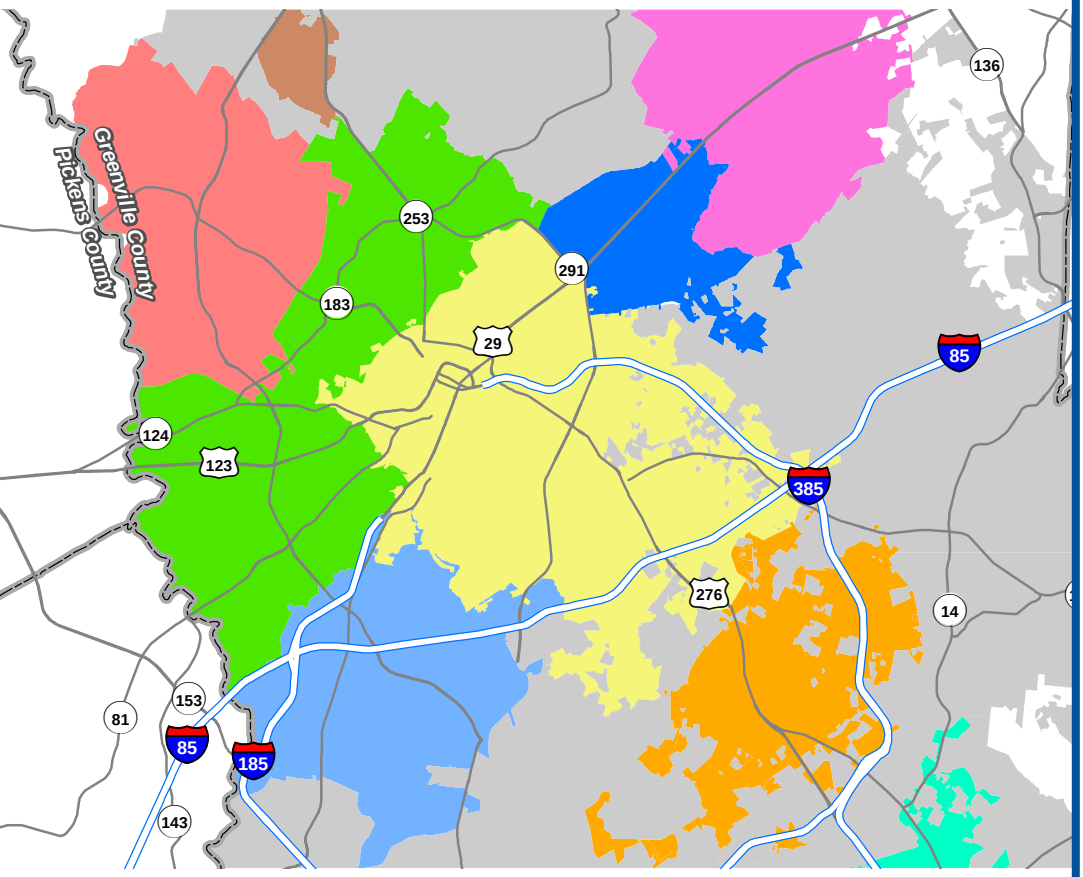
FINAL REPORT

Capital Improvement Needs Study for Sanitary Sewer Collection System Renewal in Greenville County



MAY 2020

MetroConnects
Sustainable Wastewater Solutions

CDM Smith

Table of Contents

Executive Summary

Thirteen Entities provide wastewater collection service in Greenville County, connecting to Renewable Water Resources (ReWa). These Entities are responsible for the management, maintenance, operations, capacity, and renewal of the wastewater collection system in their respective service areas.

One of these Entities, the Metropolitan Sewer District (MetroConnects), retained CDM Smith to apply a widely accepted cohort analysis planning approach to define capital improvement needs for asset renewal. The objective of this study is to help local decisionmakers better understand and approximate the amount of deferred collection system renewal that currently exists in the collection systems, and to project the anticipated future needs within a future planning period of 20-years. Ten of the thirteen Entities participated in this effort:

Special Purpose Districts

- Berea Public Service District
- Gantt Fire, Police and Sewer District
- Marietta Fire and Sewer District
- Metropolitan Sewer District
- Parker Fire and Sewer Subdistrict
- Taylors Fire and Sewer District
- Wade Hampton Fire and Sewer District

Participating Municipalities

- City of Fountain Inn
- City of Simpsonville
- City of Travelers Rest

Other Municipalities

- City of Greenville (Study by Others)
- City of Greer (Non-Material Contributor)
- City of Mauldin (Did Not Participate)

An attempt was made to include ReWa in this study. However as detailed in Section 13, the ReWa system could not be analyzed under this approach.

The U.S. Environmental Protection Agency (USEPA) and the South Carolina Department of Health and Environmental Control (DHEC) require each Entity to maintain and keep its wastewater collection system in good operating condition, as defined by published capacity, management, operations, and maintenance (CMOM) guidelines. CMOM guidelines are intended to be a flexible, dynamic framework for Entities to identify and incorporate widely-accepted wastewater industry practices. A critical element of successful CMOM is the implementation of an asset management approach which requires systems to manage infrastructure capital assets to minimize the total cost of owning and operating the system, while delivering the service levels customers desire. This includes the need for systems to perform condition assessment, identify and prioritize needs, and develop capital improvement plans to sufficiently renew aging infrastructure. Specifically, some highlights from the EPA's guidance including "*Asset Management for Sewer Collection Systems*" calls for systems to protect wastewater infrastructure and extend financial resources by:

- Proactive capital improvement planning and implementation over longer cycles to reduce annual and overall costs,
- Preventing costly premature failure by proper operations, maintenance, condition assessment, and risk prioritization,
- Optimize use of resources by shifting capital improvement planning and maintenance activities from "reactive" to "preventative",
- Maintain their systems to reduce sanitary sewer overflows and inflow and infiltration.

The following principles frame this study's approach used to determine capital improvement needs for asset renewal:

- Take a proactive approach to asset management,
- Use a forward-looking 20-year planning horizon that includes past deferred renewal,
- Relocate sewer mains and service laterals in Mill Village areas to dedicated easements and rights of way, and
- Renew laterals (from the sewer main to the property line) as an element of capital improvement need.

The objective of this project is to provide a *planning-level overview* of estimated capital improvement needs for four categories of *collection system renewal*:

- 'Catch-up' over the next 15 years with *deferred system needs*, defined as the gap between the Entity's system renewal investment to date and projections of current system renewal needs for sewer assets nearing the end of their service life.
- Completely *relocate/renew Mill Village systems* over the next eight years.
- Anticipate emerging *near-term renewal needs* to annually address additional sewer assets nearing the end of their service life over the next 20-years.
- Project *long-term levels of annual renewal* to establish a consistent, predictable level of future asset life extension.

Each participating Entity was fully engaged throughout the study:

- Initially, each Entity was asked to complete a *questionnaire* to confirm, provide, or estimate collection system characteristics (i.e., length, size, material, age), maintenance practices, condition assessment methods, and renewal histories.
- Available regional and Entity renewal histories were used to develop local *"service life expectance curves"* for the material types commonly found throughout each system.
- Recent bid tabs from local Entity and midlands South Carolina sewer renewal projects were used to develop local "*cost per foot of renewal*" factors based on the relative risk of failure of gravity sewer mains, manholes, and laterals and a proportional breakdown of required renewal methods (i.e., CIPP lining, pipe busting, and pipe replacement).
- The local service life expectancy curves were applied to sewer system characteristics provided by the Entities to estimate *deferred and near-term annual renewal requirements* (i.e., the length of pipe, number of manholes, and number of laterals).
- The "cost per foot of renewal factors" were applied to these annual renewal requirements to estimate the *annual near-term renewal cost* over a 20-year planning period as well as long-term renewal trends. No planning level contingencies are included in these estimates.
- Total estimated costs (in 2019 dollars) are determined by asset type (i.e., sewer mains, manholes, and laterals) for each type of asset renewal (**Figure ES-1),**

- Costs are also summarized for all Entities (**Table ES-1** and **Figure ES-2)**, the Special Purpose Districts (**Table ES-2** and **Figure ES-3)** and the municipalities (**Table ES-3** and **Figure ES-4**).
- The estimated annual renewal costs are based on maintaining current hydraulic capacity and do not include costs to extend sewers or increase sewer capacity.
- At the mid-point of the project, each Entity was provided draft results for comment, and renewal needs were re-projected based on any system characteristic data updates provided by the Entity. Results were again shared with the Entities prior to completion of the final report.

