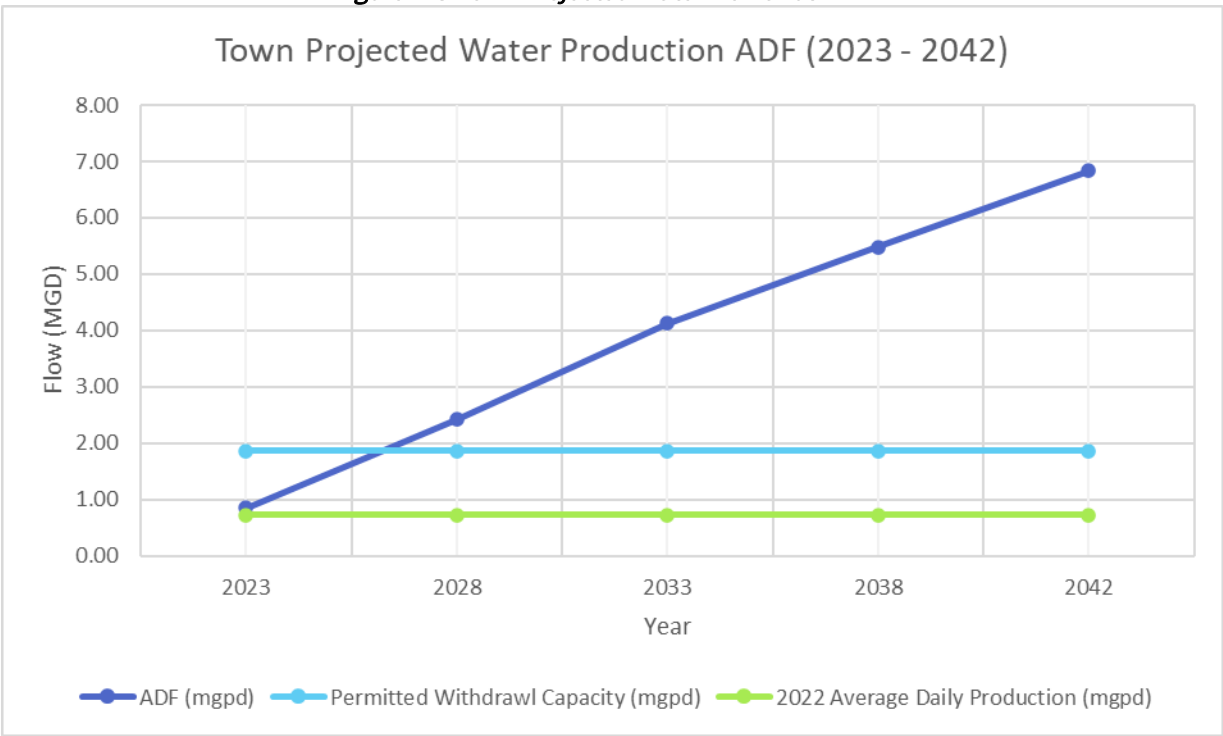
The per capita water demands developed for the Town water service area are 151 (Town) and 180 (Prison) gallons per day per capita (gpc/d) as described in Section 2.1.10. During development of these per capita water demands, any large industrial or commercial users, such as the prison were removed or separated based on billing records so as not to misrepresent the ratio of industrial/commercial water uses to residential. The projected residential water demand for the Central and West areas for the period from 2023 to 2042 were determined by utilizing the standard single family home usage of 400 gpd (broken down to a 159 gpd per capita) required by DHEC for new development; the East area utilized the BJWSA average rate of 78.5 gpc/d. After determination of the projected water demands based on the per capita rates and populations, the large commercial/industrial user demands which were previously removed were added back to the total water demands.

As previously noted, the projected water demands for the Town have been divided into five year increments: 2023 – 2027, 2028 – 2032, 2033 – 2037, and 2038 – 2042, to allow for more accurate and efficient planning of the necessary infrastructure. Table 4.3 presents the projected incremental average daily water demand for the Town.

Table 4.3 Town Projected Water Demands

Year	Town Water Production (MGD)
2023	0.85
2027	2.42
2032	4.13
2037	5.49
2042	6.84
Permitted Well Withdrawals	**1.87 MGD**
Total Storage Volume (EST)	**1.40 MGD**

Figure 4.3 Town Projected Water Demands



The demands presented in Table 4.3 and Figure 4.3 represent average daily flow. The maximum day and peak hourly factors for the water projections are the same as presented in Section 2.1.7 as they represent true peaking factors within the community.

The permitted groundwater withdrawal limits on an annual average daily basis are also provided in Table 4.3. Based on the projections, the Town does not have sufficient water production capacity to meet the needs of the population growth through the 20 year period. The production needs are estimated to exceed the permitted limits prior to 2027. The current water storage capacity in million gallons is additionally shown above in Table 4.3 for the Town's water system. The Town will exceed the storage capacity within the 20 year window.

The results of the WaterGEMS hydraulic model can be utilized to determine the need and location for any additional groundwater wells or water storage. The recommended capacity and location for additional water production facilities and storage is presented in Section 5.0.

4.5 PROJECTED SEWER GENERATION FLOWRATES

The projected sewer generation flowrates for the Town are presented below along with an analysis of the remaining available capacity at the existing WRF. Any need for expansion of the existing wastewater treatment plant or construction of new facilities is also addressed in the following sections.

4.5.1 PROJECTED AVERAGE DAILY SEWER GENERATION FLOWRATES AND AVAILABLE CAPACITY

The per capita sewer demands developed for the Town sewer service area are 169 (Town) and 178 (Prison) gallons per day per capita (gpc/d) as described in Section 2.3.7. During development of these per capita sewer demands, any large industrial or commercial users, such as the prison were removed or separated based on billing records so as not to misrepresent the ratio of industrial/commercial sewer use to residential. The projected residential sewer demand for the Central and West areas for the period from 2023 to 2042 were determined by utilizing the standard single family home usage of 300 gpd (broken down to a 131 gpd per capita) required by DHEC for new development; the East area utilized

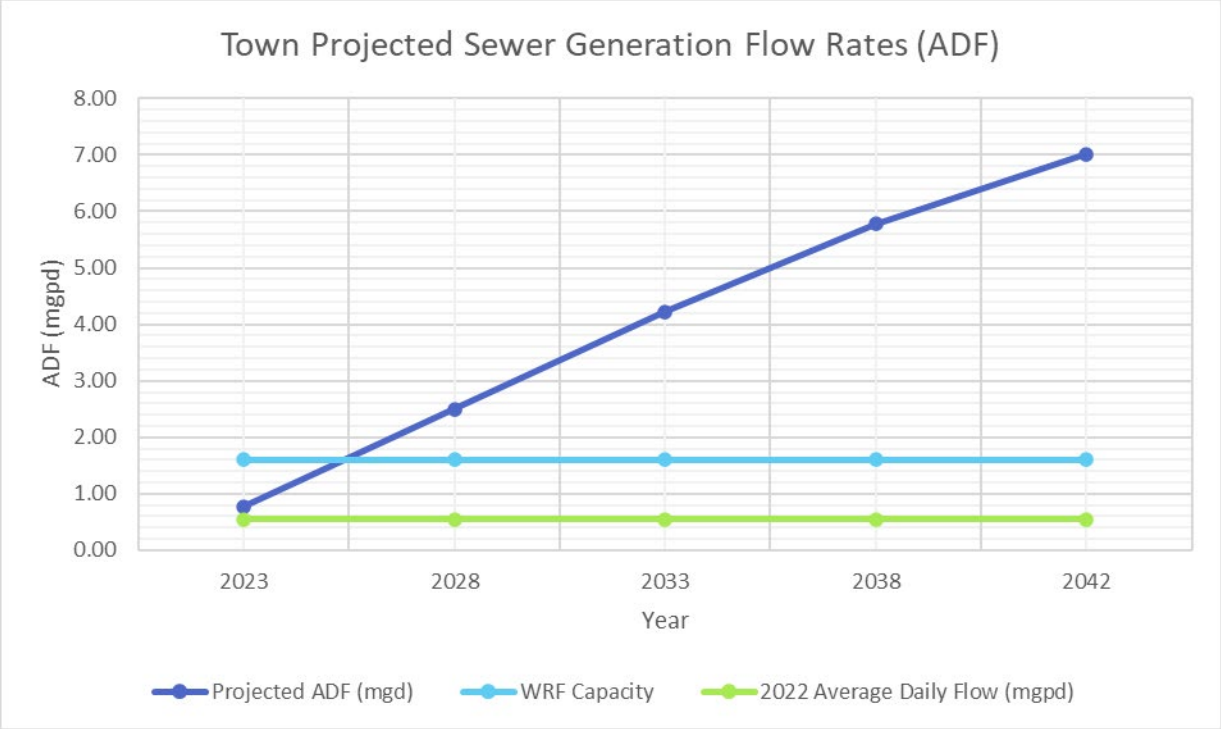
the BJWSA average rate of 88.3 gpc/d. After determination of the projected sewer demands based on the per capita rates and populations, the large commercial/industrial user demands which were previously removed were added back to the total sewer demands.

As previously noted, the projected sewer generation flowrates for the Town and future developments have been divided into five-year increments: 2023 – 2027, 2028 – 2032, 2033 – 2037, and 2038 – 2042, to allow for more accurate and efficient planning of the necessary sewer infrastructure. Table 4.4 presents the projected incremental average daily sewer generation flowrates for the Town.

Table 4.4 Projected Sewer Generation Flowrates

Year	Town WRF (MGD)
2023	0.78
2027	2.50
2032	4.22
2037	5.78
2042	7.02
Permitted AADF (MGD)	**1.6 MGD**

Figure 4.4 Town Projected Sewer Demands



The demands presented in Table 4.4 and Figure 4.4 represent average daily flow.

4.6 PROJECTED STATUS OF ON-SITE SEWER DISPOSAL SYSTEMS AND PRIVATE WELLS

On-site Sewer Disposal

On-site sewer disposal or septic systems are expected to remain a permanent element of wastewater management systems throughout the country, and when properly designed, sited, constructed, and maintained, they can be an environmentally sound method of wastewater treatment and disposal. Failures, however, are inevitable and unfortunately it is common for homeowners to believe that their septic systems are functioning properly so long as there are no backups in the home and no foul odor in the yard or adjacent areas.

There is no statistical data available on typical septic system failure rates. This may be due in part to the fact that failure potential varies significantly based on installation year and age of the system, and the soil characteristics and water table elevation of the septic system site.

There are several ways that septic systems can fail including backups of the system caused by lack of pumping and maintenance of the septic tank, clogging of the drainfield piping, or the use of an undersized system; or the capacity of the soil to absorb effluent can be reduced due to solids or other substances in the effluent clogging the soil. When septic systems fail, the effluent from the system can work its way to the surface and run off to surface water bodies or inadequately sealed wells down gradient, or poorly treated effluent from the septic system can travel down to groundwaters. A failing septic system can discharge as much as 76,650 gallons a year based on conservative per capita generation rates. These poorly treated waters which work their way in to ground water and surface waters can carry excessive nutrients, nitrogen and phosphorus, excessive organic matter, and metals, and thereby contaminate drinking water sources, cause algae growth or eutrophication, or cause a reduction in the oxygen supply of surface waters.

In the Town, there are several areas where septic systems continue to be used as noted in Section 2.3.5. These areas are scattered throughout the Town and connection of the septic systems to the centralized sewer system should be a high priority during the 20 year period as it will have a great impact on ground and surface waters as well as public health. The areas in proximity to the existing Town gravity sewer system were incorporated in the sewer generation projections to better predict the expected flowrate for the existing WRF. Septic users outside the Town limits were additionally evaluated for the potential discharge at future wastewater treatment facilities.

Septic to sewer conversion projects will be described in Section 6.

Private Wells

Similar to other municipalities within the State of South Carolina, the Town may not have been able to provide public water to all developed areas within the service area. This could have occurred for several reasons such as the cost of infrastructure to serve an area may have exceeded the benefits, both economic and environmental; the low density or sparseness of construction did not make watermain extensions feasible; or areas were developed well before an organized utility department was established. In the Town, there are several areas where private wells continue to be used as noted in Section 2.1.5. These areas are scattered throughout the Town and connection of the private well users to the centralized water system should be a high priority during the 20 year period as it will have a great impact on public health.

The areas in proximity to the existing Town water system were incorporated in the water usage projections to better predict the expected needs for the existing water system. Private well users outside the Town limits were additionally evaluated for the potential usage from future water treatment facilities.

Private well conversion projects will be described in Section 5.

4.7 FUTURE GROWTH

As mentioned above the key development areas were broken down geographically as Central, East and West and can be seen in Figure 4.7. The following sections discuss the projected infrastructure needs for each geographic area, which were informed based on the model development, calibration and assessment of the hydraulic capability of the water and sewer systems which are described in Section 5.0 and Section 6.0, respectively.

4.7.1 FUTURE GROWTH – WATER SYSTEM

With the understanding of the projected water demands in Section 4.4.1, it was necessary to utilize the Town's available water capacity in the most efficient and cost-effective manner. That said, the projected water demands were divided geographically with the East area - Moultrie Tract PDD, Pittman/Genesis PDD, Graves/Tickton Hall and Good Hope PDD requiring new water production/storage facilities and allowing the remaining proposed developments/customer base in the Central/West areas to utilize the existing Town infrastructure. The division of the water demands can be seen in Figure 4.5. It is important to note that the existing Town infrastructure will require additional production and storage capacity prior to year 2032.