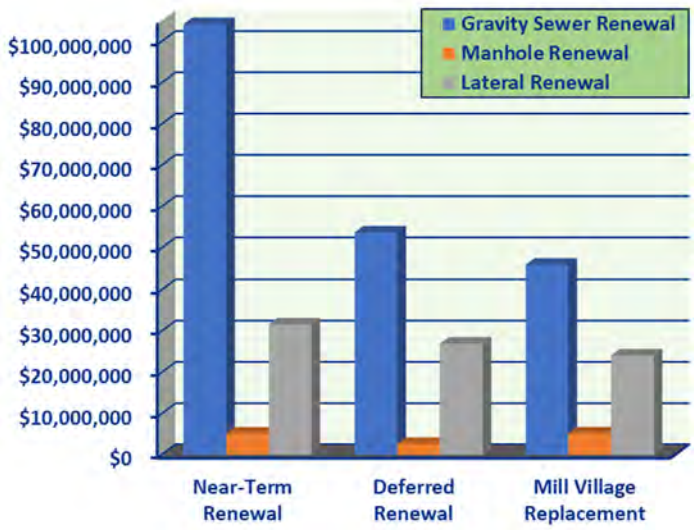


Figure ES-1. Estimated System Renewal Costs by Asset Type

- ReWa is a regional provider of trunk mains and wastewater treatment plants that collects, consolidates, and treats wastewater from the entities listed above. ReWa owns and maintains a portion of local collection system pipe networks like the other entities listed above. However, the majority of ReWa's infrastructure is larger infrastructure consisting of regional collector trunk mains. The ReWa system could not be analyzed in a similar approach to that used for these other entities and therefore is not included in the tables and charts in this executive summary. Please see Section 13 for more detail on ReWa.

The study uses regional sewer renewal experience to define a proactive approach to meeting sewer renewal needs, reducing risk and avoiding costly emergency repairs. It also equitably shares the cost of lateral renewal within the public right-of-way, avoiding potential collapse within the roadway and burdening customers with unexpected emergency repairs.

Implementation of study findings is expected to improve system resilience through measures that restore the full structural integrity of gravity sewers, manholes, and laterals nearing the end of their useful life (pump stations were not included). Point repairs and short shots of CIPP are not considered adequate to achieve full asset renewal.

The findings of this study will be used to facilitate discussion of regional cost and funding necessary to address these needs. These projected renewal needs can serve as input to future discussions on collaborative programming and financing of renewal requirements. This study recognizes, but did not quantify, additional anticipated costs that will be required to perform operation and maintenance activities, or costs associated with system growth (i.e., system cleaning, condition assessment, pump station operations, increase system capacity to address future development, service area expansion, or to meet ReWa's regional infiltration and inflow control objectives).

The following pages contain summary charts of the results of this study based on grouping of all participating entities, special purpose districts only, and finally municipal systems only.

Table ES-1. Summary of Near-Term Sewer Renewal Needs for Participating Entities

Entity Name	Deferred Sewer Renewal Outside Mill Villages		Near-Term Sewer Renewal Outside Mill Villages		Sewer Replacement Inside Mill Villages	
	Length (miles)	Estimated Cost	Length (miles)	Estimated Cost	Length (miles)	Estimated Cost
Special Purpose Districts						
Berea Public Service District	17.45	$11,227,000	24.73	$15,936,000	0.00	$0
Gantt Fire, Police and Sewer District	22.29	$14,378,000	27.47	$17,235,000	0.00	$0
Marietta Fire and Sewer District	2.02	$1,355,500	4.15	$2,504,000	0.00	$0
MetroConnects	0.00	$0	44.48	$29,946,000	0.00	$0
Parker Fire and Sewer Subdistrict	44.75	$30,081,000	45.24	$29,984,000	41.44	$75,041,000
Taylors Fire and Sewer District	10.09	$8,637,000	25.74	$17,891,000	0.00	$0
Wade Hampton Fire and Sewer District	11.72	$9,903,000	16.14	$11,211,000	0.00	$0
Special Purpose District Subtotal	**108.32**	**$75,581,500**	**187.95**	**$124,707,000**	**41.44**	**$75,041,000**
Municipalities						
City of Fountain Inn	0.00	$2,028,000	8.78	$5,931,000	0.00	$0
City of Simpsonville	0.00	$4,914,000	9.83	$6,618,000	0.00	$0
City of Travelers Rest	0.98	$ 687,000	5.47	$3,561,000	0.00	$0
Municipality Subtotal	**0.98**	**$7,629,000**	**24.08**	**$16,110,000**	**0.00**	**$0**
Total	**109.30**	**$83,210,500**	**212.03**	**$140,817,000**	**41.44**	**$75,041,000**
					Grand Total	**$299,068,500**

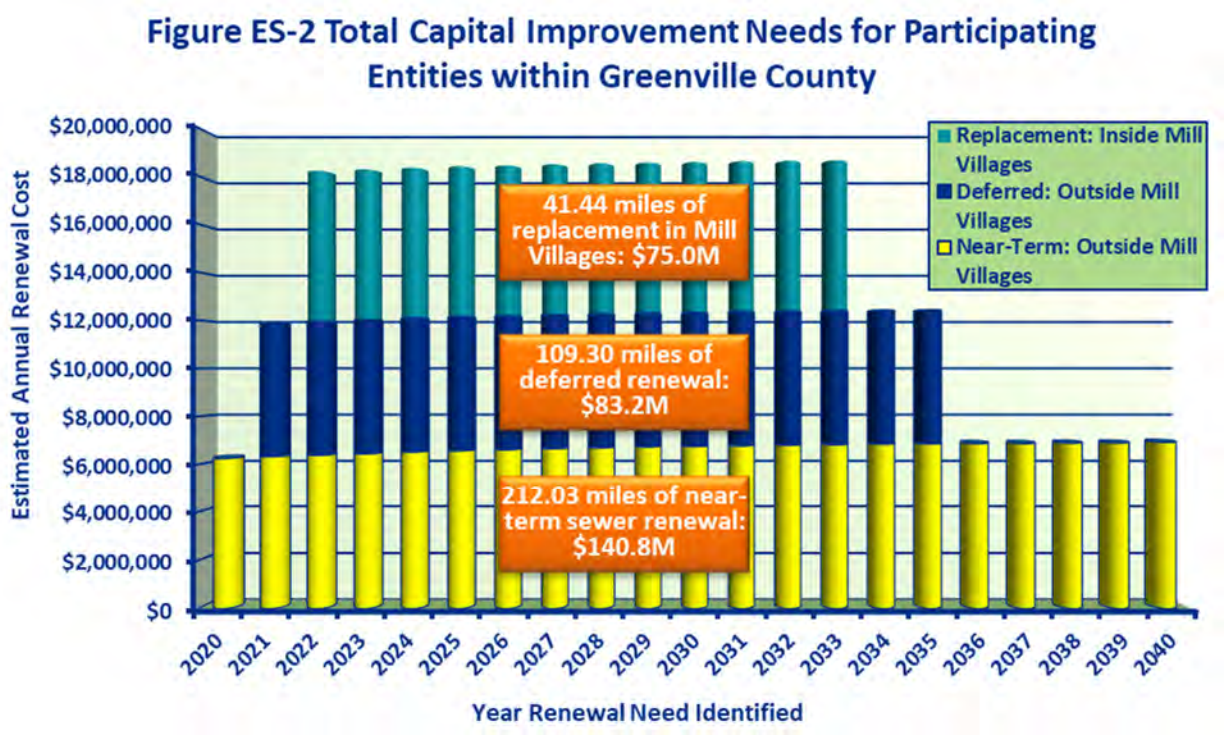


Figure ES-2. Total Capital Improvement Needs for All Participating Entities within Greenville County

Table ES-2. Summary of Near-Term Sewer Renewal Needs by Special Purpose District

Entity Name	Deferred Sewer Renewal Outside Mill Villages		Near-Term Sewer Renewal Outside Mill Villages		Sewer Replacement Inside Mill Villages	
	Length (miles)	Estimated Cost	Length (miles)	Estimated Cost	Length (miles)	Estimated Cost
Berea Public Service District	17.45	$11,227,000	24.73	$15,936,000	0.00	$0
Gantt Fire, Police and Sewer District	22.29	$14,378,000	27.47	$17,235,000	0.00	$0
Marietta Fire and Sewer District	2.02	$1,355,500	4.15	$2,504,000	0.00	$0
MetroConnects	0.00	$0	44.48	$29,946,000	0.00	$0
Parker Fire and Sewer Subdistrict	44.75	$30,081,000	45.24	$29,984,000	41.44	$75,041,000
Taylors Fire and Sewer District	10.09	$8,637,000	25.74	$17,891,000	0.00	$0
Wade Hampton Fire and Sewer District	11.72	$9,903,000	16.14	$11,211,000	0.00	$0
Special Purpose District Subtotal	**108.32**	**$75,581,500**	**187.95**	**$124,707,000**	**41.44**	**$75,041,000**