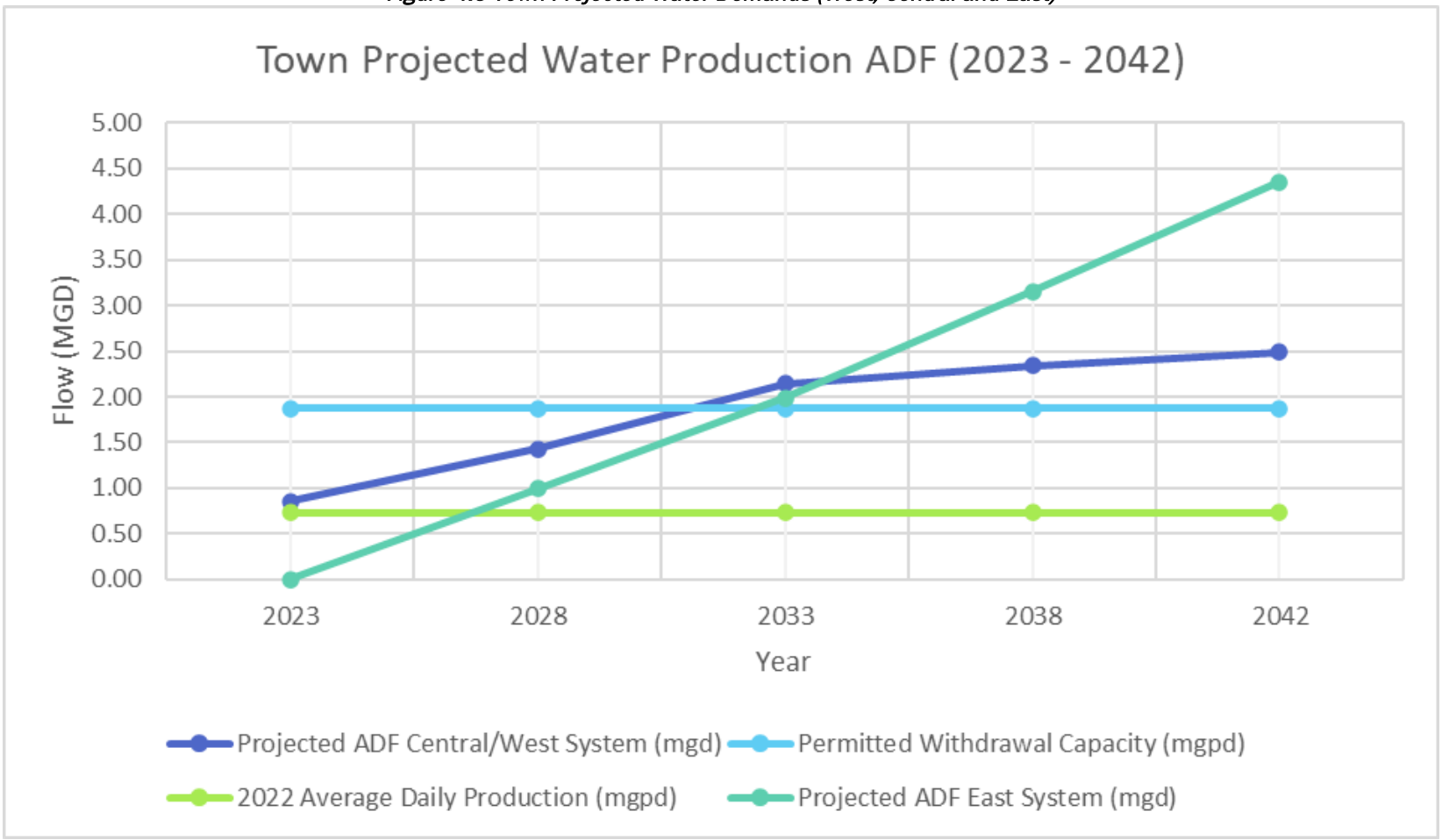
The projected Central/West area water demands developed in the sections above were then added to the hydraulic model in five year periods to assess the ability of the Town's system to serve the projected needs and to determine upgrades or expansions which will need to be made. Therefore, section 5.0 provides descriptions of the recommended expansion projects necessary for future growth of the water service areas over the 20 year planning period. These sections address the recommended location and capacity of groundwater wells, water production facilities, elevated storage tanks, private well conversion and water mains for the water system.

Table 4.5 presents the projected BJWSA incremental water demands, permitted capacity and expansion capital improvement plans (CIPs) as outlined in past BJWSA Water and Wastewater Master Plans. Based on this information it is unknown if sufficient capacity is available for the East developments; additional coordination with BJWSA is necessary.

Table 4.5 BJWSA Projected Water Demands

Year	Total (Total MGD)
2025	26.10
2030	30.30
2035	33.70
2040	36.20
2045	38.20
2015 BJWSA Permitted WTP Capacity	39.00
2015 Permitted ASR Capacity	10.44
2015 Permitted Auxillary Well Capacity	7.20
2015 Total System Capacity	**56.64**
2035 - 2045 Purrysburg WTP CIP Expansion	15.00
2030 Total System Capacity	**71.64**

Figure 4.5 Town Projected Water Demands (West, Central and East)



4.7.2 FUTURE GROWTH – SEWER SYSTEM

With the understanding of the projected sewer demands in Section 4.5.1, it was necessary to utilize the Town's available sewer treatment capacity in the most efficient and cost-effective manner. That said, similar to the water, the projected sewer demands were divided geographically with the East area - Moultrie Tract PDD, Pittman/Genesis PDD, Graves/Tickton Hall and Good Hope PDD requiring new sewer infrastructure and allowing the remaining proposed Central/West area developments/customer base to utilize the existing Town infrastructure. The division of the sewer demands can be seen in Figure 4.6. It is important to note that the existing Town infrastructure will require additional treatment capacity prior to year 2030.

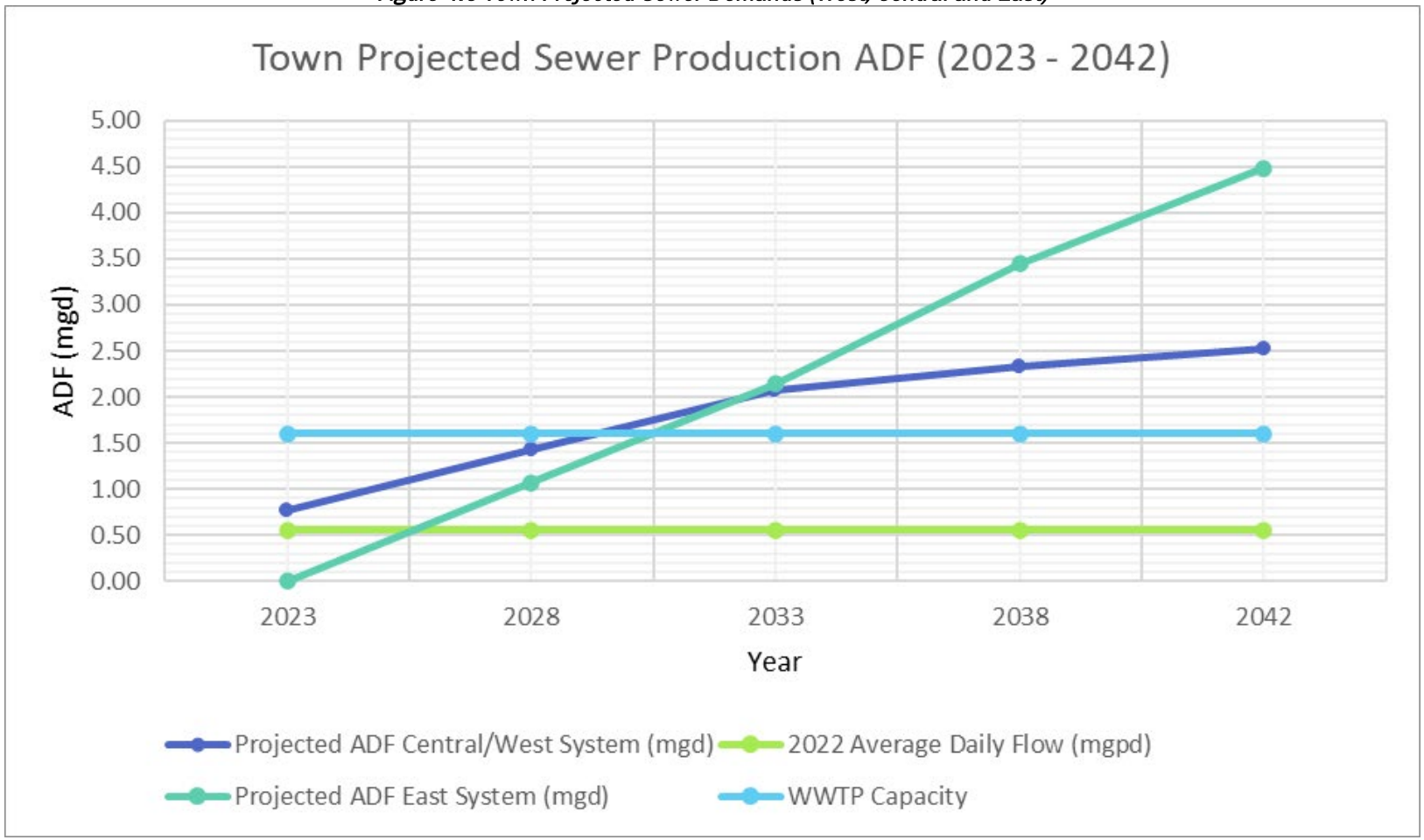
The projected Central/West area sewer demands developed in the sections above were then added to the hydraulic model in five year periods to assess the ability of the Town's system to serve the projected needs and to determine upgrades or expansions which need to be made. Therefore, section 6.0 provides descriptions of the recommended expansion projects necessary for future growth of the sewer service areas over the 20 year planning period. These sections address the recommended location and capacity of WRFs, pump stations, forcemains, major gravity sewer systems and septic conversion for the sewer system.

Table 4.6 presents the projected BJWSA incremental sewer demands, permitted capacity and expansion capital improvement plans (CIPs) as outlined in past BJWSA Water and Wastewater Master Plans and other documentation. Based on this information it is unknown if sufficient capacity is available for the East developments; additional coordination with BJWSA is necessary.

Table 4.6 BJWSA Projected Hardeeville and Cherry Point Sewer Demands

Year	Total (Total MGD)
2025	8.99
2030	10.93
2035	12.50
2040	13.00
2045	13.85
2020 Hardeeville WRF	0.52
2020 Cherry Point WRF	7.50
2020 Total System Capacity	**8.02**
2031 - 2035 Cherry Point WRF CIP Expansion	14.60
2026 - 2030 Hardeeville WRF CIP Expansion	4.00
2030 Total System Capacity	**18.60**

Figure 4.6 Town Projected Sewer Demands (West, Central and East)



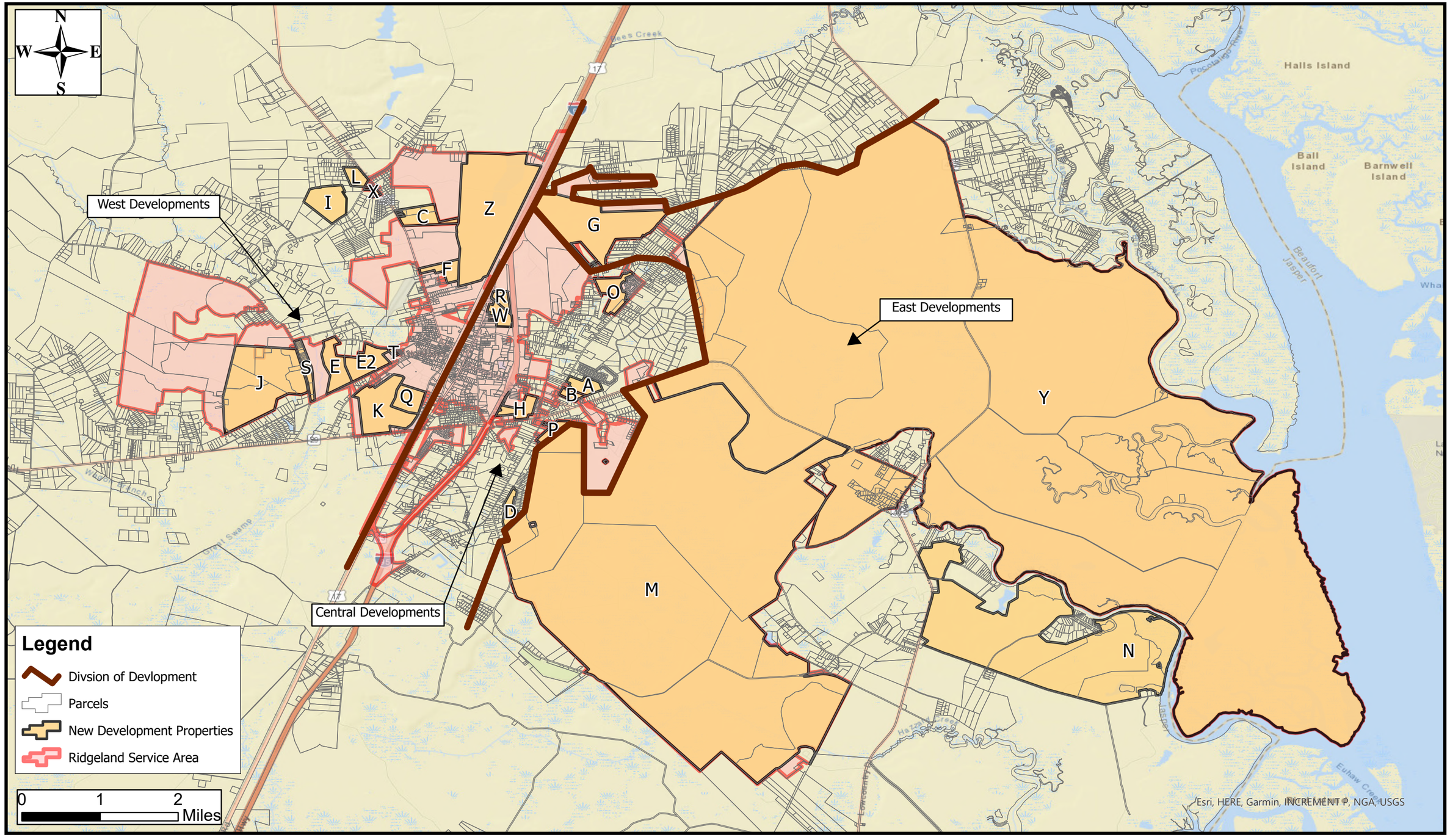


Figure 4.7
Potential Development Divisions

Regional Water and Sewer Master Plan

DISCLAIMER: This map is for reference and discussion purposes only. Data provided are derived from multiple sources with varying levels of accuracy. The information shown hereon is not intended for site specific use or design.

FOUR WATERS ENGINEERING

File Name: MasterPlanningMaps Path: P:\22-1017 Regional Water and Sewer Master Planning Project\16.0 GIS\Map Document\Report\MasterPlanningMaps\MasterPlanningMaps.aprx Date Saved: 11/3/2023 2:23 PM

5.0 – WATER SYSTEM HYDRAULIC MODEL

The goal of Section 5 is to provide an overview of the purpose and methodology for developing a hydraulic model for the water transmission and distribution system in support of future capital improvements planning and prioritizing efforts. The developed model was used to simulate flows within the transmission and distribution system under existing and future conditions. The results of the various scenario outputs were used to evaluate the overall performance of the current system and identify capital improvement and expansion alternatives to support the future service population.

This section is specifically related to the Town's major water hydraulic modeling efforts. As noted in the 2022 BJWSA Water and Wastewater Master Plan Update a separate water hydraulic model has been created to assist with planning and development.

The water model developed in 2012 for the Town was created in InfoWater developed by Innovyze. In 2022, the model was converted from InfoWater to the WaterGEMS platform developed by Bentley as it is the modeling software package adopted by the Town. WaterGEMS has an added integration with Environmental Systems Research Institute's (ESRI) ArcGIS software environment and improved interaction with GIS data. The converted model was used as the starting point for the final model utilized in the Master Plan.

5.1 TOWN WATER SYSTEM MODEL METHODOLOGY

A primary goal of the Regional Water and Sewer Master Plan is to evaluate the condition and needs of the existing water system, to eliminate redundancies in the systems and pool resources to correct existing deficiencies and plan for future growth and expansion of the service areas.

A comprehensive assessment of all components of the water system is not necessary to achieve these goals in an effective manner. As such, 4Waters collaborated with the Town to define the components of the water systems which represent the major backbone of the water distribution and transmission system including pipes, storage tanks and pumping station. In total, these components of the systems have been termed the Major Water Transmission Systems (MWTS).

The existing model network was refined and consist primarily of pipes, storage tanks and pumping stations, and included wells, valves and fire hydrants where necessary for calibration and master planning purposes. The water systems' geometry and connectivity are based on Town's GIS data layer.

The Town MWTS is composed of approximately 218,640 LF of water mains ranging in size from 4- to 12-inches, 3 wells with high service pumps and 5 elevated storage tanks.

The major portion of the data for the water system hydraulic models was from GIS feature layers and the existing model provided by the Town. Additional facility information and operational details were obtained from as-built drawings and Town staff "institutional knowledge."

The GIS water main and existing model data were "scrubbed" to repair connectivity issues and remove pipe splits at valves and fittings (for pipe of same size, material and age, where available). During this process, all 3-inch and smaller pipes, private water mains and distribution piping not significantly affecting the hydraulic performance of the major system, such as closed-loop subdivision piping were removed. The result was a more streamlined, skeletonized representation of the major water transmission and distribution network for each of the four water systems.

The skeletonized pipes were assigned unique facility IDs that could be used to relate the GIS pipe features to the model pipe elements and provide a gateway for exchanging pipe attributes and model results. Once IDs were assigned, the pipes were imported into the model and the pipe size and material, if available, were populated or updated in the element data table. Junction nodes were added or verified at intersection and pipe connections and the network was checked and repaired connectivity errors not corrected in the preliminary scrubbing and skeletonizing steps.

Tank and well locations were then imported into the model and high service pumps and facility site piping were digitized and attributed with size and material from as-built drawings and sketches. Pump

performance curves obtained from Town staff, pump manufacture representatives and online research were input and the pumps were programmed with control protocols provided by the Town.

5.2 TOWN WATER MODEL INPUTS

5.2.1 GIS DATA

The water facility GIS data and existing model imported into the model included wells, water storage tanks, water mains and fire hydrants. Most water main features were attributed with pipe diameter, material and as-built reference information which was used to determine the year of installation. Where this information was not provided, assumptions were made based on contiguous infrastructure.

Other GIS data layers, including roads, address locations, topography, aerial orthoimagery and tax parcel base data were used during model development for mapping, geocoding and spatial analysis. The model inputs including elevated storage tank data, high service pump info, and well information, were primarily based on water management system inspections or conversations with Town staff. The GIS data only provided the locations of these facilities.

5.2.2 STORAGE TANKS

The Town currently operates 5 elevated storage tanks (EST) located throughout the system. Table 5.1 lists the key storage tank data collected, calculated or approximated, and used in the models.

Table 5.1 Town Water Storage Tank Model Data

Facility Name	Facility ID	Ground (ft)	Height to Top of Tank (ft)	Tank Bottom Elevation (ft)	Maximum Water Level[1] (ft)	Volume (MG)	Diameter (ft)
High School	2	63	125	148	188	0.25	46
Captain Bill	3	43	149	157	192	0.25	40
Grahamville-Bees Creek	4	45	148	141	193	0.15	30
Prison Tank	5	49	152	201	201	0.25	40
Cypress Ridge	6	85	115	200	200	0.50	56

5.2.3 WELL/HIGH SERVICE PUMPS

4Waters has visited all of the wells for the Town and gathered high service pump (HSP) information as well as suction and discharge piping information. The data was collected from the pump base plates or from conversations and with Town staff.

Pump performance information was provided by Town staff; other pump specific curves were attempted to be obtained using serial numbers recorded from the plates. Where specific curves were not available, general manufacture performance curves for the individual pumps were used. The manufacturer's pump curves used in the model are provided in Appendix E.

Control protocols were applied to each of the pumps in the model based on set points provided by the Town. These set points correspond to specific system parameters i.e., EST levels/pressures. Currently all well/high service pumps operate off the conditions present at the Prison Tank. WaterGEMS pump control interface was used to program ON/OFF control for Prison storage tank level to match the facility's actual control schema. Table 5.2 below lists the high service pump model set points.

Table 5.2 Town High Service Pump Model Set Points

Facility Name	Control Tank/ Node	Pump ON Setpoint (Level Ft)	Pump OFF Setpoint (Level Ft)
Well No. 1	Prison EST	*	198.7
Well No. 2	Prison EST	182.0	198.7
Well No. 3	Prison EST	182.0	198.7

**Time based - cuts on 5 mintues after Well No. 2 and Well No. 3*

Minor loss coefficient, "k", values were input for the facility piping of the HSPs to account for minor losses associated with valves and bends. The minor loss is often negligible in a large-scale water system. However, "k" values can have a significant impact on head losses at high velocities, such as those just leaving a pump. This in turn plays a role in where the pump operates on its pump curve.

5.2.4 WATER MAINS

The GIS water main data was scrubbed and skeletonized as described previously in Section 5.1 and used to develop the framework for the MWTS models. Service laterals and smaller distribution lines and most closed-looped subdivision piping were not included on the modeled systems. The water mains quantities which made up the models is summarized in Table 5.3.

Table 5.3 Total Lengths of Water Main in Town Hydraulic Model

Pipe Diameter (in)	Total per Diameter (ft)
4	1,442
6	86,170
8	72,935
10	25,127
12	32,966
Total (ft)	**218,640**
(mi)	**41.4**

5.2.5 HYDRANTS

During the model calibration stage, it was necessary to identify the locations of fire hydrants throughout the distribution systems. The Town provided Fire Hydrant GIS data which identifies approximate locations of all hydrants within the system. This information was used in the calibration of the model.

5.2.6 TOPOGRAPHY

GIS contour data was provided in the units of feet, referenced to the North American Datum of 1983 (NAD83).

5.2.7 NODAL DEMANDS

During the Master Plan, the Town provided 4Waters with customer account information and billing data for the period from July 2020 to June 2021 for all water customers in the Town. The billing data was utilized and spatially referenced to model pipe and nodes to represent water usage in the model.

5.3 TOWN EXISTING CONDITIONS MODEL AND CALIBRATION

5.3.1 CALIBRATION

At the request of 4Waters, fire hydrant tests were performed by 4Waters in conjunction with Town staff in April 2021. Additionally, the fire department provided system wide fire hydrant testing for June 2020 and June 2022.

A total of 7 tests were performed and were conducted by 4Waters in conjunction with Town staff. The locations of the hydrant test were strategically designated on larger diameter water mains that were spread throughout the systems so that the major areas in each system were represented.

Fire hydrant tests provide pressure data within the system under static conditions (no hydrant flowing) and stressed conditions (fully open flow at the hydrants). Each test consisted of a flowed hydrant where the flow is measured, and a residual hydrant where the static pressure and residual pressure are measured. This test data was used in conjunction with recorded boundary conditions to calibrate parameters such as pipe roughness, "C" or minor losses. The purpose of calibration is to adjust the model so that it simulates actual system behavior. This is achieved by trying to match the model and observed pressures under normal and stressed operating conditions. The fire hydrant test results are provided in Table 5.4 below.

Table 5.4 2021 Town Hydrant Flow Test Results

Test No.	Location	Hydrant Pair		Date	Time	Static Pressure (psi)	Residual Pressure (psi)	Test Flow (GPM)	Avilible Flow at 20 psi[1] (GPM)
1	Grays Highway	56B	59B	April-21	3:00 AM	42	40	1,000	3,650
2	2nd/3rd Street	19B	14B	April-21	10:30 AM	50	44	1,130	2,695
3	Captain Bill Road	14A	16A	April-21	1:00 PM	70	60	1,250	2,981
4	Bees Creek Road	32A	34A	April-21	8:30 AM	66	55	1,155	2,501
5	Mitchellville Road	22D	20D	April-21	9:45 AM	70	44	1,000	1,424
6	Bees Creek Road	36D	34D	April-21	12:00 PM	56	44	1,060	1,918
7	Malphrus Road	55B	54B	April-21	9:30 AM	45	32	1,000	1,424

1 - Calculated using the following Hazen-Williams formula: $Q_{20} = Q_r \times (P_s - 20)^{0.54} / (P_s - P_r)^{0.54}$

For the water model calibration, the model was run in extended period simulation (EPS) mode for a 24 hour period. System pressures at elevated storage tanks and residual hydrant test pressures were compared with model results and the C-factor and minor loss coefficients were adjusted throughout the system to bring the calculated and observed system pressures flows and EST level trends in closer agreement with one another. This adjustment process was iterated until a level of confidence was achieved in the model and the model reasonably predicted system behavior. After an acceptable set of roughness adjustments, the results were transferred to developing the existing conditions model.

The 2020 hydrant testing data can be found in Appendix E.

5.3.2 EXISTING CONDITIONS MODEL

To evaluate overall performance and level of service, three separate simulations were conducted for the water system; average daily flow, (ADF), peak hourly flow (PHF) and fire flow plus maximum daily flow (MDF). This is a typical approach and these scenarios generally represent the most extreme demands on system hydraulics and components.

A peak hourly flow scenario was simulated by running the model for a 24-hour period and applying a peaking factor on the demand loading to determine any areas in the system with pressure drops below 30 psi.

The available fire flow was tested at various locations in each water system and were evaluated by running a 2 hour – 1,000 gpm fire flow. The fire flow simulations were run using MDF conditions with a minimum allowable pressure of 20 psi.

Based on historical data, the following maximum day factor was used:

- Town of Ridgeland – 2.04

The fire flow locations were applied across the distributed systems in outlying areas, along major corridors and within subdivisions to evaluate overall system coverage.

Overall, the modeled Town system performed satisfactory for ADF, MDF plus fire flow and PHF simulations. During the ADF scenario the model indicated average pressures in the 45 – 60 psi range. Adequate fire flow capabilities during MDF was achieved for the entire system, however Town water and sewer department staff and the Fire Department staff have noted concerns with fire flow and pressures along Greys Highway and Bees Creek Road near Grahamville Road.

The system has some dead-end areas in which improved levels of service could be realized through water main looping or interconnections.

An important item of note is that during the ADF simulation the Cypress Ridge EST and Grahamville tank had higher turnover in comparison to the High School, Captain Bill and Prison tank primarily due to the proximity to the well sites.

5.4 TOWN EXISTING WATER SYSTEM DEFICIENCIES AND RECOMMENDATION SUMMARY

Water quality modeling was beyond the scope of this report but it should be noted that long dead-end transmission mains could experience low disinfection residual and other water quality issues during extended periods of low demand. It is also noted that level of service could be improved by water main looping or interconnections.

As shown in the previous section, the Town model performed satisfactorily under all simulation conditions. However, there are areas of concern with EST turnover and inconsistency of pressure throughout the system primarily along Greys Highway and in the Bees Creek Road area between Captain Bills Road and south of Grahamville Road.

Tables 5.5.1 to 5.5.2 provide a summary of the Town's water system upgrades necessary to serve the current customer population. The projects listed are only related to pumping and hydraulic capacities. Any projects related to the structural, electrical or physical elements of the facility have been addressed in Section 3.

Table 5.5.1 Near Term Model Recommendations: 2023 – 2027

Water Facility Component	Short Range Recommendations: 2023 - 2027
Well Site No. 3	Install new 100 Hp pumps
	Building Expansion
	Install new piping

Table 5.5.2 5 – 10 Year Model Recommendations: 2028 – 2032

Water Facility Component	Mid Range Recommendations: 2028 - 2032
Captain Bill Road and Bees Creek Watermain Improvements	Install new 12-inch watermain
	Tie-in to existing system (10-inch and 8-inch)
Cypress Ridge Well	Install new 100 Hp pumps
	New Building and Electrical Equipment
	Tie-in to existing system (12-inch)

Dead-end lines which regularly experience low flow conditions should flush periodically or be equipped with automatic flushing devices to ensure disinfection residual and other water quality parameters are maintained.

The Town is working to install an extensive and reliable SCADA system which will be used for monitoring and control of the water distribution and pumping facilities. The SCADA system currently controls the operation of the well pumps based on the elevated tank at the Prison. Expanding the SCADA system to monitor pressures at additional locations around the distribution system would provide a better continual indication of system performance, EST turnover and may be used to fine-tune pump operation.

5.5 FUTURE CONDITIONS MODEL AND PRIVATE WELL RELATED PROJECTS

Once the determination of the existing water system deficiencies and selection of recommendations for rehabilitation were selected and the upgrades entered in to the model, the future conditions model was developed. The future conditions model is used to evaluate how well the system can serve growth in various areas and when expansions and upgrades to the system must be made – whether water main extensions or upgrades, new wells, or storage tanks. The 2023 Regional Water and Sewer Master Plan spans a study period of 20 years during which four – five year population projections and corresponding water demands have been determined.

The demands for the 2028, 2033, 2038 and 2042 periods were entered into the model based on the associated population projections. The populations were divided among nodes to best portray the arrangement of the development. Water mains were extended as necessary to serve the new developments along major corridors. Initially the water main size was estimated and was verified through model simulations. Similar to the existing conditions model, the water system was evaluated to determine overall performance and level of service at three separate simulation scenarios – ADF, MDF + fire flow and PHF.

All of the scenarios were modeled in a manner similar to the existing conditions scenario. For the ADF and PHF the minimum allowable pressure drop is 30 psi and for the MDF + fire flow simulations the minimum allowable pressure is 20 psi.

In accordance with Figure 4.1, the major proposed/anticipated developments throughout the 20 year study period focused around major roadway corridors as provided below in Table 5.6. As the layout of many of the proposed developments are not platted and because the scope of the Master Plan is major transmission systems, water system expansion components were not placed within proposed developments unless major subdivision plans were available.

Table 5.6 Major Development Corridors

Area of Development	Proposed/Anticipated Development	Development ID	Major Roadway Corridor
Central	The Groves at Bees Creek	A	Bees Creek Road
	Moultrie Tract PDD	G	I-95
	Beeks Creek Plantation - Part 2	O	Bees Creek Road
	RV with Pond	R	US-17
	Ridgeland Village	W	US-18
	Single Family	B	Bees Creek Road
	Camping World	H	I-95
	Captain Johns Graham Subdivision	P	Bees Creek Road
	Maxfield Plantation	Z	I-95
	40 Acres	D	Graham Hall Road
East	Pittman/Genesis PDD	M	Old House Road
	Graves/Tickton Hall	N	Low Country Drive
	Good Hope PDD	Y	Old House Road
West	Cypress	L	Greys Highway
	Ward Edwards	X	Greys Highway
	Thomas Haywood Academy	I	Greys Highway
	Weathersbee – Mungo	C	Greys Highway
	Fox Chase	F	Greys Highway
	Nimmer	J	Tillman Road
	Tarboro Road	S	Tillman Road
	Highlands	E	Tillman Road
	Smart Investment	K	Sisters Ferry Road
	Sisters Ferry	Q	Sisters Ferry Road

As discussed in Sections 4.6, similar to other municipalities within the State of South Carolina, the Town has not been able to provide public water to all developed areas within the service area. This could have occurred for several reasons such as the cost of infrastructure to serve an area may have exceeded the benefits, both economic and environmental; the low density or sparseness of construction did not make watermain extensions feasible; or areas were developed well before an organized utility department was established. As such, several areas that utilize private wells within the water service systems were evaluated to determine physical vicinity to water infrastructure, age of private wells and overall likelihood and perception of a homeowner to connect to the Town system. Due to the uncertainty and large acreage of the East development only the West and Central development areas were addressed for private well conversion and identified with a CIP project.

The following section provides the water system expansions necessary to serve the projected development and associated Town water demands. The Water Expansion CIPs and Order of Magnitude Cost Estimate for the Expansion CIPs are presented in Section 7.0. Any projects related to the civil, mechanical, electrical or physical elements of the facility have been addressed in Section 3.

5.6 FUTURE WATER SYSTEM RECOMMENDATION SUMMARY

The recommendations for water system expansion through the 20 year study period in the Town are presented below in Tables 5.7.1 through 5.7.4. The improvements include expansion of existing and future facilities for water main construction, water production facilities, and elevated storage tanks to serve the development with a high level of service and reliability.