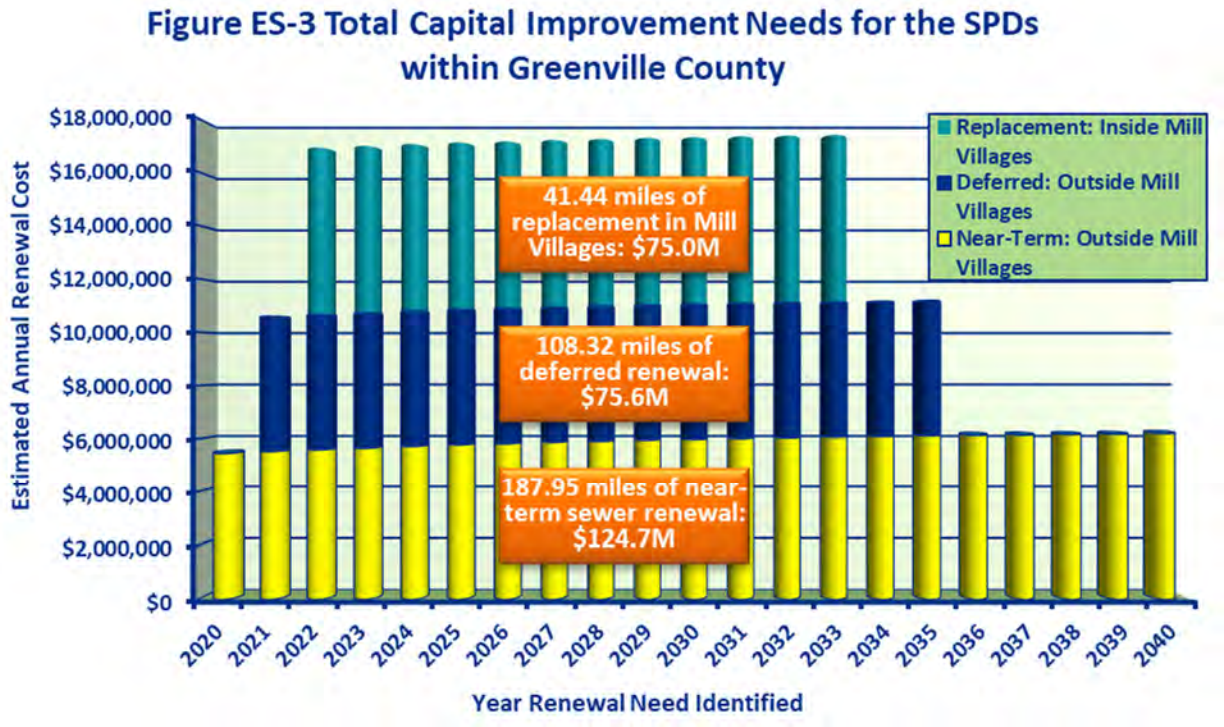


Figure ES-3. Total Capital Improvement Needs for Special Purpose Districts within Greenville County

Table ES-3. Summary of Near-Term Sewer Renewal Needs By Participating Municipality

Entity Name	Deferred Sewer Renewal Outside Mill Villages		Near-Term Sewer Renewal Outside Mill Villages		Sewer Replacement Inside Mill Villages	
	Length (miles)	Estimated Cost	Length (miles)	Estimated Cost	Length (miles)	Estimated Cost
City of Fountain Inn	0.00	$2,028,000	8.78	$5,931,000	0.00	$0
City of Simpsonville	0.00	$4,914,000	9.83	$6,618,000	0.00	$0
City of Travelers Rest	0.98	$ 687,000	5.47	$3,561,000	0.00	$0
Municipality Subtotal	**0.98**	**$7,629,000**	**24.08**	**$16,110,000**	**0.00**	**$0**

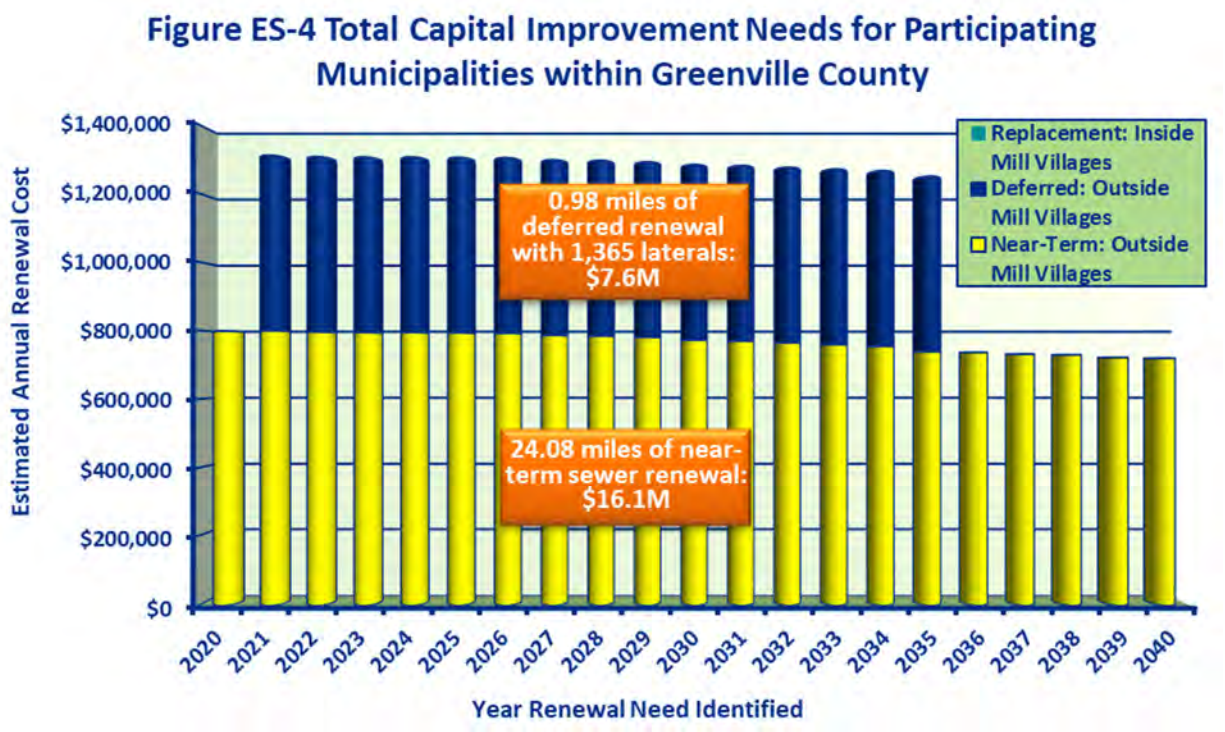


Figure ES-4. Total Capital Improvement Needs for Participating Municipalities within Greenville County

Section 1
Introduction

There are currently 13 Entities providing wastewater collection service in Greenville County. These Entities are responsible for the management, maintenance, operations, capacity, and renewal of the wastewater collection system in their respective service areas. Each Entity ultimately discharges to Renewable Water Resources (ReWa) trunk lines for eventual treatment at a ReWa water resource reclamation facility (WRRF). A significant percentage of the pipeline networks for many of these Entities were constructed in the late 1960's or 1970's, and typically consist of small diameter pipelines (8-inch) commonly constructed of clay.

The Entities providing wastewater collection are organized as either special purpose districts (SPD), or are providing service as part of a municipality. The Entities in this study have a total service area of nearly 300 square miles, provide wastewater collection to over 100,000 customers, and are responsible for over 1,500 miles of pipe collection networks, nearly half of which is composed of older vitrified clay pipe (VCP). These systems are facing evolving challenges including aging infrastructure, control of infiltration and inflow (I&I) into the collection system and meeting the capital improvement needs of the systems. **Figure 1.1** shows the service areas of the Entities involved in this Study:

<u>Special Purpose Districts</u>

- Berea Public Service District
- Gantt Fire, Police and Sewer District
- Marietta Fire and Sewer District
- Metropolitan Sewer District
- Parker Fire and Sewer Subdistrict
- Taylors Fire and Sewer District
- Wade Hampton Fire and Sewer District

<u>Participating Municipalities</u>

- City of Fountain Inn
- City of Simpsonville
- City of Travelers Rest

<u>Other Municipalities</u>

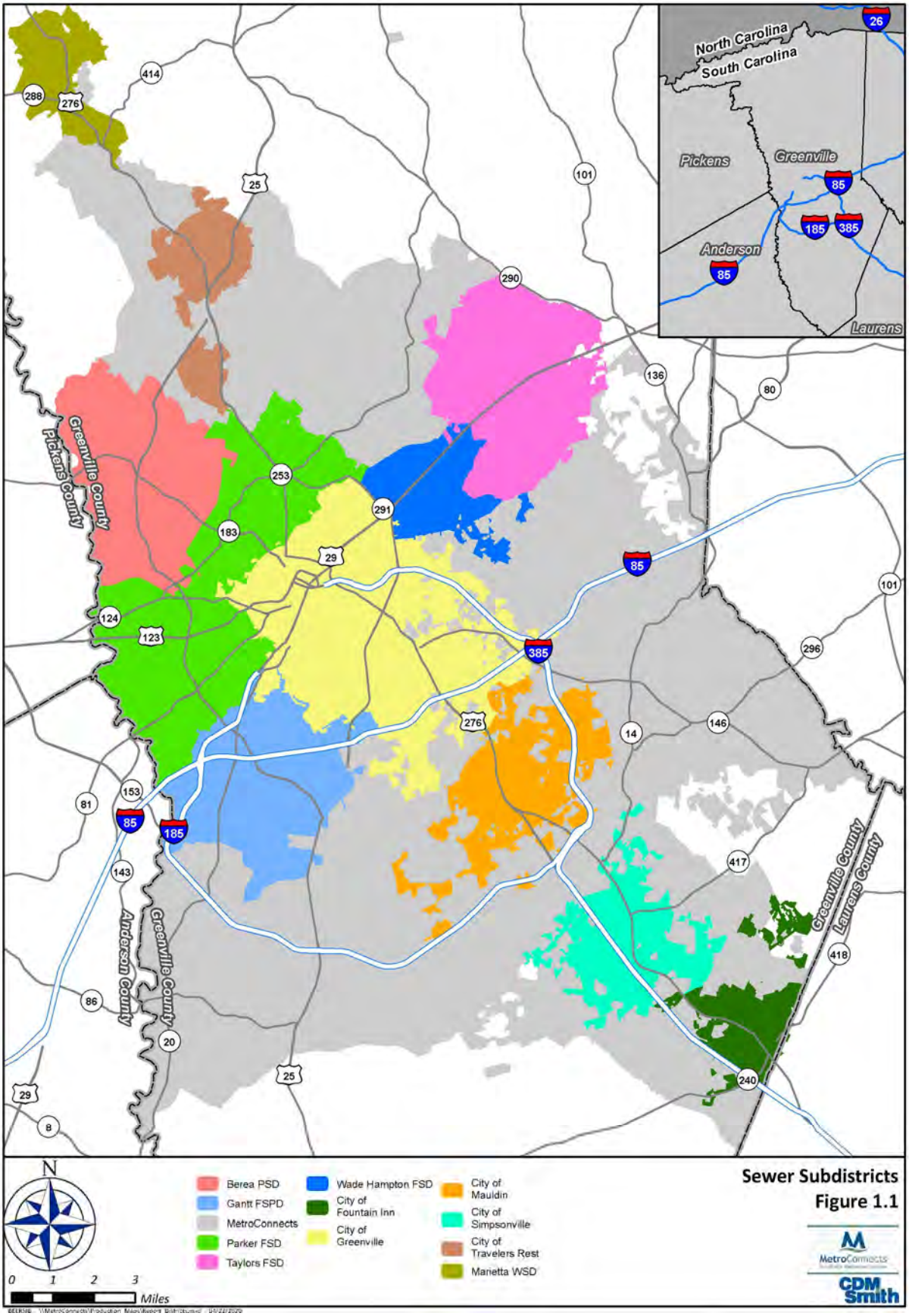
- City of Greenville (Study by Others)
- City of Greer (Non-Material Contributor)
- City of Mauldin (Did Not Participate)

1.1 Project Objective and Owner Requirements

Recently area leaders have sought to understand the current state of the wastewater collection systems in Greenville County. This study was initiated by the Metropolitan Sewer District (Metro Connects), one of the SPDs, to better understand and approximate the amount of deferred collection system renewal that currently exists in the systems, and to project the anticipated future needs within a planning period of 20-years. During workshops with the other Entities, the purpose of the study was stated as:

> *"Provide a planning level overview of estimated capital improvement needs for collection system renewal (gravity sewer mainline, manholes, and service laterals) to 'catch-up' for deferred system needs or anticipated near-term rehabilitation peak levels, in order to return the collection system to normal consistent levels of annual rehabilitation and extend the useful life of infrastructure."*

This study used collection system data provided through the cooperation of each Entity. This approach, as detailed later in this study document, then applied a cohort analysis technique often


North Carolina
South Carolina
Pickens
Greenville
Anderson
Laurens
Greenville County
Pickens County
Anderson County
Laurens County
N
0 1 2 3
Miles
Berea PSD
Gantt FSPD
MetroConnects
Parker FSD
Taylors FSD
Wade Hampton FSD
City of Fountain Inn
City of Greenville
City of Mauldin
City of Simpsonville
City of Travelers Rest
Marietta WSD
Sewer Subdistricts
Figure 1.1
MetroConnects
CDM Smith

used for infrastructure planning. The final output of the study shows the anticipated collection system renewal needs to return the structural integrity of the system to a level consistent with a proactive asset management approach to maintain sewer systems in good operating condition.

In an effort to better understand the impacts of aging infrastructure on the collection systems, MetroConnects initiated a planning-level study to better quantify each system's deferred renewal needs. The objective of this project is to provide a *planning-level overview* of estimated capital improvement needs for *collection system renewal* to 'catch-up' with *deferred system needs* and/or anticipated *near-term renewal peak levels*, in order to return the collection system to normal consistent *long-term levels of annual renewal*. Implementation of study findings is expected to improve system resilience through measures that restore the full structural integrity of the sewer, achieved either by full replacement or CIPP lining of the gravity sewer main and a fraction of the associated sewer manholes and laterals. The findings of this study will be used to facilitate discussion of regional approaches to address these needs.

1.2 Definitions

The following definitions are used frequently throughout this report:

- CIPP – Cured-in-Place Pipe, a continuous resin lining of the inside of a pipe that does not require excavation to install, restores the structural integrity of the pipe, and minimizes leakage into/out of the pipe.
- Deferred – Renewal that is needed (real or projected), that has not yet occurred.
- Infiltration and Inflow (I&I) – Surface water, rainfall-runoff, and/or groundwater that enters a sanitary sewer and impacts system capacities, often contributing to sanitary sewer overflows (SSOs).
- InfoMaster™ –The asset centric information management system licensed by Innovyze®.
- Mill Village – An area of the collection system typically built in the 1920's to 1930's; composed of clay pipe nearing the end of its useful life; located in alleyways, under buildings, and in other hard to access locations presenting specific maintenance and operation challenges; and providing less hydraulic capacity than current standards. Renewal of these systems typically requires full replacement.
- Planning Period – a near-term 'planning period' for this study has been set at 20 years
- Renewal – restoring the useful life of an asset by full rehabilitation (i.e., a CIPP liner or equivalent) or replacement. Categorized as near-term renewal needs (projected over the next 20 years) and long-term renewal trends (projected beyond 20-years).
- Service Life – The point in the life of a pipe where complete renewal is required to restore full structural and functional capabilities.
- Service Life Curve – The probability that renewal will be needed for a pipe characterized by certain attributes (i.e., age, material, cross-section), determined based on industry standards and regional renewal histories.
- Water Resource Reclamation Facility – Facility owned and operated by ReWa where wastewater is treated.

1.3 General Approach

InfoMaster was used to develop long term, macro-level pipe renewal needs based on the amount of pipe installed over time and service life expectancy curves for the different types of pipe within the system. The study projects deferred, near-term, and long-term system renewal needs. Budget-level estimates can be applied based upon local, regional, and industry-standard estimates of the service life expectancy of gravity sewer pipes of different materials and ages. Three related projections are provided:

- ***Deferred system renewal*** needs/costs projected from system creation through 2019
- ***Near-term system renewal*** needs/costs projected between 2020 and 2040
- ***Long-term system renewal*** trends projected beyond 2040.

Findings are used to define potential near-term and long-term increases in funding necessary to reach a sustainable renewal level for each wastewater collection system.

There are many challenges in performing a planning study on 10 separate Entities, all with varying rehabilitation approaches, varying data collection and maintenance standards, and varying priorities. The study approach sought to develop standard data collection processes, and to apply a consistent approach to determine collection system renewal needs. There was a strong desire to develop and apply customized standards to improve the accuracy of the results. Critical standards developed and applied in the approach included developing customized pipe service life curves, consistent and defensible approaches to manhole and lateral renewal needs, and approaches for managing data gaps from the 10 various Entities. The approach used to develop system renewal needs is defined in Section 2 Methodology and summarized as follows:

- ***Step 1: Obtain and Assess Available Data –*** The wastewater collection system renewal analysis is driven by the specific pipe materials installed over time and the estimated service life expectancy curves for those pipe materials. System GIS data and questionnaires were completed by each Entity and used to determine the primary pipe attributes – pipe material and pipe installation date – needed to estimate the timing of collection system renewal needs.
- ***Step 2: Identify and Fill Data Gaps –*** Each Entity completed a questionnaire to confirm, provide, or estimate pipe ages by decade, and ages by decade were evenly distributed to each year within the decade. An approximated service life curve that represents the material types commonly found throughout the system was applied to define the life expectancy for any pipes with an unknown material.
- ***Step 3: Assess Sewer System Risk Factors*** – System risks were defined using available information on sewer system maintenance responsibilities/practices, condition inspections/assessments, and renewal history. Relationships between sewer age/condition and pipe service life were developed based on industry standards, regional data, and sewer condition/renewal histories provided by MetroConnects and a second large SPD Entity. The relative risk of failure of gravity sewer mains, manholes, and laterals; and a proportional breakdown of required renewal methods (i.e., CIPP lining, pipe busting, and pipe replacement) was also established to develop "cost per foot of renewal" factors.

- ***Step 4: Determine System Renewal Needs*** –The year when each gravity sewer main should be renewed is estimated by applying the system risk factors defined under Step 3 to the gravity collection system lengths by age and pipe material developed under Steps 1 and 2. Then, for each year, the length of pipe, number of manholes, and number of laterals requiring renewal is determined and a renewal cost estimated. Deferred system renewal needs are defined as the projected renewal needs less actual renewal achieved through 2019. Deferred renewal is added to projected annual future renewal needs to determine total renewal requirements over a 20-year planning period as well as long-term renewal trends. Total estimated costs are determined by asset type (i.e., sewer mains, manholes, and laterals) for each Entity and totaled to define renewal needs within the Study Area. These projected renewal needs can serve as input to future discussions on collaborative programming and financing of renewal requirements.