Table 5.7.1 Near Term Recommendations: 2023 – 2027

Area of Development	Project Description
West/Central	Tillman Road Watermain Extension (12-inch)
	Tarboro to Highlands Waterman Extension (12-inch)
East	1,500 gpm Well and 1.00 MGD EST

Table 5.7.2 5 – 10 Year Model Recommendations: 2028 – 2032

Area of Development	Project Description
West/Central	-
East	1,500 gpm Well and 2 - 1.00 MGD ESTs

Table 5.7.3 10 – 15 Year Model Recommendations: 2033 – 2037

Area of Development	Project Description
West/Central	West 750 gpm Well and 0.75 MGD EST - Construction Near Nimmer Property
	West Private Well Conversion (Approximately 50)
	Central Private Well Conversion (Approximately 75)
East	1.00 MGD EST

Table 5.7.4 15 – 20 Year Model Recommendations: 2038 – 2042

Area of Development	Project Description
West/Central	West Private Well Conversion (Approximately 50)
	Central Private Well Conversion (Approximately 75)
East	750 gpm Well and 1.00 MGD EST

6.0 – SEWER SYSTEM HYDRAULIC MODEL

The goal of Section 6 is to provide an overview of the purpose and methodology for developing a hydraulic model for the sewer transmission systems. The model was used to evaluate the existing systems for deficiencies and to determine solutions to alleviate these deficiencies, in addition to supporting future capital improvements planning and prioritizing efforts. The developed model was used to simulate flows within the system under existing and future conditions. The results of the various scenario outputs were used to evaluate the overall performance of the current system and identify capital improvement and expansion alternatives to support the future service population.

This section is specifically related to the Town's major sewer hydraulic modeling efforts. As noted in the 2022 BJWSA Water and Wastewater Master Plan Update a separate sewer hydraulic model has been created to assist with planning and development.

The sewer model was created in the SewerGEMs platform developed by Bentley, which has an added integration with the Environmental System Research Institute's (ESRI) ArcGIS software environment and improved interaction with GIS data. The SewerGEMS software is capable of hydraulically modeling both gravity and pressurized sewer systems, a feature that is critical for modeling these systems which incorporate both pumped, pressurized systems and gravity sewer systems to transfer sewage to the WRF.

The SewerGEMs model utilizes dynamic wave routing that accounts for piping storage, backwater effects, entrance/exit losses, flow reversal and pressurized flow. As noted, the Town's major sewer transmission system is interspersed with segments of gravity sewer piping which have typically been designed for hydraulic capacity during a peak hour flow condition. By calculating the backwater effects in the gravity sewer, the model creates a more accurate depiction of system operation as the backwater effects may slow down the transmission of sewage and lessen the necessary capacity of pipes which would be determined solely by the traditional engineering design hydraulic calculations. The dynamic wave routing has typically been utilized for modeling of stormwater conveyance systems which is the original intended use of the SewerGEMs modeling package.

6.1 TOWN SEWER SYSTEM MODEL METHODOLOGY

A primary goal of the Regional Water and Sewer Master Plan is to evaluate the condition and needs of the existing sewer systems, to eliminate redundancies in the systems and pool resources to correct existing deficiencies and plan for any future growth and expansion of the service areas. A comprehensive assessment of all components of the sewer systems is not necessary to achieve these goals in an effective manner. As such, 4Waters collaborated with Town staff to define the components of the sewer systems which represent the major backbone of the sewer collection and transmission systems including gravity sewer mains, pump stations, forcemains, and the WRF. In total, these components of the systems have been termed the Major Sewer Transmission System (MSTS).

The Town's MSTS is composed of approximately 19,619 LF of gravity sewer mains ranging in size from 6- to 12-inch, 86 manholes, 16 pump stations, approximately 54,565 LF of sewer forcemains ranging in size from 2- to 6-inch, and the WRF.

Although a hydraulic model could be prepared for the entire sewer systems, the primary focus of the model and the evaluations is the transmission portion of the system including the pump stations, forcemains and the gravity sewer which the pump stations discharge to or which represent major corridors of flow. Modeling the entire gravity sewer collection portion of the sewer systems would not provide significant additional information and is beyond the scope of this project due to the limited availability of as-built gravity sewer drawings and the extensive effort which would be required to perform field evaluations/surveys of the manholes and gravity sewer piping. Additionally, to prepare a meaningful model of the gravity sewer system a determination of the sewer loadings throughout the entire system, the identification of all facilities and residences served by on-site sewer systems, and the anticipated inflow and infiltration into the system would be required.

Therefore, the methodology used to create a functional, informative model and planning tool was to consider the pump stations to be the upstream boundaries of the system. Only those gravity sewer

pipes and manholes, which receive discharge from upstream pump stations and forcemains, which represent major sewer flow corridors have been included in the model. The Town's hydraulic model incorporates the major transmission pump stations, the forcemains, the discharge locations for the entire system at the WRF, and any gravity sewer pipes and manholes located along the transmission routes downstream of the pump stations.

6.2 TOWN SEWER MODEL INPUTS

Each component of the model requires a variety of information, at a minimum, to perform the hydraulic calculations. SewerGEMs data objects are grouped as physical and non-physical. Physical objects refer to those network elements that can be visually shown on a map in the SewerGEMs workspace. The physical objects used for this model are junctions (manholes or pressure nodes), outfall (WRF), storage units (wet wells), conduits (gravity sewer pipes or forcemains) and pumps.

Non-physical objects represent supplementary characteristics and processes within the study area. The non-physical objects include pump curves and time patterns. Pump curves permit flow to vary with different head conditions. Time patterns allow external Dry Weather Flow (DWF) and peak hourly flow (PHF) to vary in a periodic fashion. They consist of a set of adjustment factors applied as multipliers to a baseline DWF flow rate. In this case the time pattern acts as a diurnal curve, representing flow into the system throughout the day. The diurnal curve utilized mimics the widely accepted diurnal curve developed by the American Water Works Association (AWWA).

SewerGEMs provides a note attribute on each individual component to enter and store supplemental model related information concerning installation dates, field notes and how data was achieved. In addition to being stored with the feature, all supplemental information was kept on record as a hard copy. Pump and wet well construction information is provided in Appendix E.

6.2.1 GIS DATA

The available GIS data was imported into the model and included pump station locations, gravity sewer piping, manhole location, forcemains and the WRF location. These components have been developed by 4Waters over the last few years.

6.2.2 PUMPS

In SewerGEMs, pumps are actually separate components from the wet wells as pumps can be utilized in various situations. The minimum pump information required for the model includes invert elevation, startup and shutoff depth and manufacturer pump curves. Pumps in SewerGEMs are represented by choosing various curve types. For the purpose of these models the Multiple Point (Head vs. Flow) curve was used to represent a pump where flow varies continuously with head differences between the inlet and outlet nodes. The manufacturers pump curves used in the model are provided in Appendix E.

6.2.3 WET WELLS

The minimum wet well information required for the model includes top of wet well elevations; sectional elevations such as maximum, initial, minimum, and base; and wet well diameter or area. The model uses all of the components to calculate rising and falling water levels in the wet well based on incoming loads and pumping capacity.

6.2.4 FORCEMAINS

Forcemains in the model require the following information: pipe length, size, upstream and downstream invert elevations, presence of a check valve, Hazen Williams "C" value and minor loss coefficient. The pipe material, size, and length values were typically imported into the model from available GIS data and verified by available as-builts.

The minor loss coefficient and Hazen-Williams "C" value for a forcemain are factors used in the determination of the minor loss and friction loss elements of the total dynamic head. Minor losses are head losses in a system caused by forcing water through a change in direction or through valves or fittings with obstructed or reduced diameters. Minor loss coefficients are based on historical research and experience. When modeling an existing pump and forcemain system, minor losses do not typically represent a significant portion of the total dynamic head and are usually accounted for in the friction head losses. The one exception is the minor losses at a pump station which are related to the significant number of valves and fittings on the discharge side of the pump. Therefore, the only instances where minor losses were added to the model were on the section of forcemain on the downstream side of a pump. During calibration of the model, minor losses were occasionally added to more accurately reflect the pump condition witnessed during field drawdown testing.

Friction losses are head losses caused by the resistance the pumped water encounters from the pipe wall. There are several methods for calculating friction losses but the standard, accepted method for pressure systems is the Hazen Williams. The "C" value is a roughness coefficient in the Hazen Williams equation, which accounts for the resistance of the pipe based on material and age. The "C" values used in the model were estimated based on reported material type and the age of the system. It is important to note that for all new forcemain systems a conservative "C" value of 120 – 130 was used in the model to accurately portray the condition of the piping as it ages. This will ensure that the system is able to provide the necessary capacity over its lifetime.

To model forcemains accurately it is important to account for major changes in elevation. The feature SewerGEMs utilizes is a junction, which can physically represent a manhole or a pressure node.

6.2.5 GRAVITY SEWER PIPING AND MANHOLES

The gravity sewer is composed of manhole and gravity pipe elements in the model. The minimum required information for a manhole includes the rim, diameter and invert elevations. As the majority of manholes in a sewer system are typically 4 feet in diameter, this was the standard diameter used for junction nodes in the sewer model. The model uses this diameter to determine a surface area that was used to compute changes in water depth.

The minimum required information for a gravity sewer piping includes pipe shape, pipe material, Manning's "n" value, upstream and downstream pipe inverts, length, and pipe size. The pipe material, size, and length values were typically imported into the model from available GIS data and verified by available as-builts. Pipe shape was assumed to be circular in all cases.

The Manning's "n" value is associated with calculation of the slope of the energy grade of a pipe and in the case of gravity sewer is used to determine the velocity of water in the pipe. Similar to the Hazen-Williams "C" value, the Manning's "n" value is used to account for the resistance of the pipe based on material and age. The "n" values used in the model were estimated based on reported material type and the age of the system.

6.2.6 WATER RECLIMATION FACILITY

The location of the WRF, as provided by the GIS data, was used in the model to locate the ultimate discharge outfalls for all the forcemains and gravity sewers for the system. Outfalls require an invert elevation and tailwater conditions. The tailwater conditions were considered to be a free discharge as all incoming pipes at the WRF discharge into a manhole prior to the bar screen and headworks of the facility.

6.2.7 SEWER GENERATION RATES "SEWER LOADS"

The junction DWF data table stores information regarding the sewer loads entering the collection system at the junction node. The junction DWF table was utilized to specifically load the ADF flow to particular manholes or wet wells. Importing the diurnal curve allowed the model to accurately represent the pattern

at which the flow entered the collection system. The PHF flow was loaded separately from the ADF and utilized a separate diurnal curve.

The per capita rates were then utilized to develop the existing ADF flow rates for each basin by multiplying the existing population by the per capita rate. A Peak Hourly Flow (PHF) factor was determined for each basin using the Fair-Geyer Equation (10 State Standards) and was applied to the ADF to determine the overall PHF in gallons per minute (gpm). This equation is based on population and attests to account to some degree for I&I. The flow associated with commercial, industrial and institutional users was estimated based on average water billing data provided to 4Waters by the Town. The sewer generation per basins are provided in Appendix A.

6.2.8 TOPOGRAPHY

Contour data from USGS was evaluated to determine the highest location along forcemain routes so that the static head could be accurately established. Junction (pressure) nodes were added along the forcemain routes as necessary to reflect the highest elevation of the main.

6.3 TOWN EXISTING CONDITIONS MODEL AND CALIBRATION

6.3.1 CALIBRATION

After entering all necessary data for the Town's system, trouble shooting was performed, and the model was run to analyze the hydraulic calculations and corresponding capacities of the pump stations. As previously mentioned, several of the factors in headloss calculations are subjectively based on engineering standards and experience, primarily the Hazen-Williams "C" value and the Manning's "n" value. Each of the pump capacity results was evaluated and compared to the draw down test results, or if not available the design operating condition.

In situations where the model calculated a pump's capacity to be significantly different than the draw down conditions or design operating point, the forcemain size and age, the Hazen-Williams "C" value, and the static head conditions were reevaluated and adjusted, within a reasonable range, to simulate the real-world or design operating condition.

In situations where the calculated pump's capacity was much lower than the draw down condition or design operating condition, the age of the pump station and forcemain, the size of the forcemain, and the Hazen-Williams "C" value were reevaluated to determine whether this reduced capacity was probable. Typically, as pumps age the impellers wear down, the pumps lose efficiency and are not capable of pumping the same capacity as when first installed. Additionally, as forcemains age, they can become clogged with sediments and grease, which increase the headloss through the forcemain and, therefore, reduce the capacity of the pump. Such factors could impact a reduction in capacity for pump stations which only had design operating conditions available.

Many of the pump systems utilize manifolded forcemains with more than one pump station operating on the same pipe. It was not always noted during the draw down testing whether manifolded pump stations were operating or not. If a modeled pump station showed a much lower capacity than the draw down testing results, various scenarios were evaluated in the model to determine whether the operation of manifolded pump stations was causing the reduction in pump capacity in comparison to the draw down results.

Operating storage volumes calculated by the model for the wet wells were also evaluated to review whether the model was reflecting the estimated field operating storage volumes.

6.3.2 EXISTING CONDITIONS MODEL

After calibration of the Town model was completed, an analysis of deficiencies in the systems was conducted. The analysis included an evaluation of water levels in manholes, pipe capacities which were exceeded or which were approaching full capacity, wet well capacity utilized, water levels in wet well and

any above the lead pump on level, pump run times, and operation of lag pumps. Any noted deficiencies are elaborated in the following sections.

The Town's existing conditions model includes 16 wet wells and pump setups, the corresponding forcemains, and 103 gravity sewer pipes segments between manholes, and 103 manholes. Table 6.1 provides information relating to various pump station related components in the Town system.

Table 6.1 Town Pump Station Related Information

PS	No. Pumps	Design Operating Point Per Pump	Draw Down Date	Draw Down Operating Point	Manifolded
		GPM		GPM	
1	2	–	9-13-2023	163	No
2	2	–	9-14-2023	213	No
3	3	–	5-26-2021	600*	No
4	2	–	5-26-2021	78	No
5	2	–	5-26-2021	23	No
6	2	–	5-26-2021	338	No
7	2	–	9-13-2023	127	No
8	2	–	–	–	Yes
9	2	–	–	–	Yes
10	2	–	9-13-2023	67	Yes
11	2	–	9-14-2023	321	No
12	2	–	5-26-2021	76	No
13	2	–	9-14-2023	70	No
14	2	–	9-13-2023	229	Yes
15	2	–	9-14-2023	247	No
16	2	135	9-14-2021	49	No

– denotes data that was not available

**Estimated Based on 2 Pumps Running*

The analysis of the existing conditions model resulted in deficiencies at 5 pump stations. Table 6.2 shows a comparison of the current pump station pump capacities and the required 2023 customer base pumping capacity and whether the station has sufficient capacity to meet the current level of service needed. If the station lacks sufficient capacity it is recommended that the station be upgraded.