Findings for each Entity are presented in Sections 3 through 13.

1.4 Assumptions and Limitations

The following general assumptions apply to this study. Additional assumptions pertaining to a specific Entity are presented in the associated section of this report:

- Study uses readily available and useable GIS information provided by each Entity and relies on Entity responses to questionnaires to verify the accuracy of GIS data and describe historic and current sewer maintenance and renewal practices.
- In an effort to provide a consistent, defendable comparison between the varied Entities, CDM Smith used a consistent data collection approach that could apply to all 10 Entities.
- The results of this study are planning level estimates only based on the information available and should not be construed as detailed cost estimates.
- Working with collection system data from 10 different entities posed unique challenges. Variances were frequently found in the submitted information including mapping data, historical records, data formatting, data consistency, GIS records, GIS data fields, pipe age detail, and other information. These variances required adjustments and assumptions by the project team. For significant variances discussions were held to clarify the entities response and ensure assumptions were within reason. The variances and assumptions that have been made have not materially impacted the validity of the results for this planning level study.
- While mitigation of I&I is not considered in the study, renewal recommendations may contribute to I&I mitigation requirements instituted by the regional collection and treatment authority (ReWa), affecting near-term and long-term renewal needs/costs.
- This study did not include capital improvement needs for future developments, such as new sewer extensions and/or capacity increased for existing sewers.
- Expected service life and sewer renewal costs/requirements are based upon industry standards and adjusted to match local observations of life expectancy as necessary to reflect data from previous investigations and renewal efforts provided by MetroConnects and a second large SPD. Sewer asset characteristics and renewal requirements are extrapolated from these two systems to other Entity collection systems according to the

methodology developed for this project. Site-specific investigations to define the attributes and condition of specific sewer assets is not included.

- The renewal requirements and costs of sewer assets presented in this report are valid for overall regional/systemwide planning/long-term budgeting and do not represent the renewal requirements/costs for specific sewer assets.
- Costs are in 2019 dollars and have not been accelerated. No planning-level contingency has been applied.

Section 2
Methodology

The following four-step methodology was used to evaluate deferred, near-term, and long-term gravity sewer system renewal needs for 10 Entities providing sewer service in Greenville County:

- Step 1: Obtain and Assess Available Data,
- Step 2: Identify and Fill Data Gaps,
- Step 3: Assess Sewer System Risk Factors, and
- Step 4: Determine System Repair / Renewal Requirements.

A cohort analysis approach was selected to best determine anticipated levels of wastewater collection system asset renewal. This approach, widely used for planning, was selected as the most appropriate approach due to:

- The need to develop a consistent approach for all 10 Entities,
- The need to develop an approach that could be applied in months, not years,
- The need to develop an approach that could use readily available information, not take years to develop costly input condition data.
- The need to accurately predict planning level asset renewal needs.

Project Purpose and Intent

The Study is intended to be:

- Planning level & approximate
- Focused on items that significantly impact the overall outcome
- Predicting the general levels of renewal that are anticipated over a given timeframe
- The best approach available based on timeline and information available

The Study is not intended to be:

- Accurate to an individual, specific year's renewal needs
- Accurate to a specific pipe
- Based on your system's current condition assessment
- Focused on reducing I/I or customer growth

Cohort analysis develops long term, macro-level pipe renewal needs based on the amount of pipe installed over time and service life expectancy curves for the different types of pipe within the system. Within the analysis, pipe assets are grouped together by like attributes that may affect the lifespan of a pipe such as material. The goal of the analysis is to estimate annual system renewal needs that would be expected in past and future years. The cohort analysis findings are presented in Sections 3 through 9 for the seven Special Purpose Districts, in Sections 10 through 12 for the 3 Municipalities, and in Section 13 for collections system operated by Renewable Water Resources (ReWa).

During the data collection and the analysis steps, it became obvious that pump stations and force mains were not a significant factor. Entities either had no pump station or very few that would impact the analysis in a material way. For that reason, pump station and force main assets were removed from the study.

2.1 Step 1: Obtain and Assess Available Data

The wastewater collection system renewal needs analysis is driven by the specific pipe materials installed over time and the estimated service life expectancy curves for those pipe materials. Questionnaires completed by each Entity provided the following supporting data for this Study:

- The footage, age, size, and material of the sewer pipes and manholes.
- The estimated number of active and inactive laterals in each system and the Entity's approach to lateral ownership and maintenance.
- Any Mill Village areas served by the Entity's sewer system.
- The Entity's historic system inspection, condition assessment, maintenance, and renewal practices, and existing system performance.

Questionnaires were pre-populated with collection system attributes drawn from Entity GIS data. Each Entity was asked to confirm and supplement this information.

2.1.1 Wastewater Collection System Data

Table 2-1 summarizes the wastewater collection system data for each Entity, the major data input to this assessment of wastewater collection system renewal needs. This data was generally available from geographic information system (GIS) geodatabases developed by each Entity (except Marietta) and obtained by MetroConnects in early 2019. GIS data was extracted for each Entity and summarized in questionnaires sent to the Entities to either confirm (where data was generally complete) or supplement (where data gaps exist). The following wastewater system assets were characterized in this way:

Table 2-1. Overview of Collection System Characteristics by Entity

Entity Name	Gravity Sewer Mains		Manholes	Laterals		Force	Pump Stations	
	Total (miles)	Renewed (miles)	(number)	Active	Inactive	Mains (miles)	Number	Capacity (gpm)
Special Purpose Districts								
Berea Public Service District	113.0	9.2	2,931	6,782	>78	0.1	1	38
Gantt Fire, Police & Sewer District	104.5	4.4	2,886	5,500	0	0	0	0
Marietta Fire & Sewer District	16.7	1.5	426	530	~50	0	0	0
MetroConnects	661.4	68.1	19,170	44,575	4,794	8.4	8	3,355
Parker Fire & Sewer Subdistrict	264.3	28.6	7,602	15,393	3,444	1.3	6	339
Taylors Fire & Sewer District	133.3	16.2	3,720	9,022	2,378	0.9	3	345
Wade Hampton Fire & Sewer Dist.	67.0	9.8	1,644	5,739	0	0	0	0
Subtotal	**1,360.2**	**137.8**	**38,379**	**87,541**	**10,616**	**10.7**	**18**	**4,077**
Municipalities								
City of Fountain Inn	58	13.2	1,413	4,020	200	0.7	1	275
City of Simpsonville	101.1	32.5	2,479	7,150	350	0	0	0
City of Travelers Rest	29	5.7	802	1,600	80	2.5	1	208
Subtotal	**188.1**	**51.4**	**4,694**	**12,770**	**630**	**3.2**	**2**	**483**
Total	**1,548.3**	**189.2**	**43,073**	**100,311**	**11,246**	**13.9**	**20**	**4,560**

- ***Gravity Main*** data used for this evaluation consisted of sewer lengths categorized by diameter, material, and installation date. Most Entities were able to provide summaries of sewer length by diameter and material, however most had significant gaps in installation date. The questionnaires requested lengths by installation decade, which were either completed in the questionnaire or determined through subsequent calls. From this effort, a relatively complete set of gravity sewer main characteristics was collected for each Entity. The age data is critical to the cohort analysis and each Entity worked to provide this information.
- ***Manhole*** data used for this evaluation consisted of manhole counts by material and installation date. Other than counts of total manholes, significant gaps existed in the availability of age data and consistency of material data. As such, manholes were grouped with gravity mains for evaluation.
- ***Laterals/Service Connection*** data was largely limited to counts of active and inactive laterals, and a general description of ownership/maintenance responsibilities. Lateral data was largely defined through questionnaire responses, either directly or assumed based on the number of customers reported by the Entity. Lateral maintenance from buildings to the main is largely the responsibility of property owners in most Entities, and as such little lateral renewal was typically reported by the Entities.
- ***Pump Stations and Force Mains*** were typically depicted on GIS maps, with supporting information provided via questionnaire responses for pumps (i.e., type, ownership, capacity, and installation date) and force mains (i.e., length, material). In general, most pump stations and force mains were installed in the past 20 years and typically do not require significant renewal during the planning horizon for this study.

2.1.2 System Maintenance, Assessment, and Renewal History

The questionnaires distributed to each District/Municipality were the primary source of information for system maintenance, assessment, and renewal processes, providing the following information:

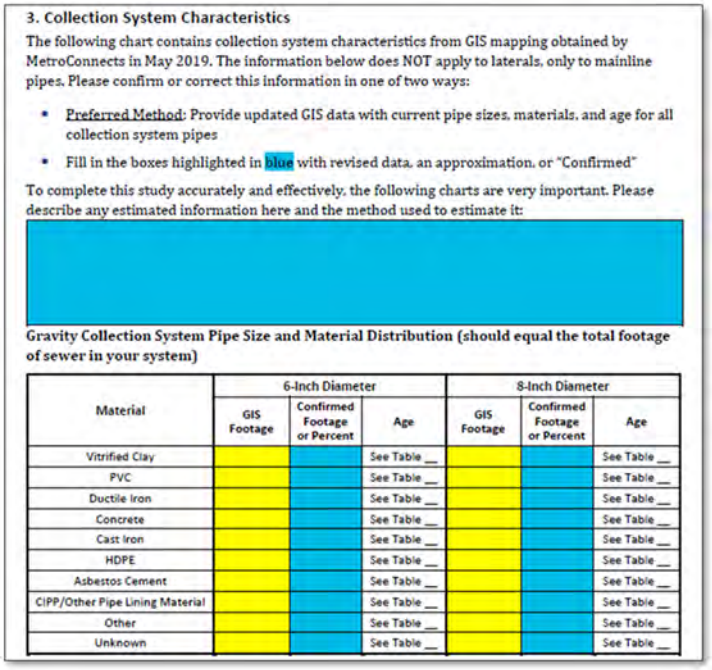
- ***Contact and Service Area Information***. Districts/Cities were asked to provide a contact for this study and information about the size of their service area and number of customers. Contact information and service area size was provided by most Entities. Mixed responses were received about number of customers, with some providing the population of their service areas, others providing customer accounts, and the remainder not responding to this question.
- ***System Condition Assessment and Maintenance***. Several questions were asked about each Entity's methods and requirements related to system condition assessment and maintenance:
  - *Gravity Main Assessments*. All Entities perform some level of system assessments, largely via CCTV surveys with a few using SL-RAT technology. Many perform assessments proactively to assess system condition or identify sources of I/I. No Entities reported non-maintenance-related hydraulic capacity constraints.

- *Gravity Main Root Control*. Most Entities control root intrusion within a portion of their system, using chemical treatment and/or hydraulic cutting. Many indicate that they install CIPP lining in mains with chronic root control problems.
- *Laterals*. A few Entities are responsible for maintaining laterals between the main and the property line, while the remainder responded that this is a property owner responsibility. Some Entities indicated that they have/will assess laterals while assessing the gravity main, and occasionally renew defective laterals in the context of a gravity main renewal project.

- ***Capital Improvement and Maintenance Projects***. All Entities reported some level of active programs to renew their gravity mains. These programs have achieved a varying level of renewal over the past 20-years, as reported for each Entity later in this report. System renewal projects typically focus on gravity mains, only addressing a small fraction of the manholes and performing "if-convenient" or no repair of laterals. A few Entities have ongoing plans for further system renewal projects, while others are awaiting findings of system assessment activities. No pump station or force main repairs were reported, as most of this infrastructure has been installed within the last 20 years.

2.2 Step 2: Identify and Fill Data Gaps

After the questionnaires (**Figure 2-1)** were returned and reviewed, CDM Smith followed up with each Entity to ensure critical information gaps were filled as best as possible. Common areas that required follow-up included getting pipe age by decade for all pipes, understanding past rehabilitation and renewal efforts, and lateral count and ownership approach. Occasionally, missing pipe ages were estimated based on the age of neighboring pipes.



3. Collection System Characteristics

The following chart contains collection system characteristics from GIS mapping obtained by MetroConnects in May 2019. The information below does NOT apply to laterals, only to mainline pipes. Please confirm or correct this information in one of two ways:

- Preferred Method: Provide updated GIS data with current pipe sizes, materials, and age for all collection system pipes
- Fill in the boxes highlighted in blue with revised data, an approximation, or "Confirmed"

To complete this study accurately and effectively, the following charts are very important. Please describe any estimated information here and the method used to estimate it:

Gravity Collection System Pipe Size and Material Distribution (should equal the total footage of sewer in your system)

Material	6-Inch Diameter			8-Inch Diameter		
	GIS Footage	Confirmed Footage or Percent	Age	GIS Footage	Confirmed Footage or Percent	Age
Vitrified Clay			See Table __			See Table __
PVC			See Table __			See Table __
Ductile Iron			See Table __			See Table __
Concrete			See Table __			See Table __
Cast Iron			See Table __			See Table __
HDPE			See Table __			See Table __
Asbestos Cement			See Table __			See Table __
CIPP/Other Pipe Lining Material			See Table __			See Table __
Other			See Table __			See Table __
Unknown			See Table __			See Table __

Figure 2-1. Excerpt from Questionnaireon Collection System Characteristics and Operating Practices

Once this was completed, information was sufficient to perform a cohort analysis to determine renewal needs for each Entity. An approximated service life curve that represents the material types commonly found throughout the system was applied to define the life expectancy for any pipes with an unknown material. To run the cohort analysis, the powerful software InfoWorks was used. InfoWorks requires each pipe to have an install date in order to apply the service life curve and project its anticipated failure year. For this reason, pipes that did not have an install year in the GIS had an approximated age assigned to them. First, questionnaires completed by each District/Municipality provided actual or estimated pipe ages by decade, which were evenly distributed to each year with the decade. Any remaining missing pipe ages were assigned by

InfoMaster based on the age of neighboring pipes. It is important to note that the analysis is a long-term forecasting tool, and, while accuracy of the data is important, minor inaccuracies in data or estimation of data is expected and will not affect the "macro" analysis greatly as long as the majority of the pipe asset data are accurate. As the Entities continue to verify the material/age of unknown pipes in their system, the long-term renewal analysis can be updated with the revised information.

2.3 Step 3: Assess Sewer System Risk Factors

System risks were defined using available information on sewer system maintenance responsibilities/practices, condition inspections/assessments, and renewal history. Relationships between sewer age/condition and pipe service life were developed based on industry standards, regional data, and SPDs with adequate sewer condition/renewal histories (i.e., MetroConnects and Taylors). The relative risk of failure of gravity sewer mains, manholes, and laterals; and a proportional breakdown of required renewal methods (i.e., CIPP lining, pipe busting, and pipe replacement) was also established to later develop "cost per foot of renewal" factors.

2.3.1 Lifespan / Service Life Expectations

To perform the analysis, service life curves were developed based on the material types seen in the various District/Municipality systems. Developing the service life curve is the most critical factor in the study and a significant driver of:

- Renewal timelines
- Deferred pipe quantity
- Costs

Vitrified Clay Pipe (VCP) was the primary focus due to high volumes in all systems, and the typically older ages of clay pipe will have a larger impact on deferred and 20-year planning period.

Expected service life is defined as the point in the life of a pipe where complete renewal is required to restore full structural and functional capabilities. The ***service life curve*** defines the probability that full renewal will be needed for a pipe characterized by certain attributes (i.e., age, material, cross-section), determined based on industry standards and regional renewal histories. This does not mean that a pipe may not have an issue requiring maintenance or repair, but simply that it will have acceptable performance to that date.

Service life curves in the InfoMaster model are typically defined by three points. While the values are customizable, the initial point on each curve is typically the date at which 90-percent of the pipes are expected to provide acceptable service without needing to be replaced. The second point on each curve is typically the date when 50-percent of the pipes are still providing acceptable service, and then the final point on each curve is the date when only 10-percent of the pipes will still provide acceptable service.

Initial service life values were developed in 2013 based on a review of industry standards and previous experience with other municipalities and national clients with similar pipe ages and materials. Pipe service life values from the American Water Works Association's (AWWA) report

entitled *Buried No Longer: Confronting America's Water Infrastructure Challenge* (AWWA, 2010), were referenced and used as a guide.

Figure 2-2 compares published industry standard sewer service life expectancy (grey line in the graph) with the actual service life of MetroConnects' VCP gravity mains that have recently been rehabilitated and/or inspected. The circular data points on the graph represent the percent of pipes of a certain age that are currently determined to be in either poor condition (i.e., a condition rating of 4) or very poor condition (i.e., a condition rating of 5) on a scale from one to five. Comparison of the graphs indicates that published industry standard sewer service life expectancy is somewhat longer than the actual sewer life expectancy of MetroConnect's gravity sewer mains. While MetroConnects' system is somewhat newer than the other systems, MetroConnects has embarked on a proactive renewal program to minimize future emergency service repairs. To account for this, a somewhat less aggressive service life estimate (yellow line in the graph) was selected for this evaluation, defined as a weighted average of the Metro experience and published industry standards.

The points on Figure 2-2 labeled "System 2" were derived from questionnaire responses on renewal histories that were provided by Taylors SPD. While these responses were not as detailed as the renewal histories provided by MetroConnects, the graph shows that the service life of Taylors' system correlates well with MetroConnects' system, providing further confidence in the service life curves derived for Greenville County VCP pipelines.