Table 6.2 Available Town Pump Station Pumping Capacity

PS	No. Pumps	Current Pump Station Pumping Capacity	2023 Customer Population Base Required Pumping Capacity*	Available Pump Station Pumping Capacity	Has Sufficient Capacity?	Current Pump Station Pumping Capacity Source
		GPM	GPM	GPM		
1	2	163	172	-9	No	Draw Down
2	2	213	69	144	Yes	Draw Down
3	3	600**	548	52	Yes	Draw Down
4	2	78	122	-44	No	Draw Down
5	2	23	1	22	Yes	Draw Down
6	2	338	150	188	Yes	Draw Down
7	2	127	151	-24	No	Draw Down
8	2	325	5	320	Yes	Model
9	2	365	22	343	Yes	Model
10	2	67	167	-100	No	Draw Down
11	2	321	8	313	Yes	Draw Down
12	2	76	10	66	Yes	Draw Down
13	2	70	85	-15	No	Draw Down
14	2	229	98	131	Yes	Draw Down
15	2	247	5	242	Yes	Draw Down
16	2	49	3	46	Yes	Draw Down

**Estimated Pump Station Capacities*

**Estimated Based on 2 Pumps Running*

Sufficient Capacity

Not Sufficient Capacity

6.4 TOWN EXISTING SEWER SYSTEM DEFICIENCIES AND RECOMMENDATION SUMMARY

Tables 6.3.1 to 6.3.4 provide a summary of the Town's pump station upgrades necessary to serve the current customer population. The projects listed are only related to pumping and hydraulic capacities. Any projects related to the structural, electrical or physical elements of the facility have been addressed in Section 3.

Table 6.3.1 Near Term Model Recommendations: 2023 – 2027

Pump Station	Short Range Recommendations: 2023 - 2027
PS-3	Install new pumps 58 HP and 316 SS guiderails
	Install new 12-foot wetwell
	Install new fused PVC discharge piping with SS fittings in wet well
PS-4	Install new pumps 25 HP and 316 SS guiderails
	Install new 8-foot wetwell
	Install new fused PVC discharge piping with SS fittings in wet well

Table 6.3.2 5 – 10 Year Model Recommendations: 2028 – 2032

Pump Station	Mid Range Recommendations: 2028 - 2032
PS-10	Install new pumps 15 HP (approximate) and 316 SS guiderails
	Install new fused PVC discharge piping with SS fittings in wet well
PS-13	Install new pumps 15 HP (approximate) and 316 SS guiderails
	Install new fused PVC discharge piping with SS fittings in wet well

Table 6.3.3 10 – 15 Year Model Recommendations: 2033 – 2037

Pump Station	Long Range 1 Recommendations: 2033 - 2037
PS-1	Install new pumps 10 - 12 HP (approximate) and 316 SS guiderails
	Install new fused PVC discharge piping with SS fittings in wet well

Table 6.3.4 15 – 20 Year Model Recommendations: 2038 – 2042

Pump Station	Long Range 2 Recommendations: 2038 - 2042
PS-7	Install new pumps 7.5 HP and 316 SS guiderails
	Install new fused PVC discharge piping with SS fittings in wet well

6.5 FUTURE CONDITIONS SEWER MODEL AND SEPTIC RELATED PROJECTS

Part of the scope of any sewer master planning document is to evaluate how the system can serve future growth and expansion within the service area. The 2023 Regional Water and Sewer Master Plan spans a period of 20 years; therefore, the sewer model has been modified to include upgrades and expansions of the sewer system which are necessary to meet the future needs. Information on anticipated future developments within the service area were reported in Section 4.

In accordance with Figure 4.1, the major proposed/anticipated developments throughout the 20 year study period focused around major roadway corridors as provided below in Table 6.4. As the layout of many of the proposed developments are not platted and because the scope of the Master Plan is major transmission systems, sewer system expansion components were not placed within proposed developments unless major subdivision plans were available.

Table 6.4 Major Development Corridors

Area of Development	Proposed/Anticipated Development	Development ID	Major Roadway Corridor
Central	The Groves at Bees Creek	A	Bees Creek Road
	Moultrie Tract PDD	G	I-95
	Beeks Creek Plantation - Part 2	O	Bees Creek Road
	RV with Pond	R	US-17
	Ridgeland Village	W	US-18
	Single Family	B	Bees Creek Road
	Camping World	H	I-95
	Captain Johns Graham Subdivision	P	Bees Creek Road
	Maxfield Plantation	Z	I-95
	40 Acres	D	Graham Hall Road
East	Pittman/Genesis PDD	M	Old House Road
	Graves/Tickton Hall	N	Low Country Drive
	Good Hope PDD	Y	Old House Road
West	Cypress	L	Greys Highway
	Ward Edwards	X	Greys Highway
	Thomas Haywood Academy	I	Greys Highway
	Weathersbee – Mungo	C	Greys Highway
	Fox Chase	F	Greys Highway
	Nimmer	J	Tillman Road
	Tarboro Road	S	Tillman Road
	Highlands	E	Tillman Road
	Smart Investment	K	Sisters Ferry Road
	Sisters Ferry	Q	Sisters Ferry Road

As discussed in Section 4.6, similar to other municipalities within the State of South Carolina, the Town has not been able to provide public sewer to all developed areas within the service area. This could have occurred for several reasons such as the cost of infrastructure to serve an area may have exceeded the benefits, both economic and environmental; the low density or sparseness of construction did not make centralized sewer systems feasible; or areas were developed well before an organized utility department was established. As such, several septic areas within the sewer service systems were evaluated to determine physical vicinity to centralized sewer, age of septic systems and overall likelihood and perception of a homeowner to connect to the Town system. Due to the uncertainty and large acreage of the East development only the West and Central development areas were addressed for septic conversion and identified with a CIP project. The following section provides the sewer system expansions necessary to serve the projected development and associated Town water demands. The Sewer Expansion CIPs and Order of Magnitude Cost Estimate for the Expansion CIPs are presented in Section 7.0. Any projects related to the civil, mechanical, electrical or physical elements of the facility have been addressed in Section 3.

6.6 FUTURE SEWER SYSTEM RECOMMENDATION SUMMARY

The recommendations for sewer system expansion through the 20 year study period in the Town are presented below in Tables 6.5.1 through 6.5.4. The improvements include expansion of existing and future facilities for pump stations, forcemain construction and water reclamation facilities to serve the development with a high level of service and reliability.

Table 6.5.1 Near Term Recommendations: 2023 – 2027

Area of Development	Project Description
West/Central	PS-3 Forcemain Upgrades (12-inch)
	Highlands Regional Triplx Pump Station
	Highlands to WRF Forcemain Extension (10-inch)
	Tarbor to Highlands Forcemain Extension (10-inch)
East	3.0 MGD WRF - Land, Design/Permitting
	3.0 MGD WRF - Construction

Table 6.5.2 5 – 10 Year Model Recommendations: 2028 – 2032

Area of Development	Project Description
West/Central	West 1.5 MGD WRF - Land, Design/Permitting
	West 1.5 MGD WRF - Construction (Public Access Reuse) and rerouting Highlands Regional Pump Station
	PS-1 Pump Upgrades
	PS-3 Pump Station Upgrades
	PS-4 Pump and Forcemain Upgrades
	PS-8 Pump Upgrades
	Greys Highway Forcemain Parallel Extension (6-inch)
East	-

Table 6.5.3 10 – 15 Year Model Recommendations: 2033 – 2037

Area of Development	Project Description
West/Central	West Septic Conversion (Approximately 115)
	Central Septic Conversion (Approximately 120)
East	3.0 MGD WRF Expansion to 6.0 MGD - Design, Permit and Construction

Table 6.5.4 15 – 20 Year Model Recommendations: 2038 – 2042

Area of Development	Project Description
West/Central	West Septic Conversion (Approximately 115)
	Central Septic Conversion (Approximately 120)
East	-

7.0 – MASTER PLAN IMPLEMENTATION

The culmination of the Regional Water and Sewer Master Plan is to provide a plan of implementation for the identified deficiencies and the proposed recommendations listed throughout the report. The Implementation Plan addresses both the Rehabilitation needs of the water and sewer systems to maintain and/or provide a desirable level of service for the current customer population and also for the Expansion needs of the systems to service growth and development in the service areas. As noted in Section 4, the Town has initiated discussions with the BJWSA to develop an understanding of regional cooperation opportunities and an approach to meet the anticipated significant water and sewer needs of the Town's East area. Based on the financial and rate evaluation of the necessary Expansion Capital Improvement Plans (CIPs) for the East area, it was determined that it would not be feasible for the Town to undertake these projects while maintaining reasonable water and sewer rates for the customer base. Accordingly, the West and Central areas Expansion CIPs are presented as a part of the Town's Implementation Plan while the East area Expansion CIPs are presented as representative projects, costs, and timelines to provide water production and sewer treatment facilities for the anticipated East area developments. The East area Expansion CIPs can be utilized during the ongoing regional partnership discussions with the BJWSA.

7.1 REHABILITATION CAPITAL IMPROVEMENT PLANS

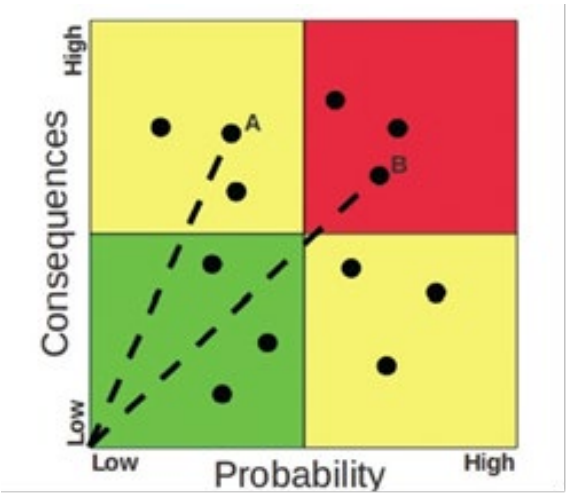
The water and sewer Rehabilitation Capital Improvement Plans (CIP) presented in the following sections incorporate all deficiencies for the Town as noted from the field assessments and Inflow & Infiltration (I&I) study as provided in Section 3.0, and the hydraulic modeling efforts presented in Section 5.0 for the water systems and Section 6.0 for the sewer systems. The purpose of the Rehabilitation CIP Implementation Plan is to address deficiencies in the systems to provide an acceptable level of service to the existing customer base population. This Rehabilitation CIP Implementation Plan will provide the Town with a method of systematically and thoroughly addressing the anticipated needs of the existing water and sewer systems over the next 20 years. The critical deficiencies of the systems have been placed in the short range, five year (2023 – 2027) and mid-range, ten year (2028 – 2032) periods with the issues anticipated to become more critical in the later portion of the study period pushed back to the long term 1, 15 year (2033 – 2037) and long term 2, 20 year (2038 – 2042) periods. As with any capital improvement plan, these plans should be re-evaluated every five years.

Figures are provided at the end of Section 7 for the proposed water and sewer Rehabilitation CIPs.

The Rehabilitation CIPs are extensive and may prove difficult for the Town to complete within the five-year implementation window based on financial requirements, availability of grant funds, staffing and management requirements. A financial analysis has been prepared for the Town's full 20-year study period Implementation Plan by Raftelis Financial Consultants (Raftelis) to ensure financial feasibility for the Town and the water and sewer rate customers. Section 7.3 discusses the revenue sufficiency evaluation.

The Rehabilitation CIPs are comprehensive and typically identify any concerns of note from the site visits or modeling. Accordingly, it may be more feasible for the Town to review the related Rehabilitation CIPs for similar critical issues which can be handled together and may be more cost effective. A few examples are the replacement of Ductile Iron discharge pipes in pump station wet wells which are corroded and the common electrical improvements such as providing wet well isolation.

7.1.1 CONSEQUENCE OF FAILURE AND RISK PRIORITIZATION



In order to provide a risk-based prioritization of the Rehabilitation CIP projects, a Consequence of Failure score was developed for each rehabilitation project. The Consequence of Failure score, similar to the Probability of Failure score, ranges from 1.0 to 5.0. The criteria for the Consequence of Failure score incorporate several factors to consider including: Social/Community factors - public image (noise/odor/discharges), outage duration, customers affected, health and safety; financial factors – financial impact, operational/resource impact; and Environmental/Regulatory factors. A score of 1.0 indicates negligible or limited impact to these factors if a facility fails and a score of 5.0 indicates potential severe impacts to public image, health and safety, financial resources, near system-wide impacts to customers, and/or consent order.

As noted, each rehabilitation project received a Consequence of Failure score which was then multiplied by the Probability of Failure score (the highest of the electrical or civil/mechanical). This developed the Risk score which was used to prioritize the Rehabilitation CIP projects. The Consequence of Failure scores and Risk score calculations for the Rehabilitation CIP projects are provided in Appendix F.

The Water and Sewer Rehabilitation CIP project scope descriptions and order of magnitude cost estimates are also provided in Appendix F.

7.1.2 WATER SYSTEMS

The following sections provide the recommended rehabilitation improvements necessary to provide an acceptable level of service and reliability within the Town's water system. These address improvements in the water production, storage and distribution facilities. The estimated order of magnitude costs are provided with the rehabilitation items prioritized.

7.1.2.1 ORDER OF MAGNITUDE COSTS – WATER REHABILATATION CIP

The estimated order of magnitude costs of the projects included in the Water Rehabilitation Capital Improvement Plan are presented below. The tables also indicate the recommended priority and five year period of recommended implementation of the projects. These estimated costs include installation, contingency (20%), and engineering, permitting and administration (10%) fees.

Table 7.1 Water Rehabilitation Capital Improvement Plan – Short Range (2023 – 2027 Implementation Window)

Total Risk Score	Water Facility Component	Recommended Improvements	Anticipated Funding Source	Order of Magnitude Costs
22.5	Water System SCADA Improvements	SCADA Upgrades at 3 Wells and 5 ESTs	2021 EDA Grant/Town Match	$ 195,000
20.0	Well Site No. 3	100 Hp well pump replacement, electrical service and panels upgrade, building expansion for chemical room, piping replacement	2022 CDBG Grant/Town Match	$ 820,000
14.0	Tank No. 2 (High School EST)	Coat interior and exterior (250,000 gal tank), replace roof vent	Pursue Grant/Town Funds	$ 364,000
12.8	Well Site No. 2	Electrical service and panels upgrade, building expansion for chemical room, new disinfection system, new generator and fuel tank	2021 EDA Grant/Town Match	$ 515,000
12.8	Lead Service Line Identification	Multi-year effort to determine water service material (public and private) of services determined unknown during inventory; excavation/test hole	Pursue DWSRF Grant/Town Match	$ 324,000
12.8	Lead Service Line Replacement (FY2023 - FY27)	Multi-year effort to replace identified Lead or GRR service lines (Main to Meter and Meter to Customer)	Pursue DWSRF Grant/Town Match	$ 194,400
12.8	AMR Water Meter Replacement	Replacement of all water system meters (~1800) with transmitter equipped meters for automated meter reading	2023 SCIIP Grant/Town Match	$ 670,214
12.8	Small Diameter/Galvanized Water Main Replacement Program (FY2027)	Annual program to upsize existing undersized and galvanized water mains; scope to be determined annually based on current issues	Town Funds/Pursue Grants	$ 250,250

Total Risk Score	Water Facility Component	Recommended Improvements	Anticipated Funding Source	Order of Magnitude Costs
8.0	Well Site No. 1	Blast/paint ductile iron well header piping and well, relocate disinfection equipment to chemical room	Town Funds	$ 23,000
Total Short Range Water Rehabilitation Capital Improvement Plan (2023 - 2027)				**$ 3,355,864**

Table 7.2 Water Rehabilitation Capital Improvement Plan – Mid-Range (2028 – 2032 Implementation Window)