Figure 2-3 graphically depicts the sewer system service life estimates developed for this study based on the methodology described above, which are also listed on **Table 2-2**. Similar adjustments were performed on the service life curve for Ductile Iron Pipe (DIP), where

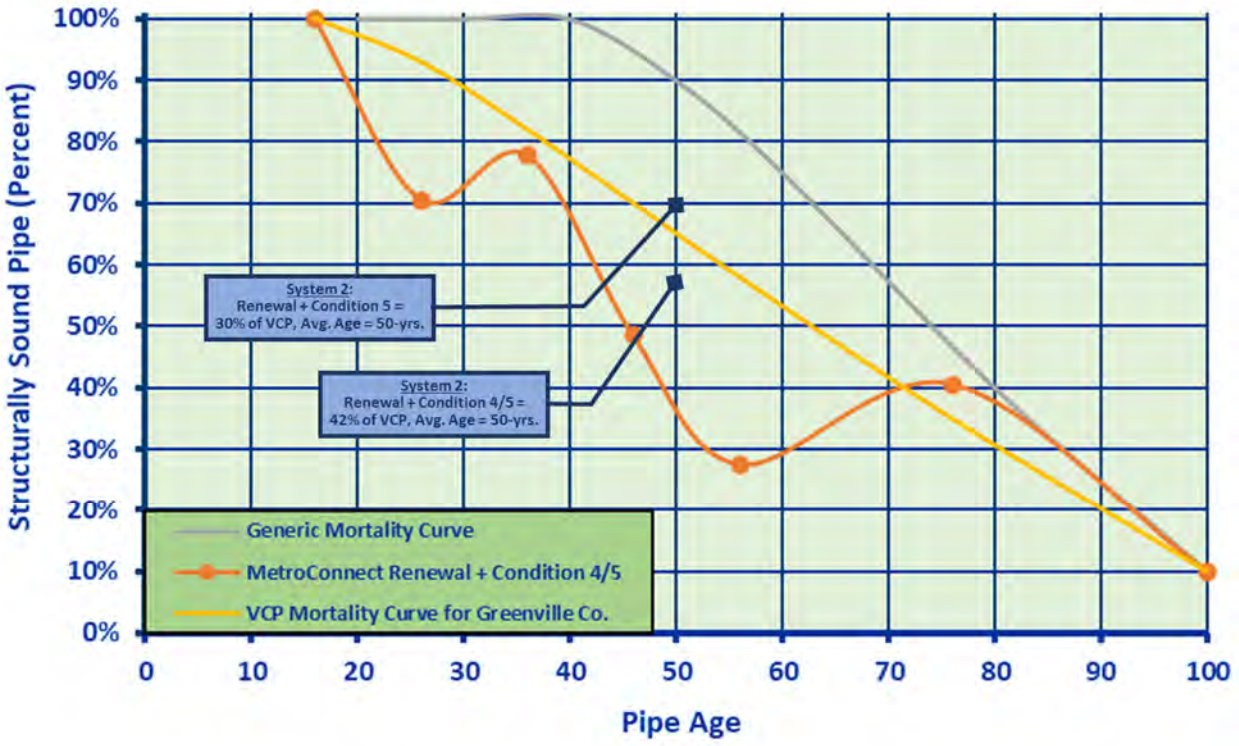


Figure 2-2. Development of the VCP Mortality Curve for Greenville County

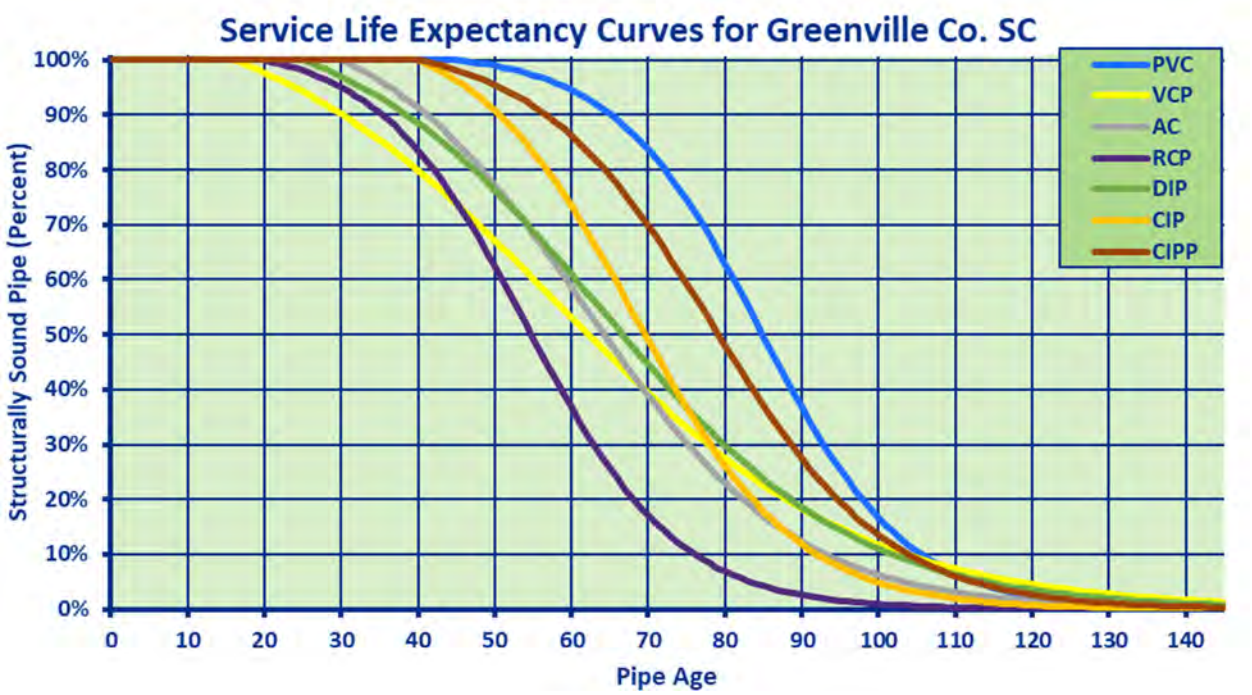


Figure2-3. Service Life Expectancy Curves for Greenville Co. South Carolina

Table 2-2. Gravity Sewer Service Life Expectancy Values Used in the Long-Term Renewal Analysis

Pipe Material	Group	Pipe Age			
		100% of Pipe Life Remaining	90% of Pipe Life Remaining	50% of Pipe Life Remaining	10% of Pipe Life Remaining
Reinforced Concrete	RCP	20	35	55	75
Cast Iron Pipe	CIP	40	50	70	90
Clay Pipe, Terracotta Pipe, and Vitrified Clay	VCP	16	29	63	100
Ductile Iron Pipe, Steel Pipe (Cond 4/5)	DIP	25	38	67	100
Polyvinyl Chloride, HDPE, Acrylonitrile Butadiene	PVC	45	65	85	105
Other, FRP, PSC, RPT	OTH	30	40	65	90
Unknown	UNK	35	50	75	100
Cured in Place Pipe Lined*	CIPP	40	55	80	100

MetroConnects also has pipe condition and renewal history data. No adjustments from industry standards were made to the service life curves for other pipe materials, where limited pipe condition/renewal history data was available. In addition, MetroConnects' polyvinyl chloride (PVC) pipe is significantly newer, with little data available to substantiate a deviation from industry standards at this time.

2.3.2 Methodology for Estimating Renewal Costs

Bid tabulations were reviewed and summarized for several recent sewer renewal projects performed by MetroConnects. These projects involved a range of CIPP lining, gravity main replacement, and associated manhole and lateral renewal. Bid tabulations for the low bidder on

each project were used to define a range of characteristic sewer renewal costs, including ancillary items such as mobilization/pre-construction activities and surface/street restoration requirements.

Bid tabulations for three sewer renewal projects in Columbia SC were also evaluated in a similar manner to contribute to understanding of projected unit costs. Columbia has an aggressive, long-term program underway for sewer rehabilitation, which is yielding higher construction costs in general as the capacity of the local contractors is maximized and additional regional/national firms are entering the market. As a result, Columbia unit prices are considered somewhat more indicative of anticipated costs as the amount of sewer renewal work increases to address aging infrastructure. Consequently, the unit prices used for this study are a blend of historic upstate and downstate renewal costs. **Table 2-3** summarizes the findings of this evaluation, defining the following per-unit costs used to estimate total sewer renewal needs over the planning period:

- *Gravity Sewer Main Renewal*: an average cost of $93.00 per foot, (which is a blended rate of CIPP lining, pipe bursting, and pipe replacement projects).
- *Gravity Sewer Main Replacement (inside Mill Villages)*: an average cost of $210.00 per foot, (which is a representative rate for pipe replacement projects, assuming 12-foot wide pavement replacement, 25 percent of sewer within an SCDOT roadway that requires flowable fill as a backfill material, and 20 percent requiring curb and gutter replacement).

Table 2-3. Development of Renewal Unit Costs from South Carolina Bid Tabulations

Pipe Diameter (inches)	Percent of Total	Average Construction Cost		Estimated Greenville Co. Construction Cost (per ft)	Breakdown by Renewal Method	Manhole Renewal (per MH)	Lateral Renewal (per Lateral)
		Metro (per Ft)	Columbia (per ft)				
Renewal Method: CIPP							
8	88%	$35.49	$60/70	$55.00	88%		
10	7%	---	$66/69	$60.00			
12	5%	---	$77.31	$70.00			
Subtotal	**100%**			**$56.10**			
Renewal Method: Pipe Busting							
8	85%	---	$118.73	$105.00	8%		
10	10%	---	$156.09	$140.00			
12	5%	---	$363.53	$225.00			
Subtotal	**100%**			**$114.50**			
Renewal Method: Replacement (Including Abandonment of Existing Sewer)							
8	95%	$287.52	$345.47	$300.00	4%		
10	0%		---	$325.00			
12	5%		$379.00	$360.00			
Subtotal	**100%**			**$303.00**			
				Weighted Average Unit Construction Cost:	**$71**	**$2,500**	**$4,000**
				Construction Contingency @ 10%	$7	$300	$400
				Blended Unit Construction Costs:	**$78**	**$2,800**	**$4,400**
				SSES/Professional Services During Design @ 12%	$9	$300	$480
				Professional Services During Construction @ 5%	$4	$100	$200
				General Administration & Legal @ 4%	$3	$160	$160
				Blended Unit Project Cost:	**$93**	**$3,300**	**$5,200**

- *Manhole Renewal*: an average cost of $3,300 per manhole for full cementitious lining/coating.
- *Lateral Renewal (from main to property line):* an average cost of $5,200 per lateral, largely based on replacement costs.