Total Risk Score	Water Facility Component	Recommended Improvements	Anticipated Funding Source	Order of Magnitude Costs
12.8	Grays Highway - Cypress Ridge Well	Propose a new 750 gpm well in the north reach of the 12-inch water main, at Cypress Ridge - colocated with EST, if possible	Pursue Grant/Town Funds	$ 1,670,500
12.3	Water Main Replacement (Transite (AC)/CIP Pipe) Program (FY2031- 32)	Annual program to identify and replace Transite or Cast Iron water mains	Town Funds/Pursue Grants	$ 500,500
12.0	Lead Service Line Replacement (FY2028 - FY32)	Multi-year effort to replace identified Lead or GRR service lines (Main to Meter and Meter to Customer)	Pursue DWSRF Grant/Town Match	$ 777,600
12.0	Captain Bill Rd and Bees Creek Rd Water Main Improvements	Install new 12-inch water main along Bees Creek Rd between Captain Bill Rd and south of Grahamville Rd	Pursue Grant/Town Funds	$ 1,372,930
12.0	Small Diameter/Galvanized Water Main Replacement Program (FY2028 - 32)	Annual program to upsize existing undersized and galvanized water mains; scope to be determined annually based on current issues	Town Funds/Pursue Grants	$ 1,251,250
12.0	Tank No. 3 (Captain Bill EST)	Coat interior and exterior (250,000 gal tank), install ladder gate	Pursue Grant/Town Funds	$ 364,000
Total Mid-Range Water Rehabilitation Capital Improvement Plan (2028 - 2032)				**$ 5,936,780**

Table 7.3 Water Rehabilitation Capital Improvement Plan – Long Range 1 (2033 – 2037 Implementation Window)

Total Risk Score	Water Facility Component	Recommended Improvements	Anticipated Funding Source	Order of Magnitude Costs
11.4	Water Main Replacement (Transite (AC)/CIP Pipe) Program (FY2033 - 37)	Annual program to identify and replace Transite or Cast Iron water mains	Town Funds/Pursue Grants	$ 1,251,250
10.5	Small Diameter/Galvanized Water Main Replacement Program (FY2033- 37)	Annual program to upsize existing undersized and galvanized water mains; scope to be determined annually based on current issues	Town Funds/Pursue Grants	$ 1,251,250
10.0	Tank No. 5 (Prison EST)	Coat interior and exterior (250,000 gal tank)	Pursue Grant/Town Funds	$ 351,000
9.0	Tank No. 4 (Grahamville/Bees Creek EST)	Coat interior and exterior (150,000 gal tank)	Pursue Grant/Town Funds	$ 195,000
9.0	Tank No. 6 (Cypress Ridge EST)	Coat interior and exterior (500,000 gal tank)	Pursue Grant/Town Funds	$ 650,000
Total Long Range 1 Water Rehabilitation Capital Improvement Plan (2033 - 2037)				**$ 3,698,500**

Table 7.4 Water Rehabilitation Capital Improvement Plan – Long Range 2 (2038 – 2042 Implementation Window)

Total Risk Score	Water Facility Component	Recommended Improvements	Anticipated Funding Source	Long Range 2 Rehab (2038 - 2042)
8.8	Water Main Replacement (Transite (AC)/CIP Pipe) Program (FY2038 - 42)	Annual program to identify and replace Transite or Cast Iron water mains	Town Funds/Pursue Grants	$ 1,251,250
7.5	Small Diameter/Galvanized Water Main Replacement Program (FY2038 - 42)	Annual program to upsize existing undersized and galvanized water mains; scope to be determined annually based on current issues	Town Funds/Pursue Grants	$ 1,251,250
Total Long Range 2 Water Rehabilitation Capital Improvement Plan (2038 - 2042)				**$ 2,502,500**

7.1.3 SEWER SYSTEMS

The following sections provide the recommended rehabilitation improvements necessary to provide an acceptable level of service and reliability within the Town's sewer system. These address improvements at the WRF, the pump stations, forcemains and gravity sewer systems. The estimated order of magnitude costs are provided with the rehabilitation items prioritized.

7.1.3.1 ORDER OF MAGNITUDE COSTS – SEWER REHABILATATION CIP

The estimated order of magnitude costs of the projects included in the Sewer Rehabilitation Capital Improvement Plan are presented below. The tables also indicate the recommended priority and five year period of recommended implementation of the projects. The estimated costs for the Sewer Rehabilitation CIPs include installation, contingency (typically 20%), and engineering, permitting, and administration (10%) fees.

Table 7.5 Sewer Rehabilitation Capital Improvement Plan – Short Range (2023 – 2027 Implementation Window)

Total Risk Score	Sewer Facility Component	Recommended Improvements	Anticipated Funding Source	Order of Magnitude Costs
25.00	I&I Priority #1 - Smoke Testing	Smoke test remaining 50% of sewer system for deficiencies (~39,500 LF)	Town Funds	$ 40,000
25.00	I&I Priority #2 - CCTV and Cleaning	CCTV and Cleaning of 50% of remaining gravity sewer which has not been previously video inspection (~32,750 LF)	Town Funds	$ 135,000
25.00	WRF - Sludge Lagoon Floating Aerators	Install four new 25 Hp floating aerators and control panels for sludge lagoon	2023 SCIIP Grant/Town Match	$ 330,130
22.50	Sewer System SCADA Improvements	SCADA Upgrades at 16 pump stations	2021 EDA Grant/Town Match	$ 390,000
20.00	PS-3	Complete replacement; Construction of new 12' dia wet well and duplex 58 pumps, valve vault, and influent manhole system, electrical upgrades and generator, future provision; access road improvements, system manhole rehab	2021 EDA Grant/Town Match	$ 2,354,116
20.00	PS-4	Complete replacement; Construction of new 8' dia wet well and duplex 25 pumps, valve vault, and influent gravity reroute, electrical upgrades and generator, future expansion provision	2021 EDA Grant/Town Match	$ 1,297,025
20.00	PS-6	New duplex 20 Hp pumps, wet well coating, replace discharge piping, install bypass pumpout, new flow meter, electrical upgrades and local generator	2021 EDA Grant/Town Match	$ 667,015

Total Risk Score	Sewer Facility Component	Recommended Improvements	Anticipated Funding Source	Order of Magnitude Costs
20.00	Gravity Sewer and Manhole Rehabilitation - Sewer Sub-Basins WRF, PS3, and PS4	Rehabilitation of ~9000 LF of gravity sewer piping by CIPP/Pipebursting and coating and rehabilitation of ~50 manholes	2023 RIA Grant (Applied)/Town Match	$ 1,049,950
20.00	WRF - Sludge Lagoon Liner Replacement	Replacement of original liner in sludge lagoon at WRF; 30 years old and compromised. Anticipate full replacement needed. Lagoon approximately 240 ft long x 112.5 ft wide	Town Funds	$ 454,450
18.00	PS-12	New duplex 3 Hp pumps, wet well coating, raise wet well/vault top, replace discharge piping, install bypass pumpout, new ww wizard, electrical upgrades and local generator	2021 EDA Grant/Town Match	$ 571,640
16.00	PS-9	Install wet well coating, raise wetwell/vault/MH tops, replace discharge piping, replace bypass pumpout, new ww wizard, electrical upgrades, site grading/raise elev, access roadway improvements	Pursue Grant/Town Match	$ 685,170
16.00	Priority #3 - Sewer Main Rehabilitation Program (FY2026 - 27)	Annual Program; Based on findings of Smoke Testing and CCTV/Cleaning - develop priority areas for gravity sewer pipe and manhole rehabilitation; Estimate rehabilitation of approximately 1/2+ mile of gravity sewer (and manholes connected) per year	Pursue Grant/Town Funds	$ 500,500
14.00	PS-8	Install wet well coating, replace discharge piping, replace bypass pumpout outside wet well, new ww wizard, electrical upgrades and new generator, relocate fencing at rear of site	Pursue Grant/Town Match	$ 584,480

Total Risk Score	Sewer Facility Component	Recommended Improvements	Anticipated Funding Source	Order of Magnitude Costs
13.50	PS-1	Electrical upgrades (correct grounding/bonding, provide junction boxes, surge protection at disconnect and control panel, cable grips)	Town Funds	$ 43,000
12.00	PS-5	Install new 2.5 Hp duplex grinder pumps, replace discharge piping, install new bypass pump out on forcemain, electrical upgrades and new generator	Pursue Grant/Town Match	$ 333,120
12.00	PS-7	Install wet well coating, replace discharge piping, relocate fence at rear of site for electrical clearances, electrical upgrades (new NEMA 4X SS ATS, correct grounding/bonding, provide junction boxes, surge protection at disconnect and control panel, cable grips)	Pursue Grant/Town Match	$ 116,000
12.00	PS-10	Electrical upgrades (new service disconnect, correct grounding, provide junction boxes, surge protection at disconnect and control panel, cable grips)	Town Funds	$ 50,000
10.50	PS-11	New duplex 15 Hp pumps, wet well coating, replace discharge piping and blast/paint in vault, new ww wizard, electrical upgrades and new generator and NEMA 4X SS ATS	Pursue Grant/Town Match	$ 552,000
6.00	PS-15	Electrical upgrades (new service disconnect, correct grounding, provide junction boxes, cable grips, new door seal on ATS)	Town Funds	$ 35,000
2.50	PS-16	Electrical upgrades (new surge protection at service disconnect, surge protection in control panel, correct grounding, provide junction boxes, cable grips)	Town Funds	$ 35,000
Total Short Range Sewer Rehabilitation Capital Improvement Plan (2023 - 2027)				**$ 10,223,596**

Table 7.6 Sewer Rehabilitation Capital Improvement Plan – Mid-Range (2028 – 2032 Implementation Window)

Total Risk Score	Sewer Facility Component	Recommended Improvements	Anticipated Funding Source	Order of Magnitude Costs
14.00	PS-13	Install new duplex 12 Hp pumps, install wet well coating, replace discharge piping, blast/paint in vault, remove/replace wet well/vault top slabs with new raised, electrical upgrades (new NEMA 4X SS ATS and generator, correct grounding/bonding, provide junction boxes, resplace service disconnect, provide overcurrent protection, replace surge protection, provide new equipment rack above 100 yr flood elev, cable grips)	Pursue Grant/Town Funds	$ 579,000
14.00	Priority #3 - Sewer Main Rehabilitation Program (FY2028 - 32)	Annual Program; Based on findings of Smoke Testing and CCTV/Cleaning - develop priority areas for gravity sewer pipe and manhole rehabilitation; Estimate rehabilitation of approximately 1/2+ mile of gravity sewer (and manholes connected) per year	Pursue Grant/Town Funds	$ 1,251,250
12.25	PS-14	Install new duplex 10 Hp pumps, install wet well coating, replace discharge piping, blast/paint in vault, install new wet well wizard, remove/replace wet well/vault top slabs with new raised, electrical upgrades (new NEMA 4X SS ATS and generator, correct grounding/bonding, provide junction boxes, resplace service disconnect, provide overcurrent protection, replace surge protection, cable grips)	Pursue Grant/Town Funds	$ 496,000
12.00	PS-10	Install new duplex 15 Hp pumps, install wet well coating, replace discharge piping and blast/paint in vault, replace check valves, new ww wizard, new NEMA 4X SS ATS	Pursue Grant/Town Funds	$ 333,000
11.25	PS-2	Install new duplex 5 Hp pumps, install wet well coating	Pursue Grant/Town Funds	$ 86,000
Total Mid-Range Sewer Rehabilitation Capital Improvement Plan (2028 - 2032)				**$ 2,745,250**

Table 7.7 Sewer Rehabilitation Capital Improvement Plan – Long Range 1 (2033 – 2037 Implementation Window)

Total Risk Score	Sewer Facility Component	Recommended Improvements	Anticipated Funding Source	Order of Magnitude Costs
10.50	Priority #3 - Sewer Main Rehabilitation Program (FY2033 - 37)	Annual Program; Based on findings of Smoke Testing and CCTV/Cleaning - develop priority areas for gravity sewer pipe and manhole rehabilitation; Estimate rehabilitation of approximately 1/2+ mile of gravity sewer (and manholes connected) per year	Pursue Grant/Town Funds	$ 1,251,250
9.00	PS-1	Install new duplex 10 - 12 Hp pumps, install wet well coating, blast/paint Ductile Iron discharge piping, valves and bypass assembly	Pursue Grant/Town Funds	$ 272,000
9.00	PS-2	Install new duplex 5 Hp pumps, install wet well coating	Pursue Grant/Town Funds	$ 148,000
5.00	PS-15	Install new duplex 5 - 7.5 Hp pumps, install wet well coating, replace discharge piping and blast/paint in vault, new ww wizard	Pursue Grant/Town Funds	$ 202,000
Total Long Range 1 Sewer Rehabilitation Capital Improvement Plan (2033 - 2037)				**$ 1,873,250**

Table 7.8 Sewer Rehabilitation Capital Improvement Plan – Long Range 2 (2038 – 2042 Implementation Window)

Total Risk Score	Sewer Facility Component	Recommended Improvements	Anticipated Funding Source	Order of Magnitude Costs
10.00	PS-7	Install new duplex 7.5 Hp pumps	Pursue Grant/Town Funds	$ 172,000
7.50	Priority #3 - Sewer Main Rehabilitation Program (FY2038 - 42)	Annual Program; Based on findings of Smoke Testing and CCTV/Cleaning - develop priority areas for gravity sewer pipe and manhole rehabilitation; Estimate rehabilitation of approximately 1/2+ mile of gravity sewer (and manholes connected) per year	Pursue Grant/Town Funds	$ 1,251,250
Total Long Range 2 Sewer Rehabilitation Capital Improvement Plan (2038 - 2042)				**$ 1,423,250**

7.2 EXPANSION CAPITAL IMPROVEMENT PLAN

The Town and the BJWSA are anticipating growth, development and redevelopment within the 20-year period of this study, therefore this Regional Water and Sewer Master Plan has also addressed the long-term future needs of both the water and sewer systems to serve these new developments within the Town's service area and other planned annexation areas. The water and sewer Expansion Capital Improvement Plans presented in the following sections incorporate all the upgrades necessary, on a broad basis, to provide water and sewer service to the growth and developments in the Central, West and East geographic areas that have been identified and to address conversion of private well and septic systems. As noted, the Town has initiated discussions with the BJWSA to develop an understanding of regional cooperation opportunities and an approach to meet the anticipated significant water and sewer needs of the Town's East area. Based on the financial and rate evaluation of the necessary Expansion Capital Improvement Plans (CIPs) for the East area, it was determined that it would not be feasible for the Town to undertake these projects while maintaining reasonable water and sewer rates for the customer base. Accordingly, the West and Central areas Expansion CIPs are presented as a part of the Town's Implementation Plan while the East area Expansion CIPs are presented as representative projects, costs, and timelines to provide water production and sewer treatment facilities for the anticipated East area developments.

Figures are provided at the end of Section 7 for the proposed water and sewer Expansion CIPs.

Due to the scope of the necessary expansion projects, the descriptions of the projects are not presented here but are instead provided in Sections 5.0 – Water Hydraulic Model and Section 6.0 – Sewer Hydraulic Model. Supporting detail of project scope and cost is provided in Appendix F.

The projects have been prioritized by geographic area and by water or sewer system, and are in order of need to address the projected growth and development accordingly. An attempt has been made to develop the Expansion CIP timeline in a reasonable manner such that Engineering, Design, Permitting and Construction can be completed as needed to serve anticipated development. It will be vital to proper planning to regularly coordinate the Expansion CIPs with the Town Planning Department, the BJWSA (as relevant), and known developers so that the infrastructure needs can be properly addressed.

7.2.1 WATER SYSTEMS

7.2.1.1 ORDER OF MAGNITUDE COSTS – WATER EXPANSION CIP

The estimated order of magnitude costs of the projects included in the Water Expansion Capital Improvement Plan are provided below. The tables also indicate the recommended priority and five year period of implementation of the projects to meet the anticipated growth. These estimated costs include installation, contingency (20%), and engineering, permitting, and administration (10%) fees.

Table 7.9 Central-West Region Water Expansion Capital Improvement Plan

Overall Priority	Water Project Description	Recommended Implementation Window	Order of Magnitude Costs	Implementation Window Totals
1	Tillman Road 12" Water main from Highlands to Tie-in to Town at Floyd/Hwy 278	0 - 5 yrs (2023 - 2027)	$ 2,463,500	$ 3,562,100
2	Tillman Road 12" Water main from Tarboro Road to Highlands	0 - 5 yrs (2023 - 2027)	$ 1,098,600	
3	New 750 gpm Well and 1.0 Mgal EST at Nimmer Property (Tillman and Tarboro area)	5 - 10 yrs (2028 - 2032)	$ 5,245,500	$ 5,245,500
4	Private Wells Phase Out Program (Annual Program 2033 - 2037)	10 - 15 yrs (2033 - 2037)	$ 2,437,500	$ 2,437,500
5	Private Wells Phase Out Program (Annual Program 2038 - 2042)	15 - 20 yrs (2038 - 2042)	$ 2,437,500	$ 2,437,500
Total Central-West Region Water Expansion Capital Improvement Plan				**$ 13,682,600**

Table 7.10 East Region Water Expansion Capital Improvement Plan

Overall Priority	Water Project Description	Recommended Implementation Window	Order of Magnitude Costs	Implementation Window Totals
1	New 1500 gpm Well and 1.0 Mgal EST for East Region (Location TBD)	0 - 5 yrs (2023 - 2027)	$ 6,903,000	$ 6,903,000
2	New 1500 gpm Well and Two 1.0 Mgal EST for East Region (Locations TBD)	5 - 10 yrs (2028 - 2032)	$ 10,868,000	$ 10,868,000
3	New 1.0 Mgal EST for East Region (Location TBD)	10 - 15 yrs (2033 - 2037)	$ 3,965,000	$ 3,965,000
4	New 750 gpm Well and 1.0 Mgal EST for East Region; location TBD	15 – 20 yrs (2038 – 2042)	$ 5,635,500	$ 5,635,500
Total East Region Water Expansion Capital Improvement Plan				**$ 27,371,500**

7.2.2 SEWER SYSTEMS

7.2.2.1 ORDER OF MAGNITUDE COSTS – SEWER EXPANSION CIP

The estimated order of magnitude costs of the projects included in the Sewer Expansion Capital Improvement Plan are provided below. The tables also indicate the recommended priority and five year period of recommended implementation of the projects to meet the anticipated growth. These estimated costs include installation, contingency (20%), and engineering, permitting, and administration (10%) fees.

Table 7.11 Central – West Region Sewer System Expansion Capital Improvement Plan

Overall Priority	Sewer Project Description	Recommended Implementation Window	Order of Magnitude Costs	Implementation Window Totals
1	Tillman Road 10" Forcemain from Highlands to Jimmy Mixson WRF	0 – 5 yrs (2023 – 2027)	$ 4,282,300	
2	Highlands Regional Triplex Pump Station	0 – 5 yrs (2023 – 2027)	$ 2,249,650	$ 8,163,400
3	Tillman Road 10" Forcemain from Tarboro Road to Highlands	0 – 5 yrs (2023 – 2027)	$ 995,100	
4	PS-3 Forcemain Upgrade to 12"	0 – 5 yrs (2023 – 2027)	$ 636,350	
5	New West Development WRF – Land, Design/Permitting	5 – 10 yrs (2028 – 2032)	$ 1,500,000	
6	PS-4 Forcemain Upgrade to 6"	5 – 10 yrs (2028 – 2032)	$ 398,450	
7	PS-3 Upgrade	5 – 10 yrs (2028 – 2032)	$ 2,250,000	
8	PS-4 Upgrade	5 – 10 yrs (2028 – 2032)	$ 208,000	$ 27,040,950
9	Grays Highway Forcemain 6" Parallel Extension	5 – 10 yrs (2028 – 2032)	$ 2,171,000	
10	PS-8 Upgrade	5 – 10 yrs (2028 – 2032)	$ 279,500	
11	PS-1 Upgrade	5 – 10 yrs (2028 – 2032)	$ 234,000	
12	New West Development 1.5 MGD WRF – Construction	5 – 10 yrs (2028 – 2032)	$ 20,000,000	

13	Septic System Phase Out Program (Annual Program 2033 – 2037)	10 – 15 yrs (2033 – 2037)	$ 7,637,500	$ 7,637,500
14	Septic System Phase Out Program (Annual Program 2038 – 2042)	15 – 20 yrs (2038 – 2042)	$ 7,637,500	$ 7,637,500
Total Central-West Region Sewer Expansion Capital Improvement Plan				**$ 50,479,350**

Table 7.12 East Region Sewer System Expansion Capital Improvement Plan

Overall Priority	Sewer Project Description	Recommended Implementation Window	Order of Magnitude Costs	Implementation Window Totals
1	East Development WRF – Land, Design/Permitting	0 – 5 yrs (2023 – 2027)	$ 3,000,000	$ 43,000,000
2	New East Development WRF – Construction (Initial 3 MGD)	0 – 5 yrs (2023 – 2027)	$ 40,000,000	
3	East Development WRF Expansion to 6 MGD-Design, Permit and Construction	10 – 15 yrs (2033 – 2037)	$ 42,000,000	$ 42,000,000
Total East Region Sewer Expansion Capital Improvement Plan				**$ 85,000,000**

7.3 FINANCIAL ELEMENT

This section provides an evaluation and discussion of project funding for the recommended Master Plan projects. The Town of Ridgeland maintains a public utility and relies primarily on user fee revenue billed monthly to its water customers. The Town also earns revenue through miscellaneous customer services, penalties, and capital improvement fees collected from new development. As part of the master plan, Raftelis has developed a 20-year financial model to evaluate the adequacy of revenues to fund the Master Plan capital projects and ongoing operating expenses. A summary of Raftelis' financial feasibility evaluation is provided below; the Raftelis Ridgeland SC Master Plan Financial Feasibility Memo is provided as Appendix G. The objectives of the Raftelis study were 1) to update the Town's existing financial model to incorporate the Master Plan water and sewer CIPs and 2) to forecast future rate increases that will be sufficient to cover all revenue requirements for the water and sewer utility, including the updated CIP.

7.3.1 CAPITAL FUNDING

The Master Plan projects have the following anticipated major funding sources:

1) Renewal and Replacement Fund ("R&R Fund"): This is a dedicated Town fund for existing capital asset renewal and replacement. Annually a certain amount of current year rate revenue is transferred into the R&R Fund.

2) Capital Improvement Fees: New development is required to pay capital improvement fees to accommodate for the use of transmission and treatment capacity. Such funds are reserved by the Town and dedicated to growth related projects. Some projects identified in the Master Plan will only be funded if developers proceed with the planned developments and such projects will be paid for by developer funds.

3) State and Federal Grants: The Town regularly pursues infrastructure grants from both State and Federal agencies such as South Carolina RIA, Community Development Block Grant, USDA Rural Development, and the US Economic Development Agency. The available grants vary in amount and criteria and typically require matching funds for a portion of the grant amount. For projects in the Master Plan capital projects which identify a specific grant funding source, the grant has been awarded to the Town.

4) State Revolving Fund (SRF) Loans: For large scale projects, the Town may need to pursue SRF loans. Debt service was projected for any projects estimated to be funded with SRF loans. The SRF loans were projected to be 20-year term with 2.5% interest and 1.0% issuance costs.

A breakdown of the estimated funding sources utilized in the Raftelis evaluation are provided in the memo in Appendix G.

7.3.2 REVENUE REQUIREMENTS

The financial element is primarily concerned with project funding as outlined above. These funding sources are integrated into a multi-year financial model to identify revenue sufficiency and debt service coverage trends. Two critical goals for the financial element are minimum year end reserves and debt service coverage. As noted, the Town plans to utilize a combination of expected grants, loans, cash and fund balance to fund the CIP and minimize the level of rate increases needed. The Town plans to cash fund (PAYGO) an average of $600,000 of capital costs which will be used to finance smaller scale projects over the forecast period. In order to help the Town keep pace with inflationary pressures and to fund necessary water and sewer system improvements, an annual 4% rate increase will need to be implemented across the board. Should the Town proceed with planned expansion projects, a 10% rate increase will be necessary by fiscal year 2036, based on current information. Annual financial planning updates should

be continued to evaluate whether such rate increases will be necessary. It is possible that a combination of more growth than planned and additional grant funding can reduce the rate increases.

7.3.3 REVENUE SUFFICIENCY CONCLUSIONS

Raftelis has reviewed the Master Plan capital improvement plan for the full 20-year study period and the expanded plan with each recommended rehabilitation and expansion project identified by year. Overall, the Town's water and sewer utility is in a strong financial position. The planned rate adjustments noted, fund balance reserves and debt service coverage remain strong in fiscal year 2025 and throughout the forecast period.

Grays Highway - Cypress Ridge Well
Mid Range (2028 - 2032)
Propose a new 750 gpm well in the north reach of the 12-inch water main, at Cypress Ridge - colocated with EST, if possible

Well Site No. 3
Short Range (2023 - 2027)
100 HP well pump replacement, electrical service and panels upgrade, building expansion for chemical room, piping replacement

Well Site No. 2
Short Range (2023 - 2027)
Electrical service and panels upgrade, building expansion for chemical room, new disinfection system, new generator and fuel tank

Well Site No. 1
Short Range (2023 - 2027)
Blast/paint ductile iron well header piping and well, relocate disinfection equipment to chemical room

Captain Bill Rd and Bees Creek Rd
Water Main Improvements
Mid Range (2028 - 2032)
Install new 12-inch water main along Bees Creek Rd between Captain Bill Rd and south of Grahamville Rd

Legend

- Water Well Site
- Water Storage Tank
- Water Main Improvements
- Water Main
- Ridgeland Water Service Area

0 0.5 1 Miles

Esri, HERE, Garmin, INCREMENT P, NGA, USGS

Town Water System Rehabilitation CIP

Regional Water and Sewer Master Plan

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Legend
- Water Reclamation Facility
- Pump Stations
- Effluent Forcemain
- Gravity Main
- Force Main
- Ridgeland Sewer Basins

PS-8
Short Range (2023 - 2027)
Install wet well coating, replace discharge piping, replace bypass pumpout outside wet well, new ww wizard, electrical upgrades and new generator, relocate fencing at rear of site

PS-12
Short Range (2023 - 2027)
New duplex 3 Hp pumps, wet well coating, raise wet well/vault top, replace discharge piping, install bypass pumpout, new ww wizard, electrical upgrades and local generator

PS-6
Short Range (2023 - 2027)
New duplex 20 Hp pumps, wet well coating, replace discharge piping, install bypass pumpout, new flow meter, electrical upgrades and local generator

PS-3
Short Range (2023-2027)
Complete replacement; Construction of new 12" dia wet well and duplex 58 Hp pumps, valve vault, and influent manhole system, electrical upgrades and generator, future provision; access road improvements; and upstream manhole rehabilitation

PS-9
Short Range (2023 - 2027)
Install wet well coating, raise wetwell/vault/MH tops, replace discharge piping, replace bypass pumpout, new ww wizard, electrical upgrades, site grading/raise elev, access roadway improvements

PS-14
Mid Range (2028 - 2032)
Install new duplex 10 Hp pumps, install wet well coating, replace discharge piping, blast/paint in vault, install new wet well wizard, remove/replace wet well/vault top slabs with new raised, electrical upgrades (new NEMA 4X SS ATS and generator, correct grounding/bonding, provide junction boxes, replace service disconnect, provide overcurrent protection, replace surge protection, cable grips)

PS-16
Short Range (2023 - 2027)
Electrical upgrades (new surge protection at service disconnect, surge protection in control panel, correct grounding, provide junction boxes, cable grips)

PS-5
Short Range (2023 - 2027)
Install new 2.5 Hp duplex grinder pumps, replace discharge piping, install new bypass pump out on forcemain, electrical upgrades and new generator

PS-1
Short Range (2023 - 2027)
Electrical upgrades (correct grounding/ bonding, provide junction boxes, surge protection at disconnect and control panel, cable grips)
Long Range (2033 - 2037)
Install new duplex 10 - 12 Hp pumps, install wet well coating, blast/paint Ductile Iron discharge piping, valves and bypass assembly

WRF - Sludge Lagoon Floating Aerators
Short Range (2023 - 2027)
Install four new 25 Hp floating aerators and control panels for sludge lagoon
WRF - Sludge Lagoon Linear Replacement
Short Range (2023 - 2027)
Replacement of original liner in sludge lagoon at WRF; 30 years old and compromised. Anticipate full replacement needed. Lagoon approximately 240 ft long x 112.5 ft wide

PS-7
Short Range (2023 - 2027)
Install wet well coating, replace discharge piping, relocate fence at rear of site for electrical clearances, electrical upgrades (new NEMA 4X SS ATS, correct grounding/bonding, provide junction boxes, surge protection at disconnect and control panel, cable grips)
Long Range 2 (2038 - 2042)
Install new duplex 7.5 Hp pumps

PS-2
Mid Range (2028 - 2032)
Install new duplex 5 Hp pumps, install wet well coating
Long Range (2033 - 2037)
Install new duplex 5 Hp pumps, install wet well coating

PS-13
Mid Range (2028 - 2032)
Install new duplex 12 Hp pumps, install wet well coating, replace discharge piping, blast/paint in vault, remove/replace wet well/vault top slabs with new raised, electrical upgrades (new NEMA 4X SS ATS and generator, correct grounding/ bonding, provide junction boxes, replace service disconnect, provide overcurrent protection, replace surge protection, provide new equipment rack above 100 yr flood elev, cable grips)

PS-10
Short Range (2023 - 2027)
Electrical upgrades (new service disconnect, correct grounding, provide junction boxes, surge protection at disconnect and control panel, cable grips)
Mid Range (2028 - 2032)
Install new duplex 15 Hp pumps, install wet well coating, replace discharge piping and blast/paint in vault, replace check valves, new ww wizard, new NEMA 4X SS ATS

PS-4
Short Range (2023 - 2027)
Complete replacement; Construction of new 8' dia wet well and duplex 25 pumps, valve vault, and influent gravity reroute, electrical upgrades and generator, future expansion provision

PS-11
Short Range (2023 - 2027)
New duplex 15 Hp pumps, wet well coating, replace discharge piping and blast/paint in vault, new ww wizard, electrical upgrades and new generator and NEMA 4X SS ATS

PS-15
Short Range (2023 - 2027)
Electrical upgrades (new service disconnect, correct grounding, provide junction boxes, cable grips, new door seat on ATS)
Long Range (2033 - 2037)
Install new duplex 5 - 7.5 Hp pumps, install wet well coating, replace discharge piping and blast/paint in vault, new ww wizard

0 0.5 1 Miles

Esri, HERE, Garmin, USGS, NGA, ...

Town Sewer System Rehabilitation CIP

Regional Water and Sewer Master Plan

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Central - West Region
Overall Priority 3
Long Range (2033 - 2037)
New 750 gpm Well and 0.75 Mgal EST at Nimmer Property (Tillman and Tarboro area)

Central/West Developments

East Developments

Central - West Region
Overall Priority 2
Short Range (2023 - 2027)
Tillman Road 12" Water main from Tarboro Road to Highlands

Central - West Region
Overall Priority 1
Short Range (2023 - 2027)
Tillman Road 12" Water main from Highlands to Tie in to Town at Floyd/ Hwy 278

East Region
Overall Priority 1
Short Range (2023 - 2027)
New 1500 gpm Well and 1.0 Mgal EST for East Region (Location TBD)
Overall Priority 2
Mid Range (2028 - 2032)
New 1500 gpm Well and Two 1.0 Mgal EST for East Region (Locations TBD)
Long Range (2033 - 2037)
1.0 Mgal EST for East Region (Location TBD)
Long Range (2038 - 2042)
New 750 gpm Well and 1.0 Mgal EST for East Region (Location TBD)

Legend
- New Well & EST (Locations TBD)
- Water Well Site
- Water Storage Tank
- Watermain Expansion
- Water Main
- New Development Properties
- Ridgeland Town Limit
- Parcels

0 2 4 Miles

Esri, HERE, Garmin, INCREMENT P, NGA, USGS

Town Water System Expansion CIP

Regional Water and Sewer Master Plan

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Central - West Region
Overall Priority 11
Mid Range (2028 - 2032)
PS-1 Upgrade

Central - West Region
Overall Priority 10
Mid Range (2028 - 2032)
PS-8 Upgrade

Central - West Region
Overall Priority 9
Mid Range (2028 - 2032)
Grays Highway Forcemain 6" Parallel Extension

Central - West Region
Overall Priority 5
Mid Range (2028 - 2032)
New West Development WRF - Land,Design/ Permitting
Overall Priority 12
Mid Range (2028 - 2032)
New West Development WRF - Construction

East Region
Overall Priority 1
Short Range (2023 - 2027)
East Development WRF - Land,Design/Permiting(Location TBD)
Overall Priority 2
Short Range (2023-2027)
New East Development WRF - Construction (Initial 3 MGD)
(Location TBD)
Overall Priority 3
Long Range 1 (2033 - 2037)
East Development WRF Expansion to 6 MGD- Design, Permit and Construction (Location TBD)

Central - West Region
Overall Priority 1
Short Range (2023 - 2027)
Tillman Road 10" Forcemain from Highlands to Jimmy Mixson WRF
Overall Priority 2
Short Range (2023 - 2027)
Highlands Regional Triplex Pump Station
Overall Priority 3
Short Range (2023 - 2027)
Tillman Road 10" Forcemain from Tarboro Road to Highlands

Central - West Region
Overall Priority 4
Short Range (2023 - 2027)
PS-3 Forcemain Upgrade to 12"
Overall Priority 7
Mid Range (2028 - 2032)
PS-3 Upgrade

Central - West Region
Overall Priority 6
Mid Range (2028 - 2032)
PS-4 Forcemain Upgrade to 6"
Overall Priority 8
Mid Range (2028 - 2032)
PS-4 Upgrade

Central/West Developments

East Developments

PS 8
PS 9
PS 16
PS 5
PS 12
PS 6
PS 14
PS 3
PS 15
PS 1
PS 7
PS 4
PS 10
PS 2
PS 11
PS 13

Halls Island
Bird Island

Legend

- Proposed Pump Station
- New WRF (Locations TBD)
- Water Reclamation Facility
- Pump Stations
- Gravity Main
- Force Main
- Forcemain Expansion
- Ridgeland Sewer Basins
- New Development Properties
- Ridgeland Town Limit
- Parcels

0 2 4 Miles

Town Sewer System Expansion CIP

Regional Water and Sewer Master Plan

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8.0 – CONCLUSIONS AND RECOMMENDATIONS

The Town of Ridgeland (Town) has set a goal to develop a 20-year water and sewer master plan using a regional approach to determine the most efficient and cost effective manner to improve the reliability and performance of the Town's existing water and sewer infrastructure and to identify the water and sewer system improvements and strategies needed to serve the growth projected to occur in the Town and adjacent areas of Jasper County over the planning period. To this end, the Town commissioned 4Waters to prepare a Regional Water and Sewer Master Plan to assess the status of the existing Town water and sewer systems and to plan for capital improvements that meet the current and projected needs of the Town and adjacent areas of Jasper County, whether by the Town or the BJWSA.

In order to assess inefficiencies in the systems, an evaluation of the major components of the water and sewer systems was conducted which incorporated and extrapolated other various recent assessments conducted by the Town including the 2019 evaluation which resulted in development of a Water and Sewer Capital Improvement Plan (CIP) which was used to support grant applications. Hydraulic models of the water and sewer systems were developed with the Bentley Systems WaterGEMs and SewerGEMs software packages, respectively and calibrated. The previously prepared 2017 *Inflow and Infiltration (I&I) Abatement Analysis* for the sewer systems was updated and extrapolated based on available recent and historic rainfall and flow data and in comparison with sewer infrastructure evaluation and rehabilitation efforts completed since the 2017 study, to properly update and prioritize significant I&I loadings and sources. Water demands and sewer generation rates were developed and extended to 2042 for the service areas based on an analysis of actual flows and treatment volumes, billing data, and population projections prepared by 4Waters with Town involvement and information provided by PDDs and developers in the region.

The overall service area of the Town's water and sewer systems include the existing Town infrastructure limits and unserved areas within the Town boundary or within the annexation process. These areas have been delineated with this Master Plan into three core development areas: the Central, West, and East regions, reference Figure 4.7. The projected growth and development of these regions and planned water and sewer service resulted in two planned water and sewer systems, the existing Town water and sewer system which includes the Jimmy Mixson WRF, three water production wells and five ESTs and will serve the Central and West regions, and a proposed water and sewer system focused on the East region.

As noted in Section 4, the Town initiated discussions with the BJWSA in March 2023 to develop an understanding of regional cooperation opportunities and an approach to meet the anticipated significant water and sewer needs of the Town's East area. Estimated impacts to the Town's water and sewer customer base limit the Town's ability to undertake construction and operation of water production and sewer treatment and disposal facilities to serve the anticipated East area developments. Accordingly, the West and Central areas Expansion CIPs are presented as a part of the Town's Implementation Plan while the East area Expansion CIPs are presented as representative projects, costs, and timelines to provide water production and sewer treatment facilities for the anticipated East area developments. The East area Expansion CIPs can be utilized during the ongoing regional partnership discussions with the BJWSA. Options for partnering with BJWSA are anticipated to potentially include a combination of Wholesale and Franchise Agreements based on the timing and location of development.

8.1 CONCLUSIONS

One of the first tasks of the Master Plan Update was to assess the systems condition by performing field inspections of the major water and sewer transmission systems and evaluating the water reclamation facility and the well/water production facilities' operating abilities. The information gathered was used for comparison to the 2019 assessments and enabled the development of an understanding of the level of maintenance typically provided and typical upgrades to the systems.

The results of the facility inspections and the hydraulic models indicate that the water facilities are effectively well operated and are in relatively good condition or are already scheduled for rehabilitation as is the case with Well No. 2 which is part of the EDA Water & Sewer Resiliency Improvements project

scheduled to start construction in fall 2023 and Well No. 3 which is funded by a CDBG grant and scheduled for construction in late 2023/spring 2024. Typical issues with the well sites are the age of the electrical equipment reaching end of life and additional deterioration from chemical disinfection systems. There is an indication from the hydraulic modeling and information received from the Town Water and Sewer Department that there are areas of limited water pressure and resiliency concerns, particularly along Bees Creek Road and Grey's Highway. These concerns have been addressed in the Water Rehabilitation CIP with a recommended well to be co-located with the Cypress Ridge EST and for water main upgrades along Bees Creek Road.

The Town's sewer pumping and transmission systems all generally function properly but there were several pump stations, particularly from an electrical standpoint which were so deteriorated or near end of life that they were assessed as being in a Poor condition. A significant number of these facilities including PS3, PS4, PS6, and PS12 are included in the EDA project and scheduled to begin construction in fall 2023. Town Water and Sewer Department management and staff are aware of these facility conditions and are working to develop and implement feasible and cost effective solutions for repair and operational reliability until capital projects can be funded. Many of the pump station facilities were noted as having significant or severe corrosion – particularly on the ductile iron pump discharge piping. The failure of the discharge piping effectively results in failure of the pump station, subsequent sewer system overflows, and could lead to regulatory action.

The hydraulic sewer models and operational data provided by the Town indicate that overall the pumping and piping systems in the WRF sewer system are capable of handling the base sewer flows but not necessarily in accordance with industry standards and regulatory requirements for backup capacity. In particular, two pump stations PS4 and PS10 were identified as having insufficient pumping capacity for the current base flow condition. PS4 is part of the EDA project and is scheduled for a complete replacement with increased pumping capacity starting in fall 2023.

The occurrence of I&I has a significant impact on the WRF collection system and leads to loss of system and treatment capacity, additional operation costs to transfer and treat I&I, and can cause structural damage and loss of integrity in the system. Significant portions of the Town's sewer system is an older system with significant amounts of VCP (clay) pipe and brick manholes which is susceptible to I&I. Starting in 2017, the Town began investigating the I&I in the system and has developed an implementation plan and program, continued with the evaluation included in this Master Plan, to utilize a systematic approach to identifying the sources of I&I in the sewer sub-basins and utilizing an arsenal of tactics including CCTV cleaning and inspection, smoke testing, and flow monitoring. The sewer sub-basins are being regularly prioritized to focus funding on the rehabilitation of areas of the collection system which will provide the most cost effective and impactful reduction in I&I.

8.2 RECOMMENDATIONS

In summary, for all of the water and sewer systems, Rehabilitation Capital Improvement Projects (CIP) totaling $15.5 million and $16.3 million, respectively, have been identified for completion over the 20 year study period, although a majority are recommended for completion within the next ten years. A breakdown of the Rehabilitation CIPS by primary function can be seen below for both the water and sewer systems. The Programmatic/Regulatory division includes addressing the lead service line identification/replacement and programs for small diameter pipe replacement and Transite/CIP water main replacement.

Table 8.1 Master Plan Summary Water and Sewer Rehabilitation CIPs

Water Rehabilitation CIPS					
Project Type	**5 Yr**	**10 Yr**	**15 Yr**	**20 Yr**	**Total**
Water Production and Storage	$ 1,917,000	$ 2,034,500	$ 1,196,000	$ -	**$ 5,147,500**
Transmission/Conveyance	$ 670,214	$ 1,372,930	$ -	$ -	**$ 2,043,200**
Programmatic/Regulatory	$ 768,650	$ 2,529,350	$ 2,502,500	$ 2,502,500	**$ 8,303,000**
Total Water Rehabilitation CIPS	**$ 3,356,000**	**$ 5,937,000**	**$ 3,699,000**	**$ 2,503,000**	**$ 15,495,000**

Sewer Rehabilitation CIPS					
Project Type	**5 Yr**	**10 Yr**	**15 Yr**	**20 Yr**	**Total**
Water Reclamation Facility	$ 784,580	$ -	$ -	$ -	**$ 784,580**
Collection/Transmission	$ -	$ -	$ -	$ -	**$ -**
Pump Station	$ 7,713,566	$ 1,494,000	$ 622,000	$ 172,000	**$ 10,001,600**
Inflow & Infiltration	$ 1,725,450	$ 1,251,250	$ 1,251,250	$ 1,251,250	**$ 5,479,200**
Total Rehabilition Sewer CIPS	**$ 10,224,000**	**$ 2,746,000**	**$ 1,874,000**	**$ 1,424,000**	**$ 16,268,000**

The Town is poised for extensive growth in various areas including new development in the western and eastern areas within the Town's border or in the annexation process. These new developments will need water and sewer infrastructure and will be looking to the Town for supply and collection services and treatment. Completion of the Rehabilitation CIP projects listed in Section 7.0 will successfully bring the existing water and sewer infrastructure to an acceptable and reliable level of service which can then be extended or expanded as necessary to serve future growth. The Expansion CIP developed for projected water and sewer population growth throughout the 20 year study period include approximately $41.0 million for water system expansions and approximately $135.5 million for sewer system expansions, inclusive of the Central, West, and East development areas. A breakdown of the Expansion CIPS can be seen below for both the water and sewer systems which rolls up both the Central-Western and Eastern region systems, separately.

Table 8.2 Master Plan Summary Water and Sewer Expansion CIPs

Water Expansion CIPS					
Central/West Regions					
Project Type	**5 Yr**	**10 Yr**	**15 Yr**	**20 Yr**	**Total**
Water Production and Storage	$ -	$ 5,245,500	$ -	$ -	**$ 5,245,500**
Transmission/Conveyance	$ 3,562,100	$ -	$ -	$ -	**$ 3,562,100**
Private Wells Phase Out	$ -	$ -	$ 2,437,500	$ 2,437,500	**$ 4,875,000**
East Region					
Project Type	**5 Yr**	**10 Yr**	**15 Yr**	**20 Yr**	**Total**
Water Production and Storage	$ 6,903,000	$ 10,868,000	$ 3,965,000	$ 5,635,500	**$ 27,371,500**
Transmission/Conveyance	$ -	$ -	$ -	$ -	**$ -**
Private Wells Phase Out	$ -	$ -	$ -	$ -	**$ -**
Total Water Expansion CIPS	**$ 10,465,100**	**$ 16,113,500**	**$ 6,402,500**	**$ 8,073,000**	**$ 41,054,100**

Sewer Expansion CIPS					
Central/West Regions					
Project Type	**5 Yr**	**10 Yr**	**15 Yr**	**20 Yr**	**Total**
Water Reclamation Facility	$ -	$ 21,500,000	$ -	$ -	**$ 21,500,000**
Collection/Transmission	$ 5,913,750	$ 2,569,450	$ -	$ -	**$ 8,483,200**
Pump Station	$ 2,249,650	$ 2,971,500	$ -	$ -	**$ 5,221,150**
Septic System Phase Out	$ -	$ -	$ 7,637,500	$ 7,637,500	**$ 15,275,000**
East Region					
Project Type	**5 Yr**	**10 Yr**	**15 Yr**	**20 Yr**	**Total**
Water Reclamation Facility	$ 43,000,000	$ -	$ 42,000,000	$ -	**$ 85,000,000**
Collection/Transmission	$ -	$ -	$ -	$ -	**$ -**
Pump Station	$ -	$ -	$ -	$ -	**$ -**
Septic System Phase Out	$ -	$ -	$ -	$ -	**$ -**
Total Sewer Expansion CIPs	**$ 51,163,400**	**$ 27,041,000**	**$ 49,637,500**	**$ 7,637,500**	**$ 135,479,400**

The Town established a goal to provide reliable and environmentally responsible water and sewer service which ensures the availability of suitable level of service for the existing customer base and the anticipated future growth within the Town's boundary and annexation process. The completion of the Regional Water and Sewer Master Plan, the I&I Assessment and Reduction Plan, and the general commitment of the Town Council, Administration and staff, provide the Town Water & Sewer Department with the necessary resources, information and guidance to achieve the goals and obligations of providing a high level of service to the customer base for the Central and West areas. To determine a viable solution for water and sewer service for the planned East development area, continued collaboration and coordination will be needed between the Town and the BJWSA.