These unit costs are based upon the actual cost of renewal projects in South Carolina using a blend of technologies (i.e., pipe bursting, CIPP, etc.) and site conditions and the following assumptions:

- Unit construction costs include costs for installation, mobilization, pavement removal/ replacement, erosion and sediment control, bypass pumping, initial CCTV assessments, testing, and a 10% construction contingency.
- Professional services during design (12% of construction costs), construction (5% of construction costs), and general administrative/legal costs (4% of construction costs).
- No planning level contingencies are included; all dollars are in 2019 dollars.

2.4 Step 4: Determine System Renewal Needs

The year where renewal of each gravity sewer main is most likely is estimated by applying the system risk factors (service life curve) defined under Step 3 to the gravity collection system lengths by age and pipe material developed under Steps 1 and 2. Then, for each year, the length of pipe, number of manholes, and number of laterals requiring renewal is determined and a renewal cost estimated.

Deferred system renewal needs are defined as the projected renewal needs less actual renewal achieved through 2019. Deferred renewal is added to projected annual future renewal needs to determine total renewal requirements over a 20-year planning period as well as long-term renewal trends. Total estimated costs are determined by asset type (i.e., sewer mains, manholes, and laterals) for each District/Municipality, and totaled to define renewal needs within the County. These projected renewal needs can serve as input to future discussions on collaborative programming and financing of renewal requirements.

2.4.1 Methodology for Estimating Renewal Needs Inside Mill Villages

Sewers associated with Mill Villages are generally much older and often located outside roadway rights-of-way (e.g., in alleys, on private property, etc.) As such, the entire system within the Mill Village area is targeted for replacement during the near-term (20-year) planning period. The following methodology and assumptions were used:

- Boundaries of Mill Villages provided by MetroConnects and/or the Subdistrict were superimposed on the gravity sewer main alignments provided in the Subdistrict GIS.
- Gravity sewer mains within each Mill Village boundary were assumed to be associated with the Mill Village and separated from the remaining gravity sewer mains.
- The new gravity sewer system inside the Mill Villages is assumed to require 85 percent of the existing gravity sewer main length based on actual metrics of gravity sewer mains recently replaced by MetroConnects within two Mill Villages.

- New manholes will be installed along the entire length of the replacement gravity main, assumed to be located at the same average spacing as the existing system.
- New laterals will be installed from the gravity main to the property line for every active customer along the entire length of the replacement gravity main. In addition, laterals will be extended from the property line to the building for 50 percent of the properties where a new lateral alignment is required to connect to the relocated gravity main.

2.4.2 Methodology for Estimating Sewer Main Renewal Needs Outside Mill Villages

Future gravity main renewal requirements for the various Entities were determined in the following manner:

- Sewer lengths within each pipe material/age category are based on the information provided by the District/Municipality, as summarized earlier in this section. Pipe footage assigned to a certain decade was equally distributed over the 10-year period.
- Sewer pipeline/service life relationships (i.e., the estimated service life of a pipe material type) were determined using industry experience and historic local/regional data relating pipe age to observed structural deterioration, as described in Section 2.3 of this report. (It is important to keep in mind that pipe age and material service life relationships may not fully address infiltration/inflow control needs.)
- The age of sewers replaced or rehabilitated with CIPP liner over the past 20 years were adjusted to the estimated date of renewal. Sewers receiving point repairs or short shots of CIPP liner are not considered to be fully renewed and their ages are based on their original installation date/material.
- The actual sewer age/material was compared to the sewer service life relationships to determine the approximate date when renewal of the sewer main is projected to be needed.

2.4.3 Methodology for Estimating Manhole and Lateral Renewal Needs

- For each segment of gravity sewer main scheduled for renewal each year, renewal is projected for 25 percent of the manholes (i.e., one in four) and 40 percent of the laterals (i.e., four in ten) associated with that gravity main section. These ratios for the planning period were supported by examining recent rehabilitation projects.
- The remaining manholes (75%) and laterals (60%) will need renewal at some point in the future, anticipated to be beyond the 20-Year Planning period used for financial projections.
- The number of manholes and laterals along a gravity sewer main segment are estimated based upon the systemwide average length of sewer mainline per manhole and per lateral.
- Past gravity sewer main renewal is assumed to have included needed manhole renewal.
- For past mainline renewal that did not include lateral renewal, 40% of laterals assumed to be located on that length of mainline are counted as deferred laterals.

2.4.4 Long-Term System Renewal Results

The evaluation methodology described in the previous three subsections was applied to determine the status of sewer renewal for a particular District/Municipality in 2019, project

near-term system renewal, and illustrate long-term renewal trends. Projected system renewal needs are estimated and graphed each year by pipe material, with projected renewal needs increasing as pipe inventory ages, diminishing as renewal occurs, and typically increasing again to represent the next cycle of system renewal. Three figures are generated to illustrate this cycle:

- The first figure (**Figure 2-4)** "looks back" at past projected system renewal needs compared with actual system renewal achieved.
- The second figure (**Figure 2-5**) "looks forward" to near-term projected renewal needs during a 20-year planning period (i.e., FY2020 through FY2040) and continuing until 2080 to reveal long-term sewer renewal trends. Deferred renewal needs are the difference between the "look back" projection of projected needs and the actual system renewal achieved, spread across a 15-year time period starting in 2021.
- The third figure (**Figure 2-6)** illustrates the estimated annual renewal costs for near term sewer renewal, deferred system renewal, and replacement of sewers in Mill Villages, each determined using the cost estimating methodology presented earlier in this section and distributed over the 20-year planning period established for this project.

The cohort analysis findings are presented in Sections 3 through 9 for the seven Special Purpose Districts, in Sections 10 through 12 for the 3 Municipalities, and in Section 13 for collections system operated by Renewable Water Resources (ReWa).

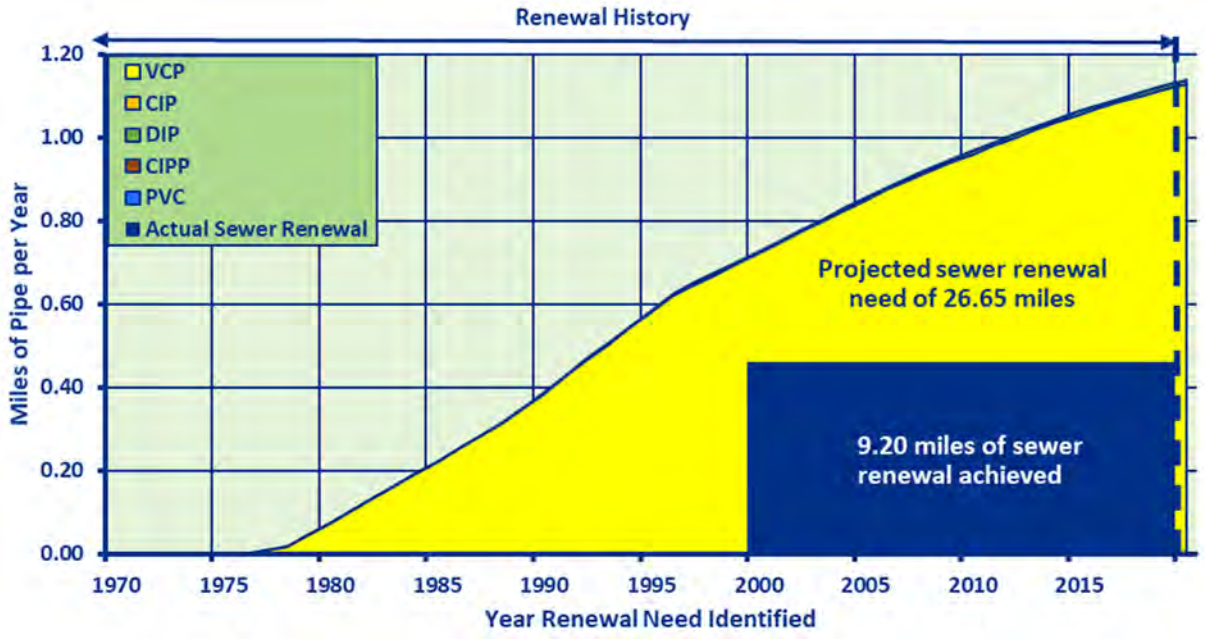


Figure 2-4. Example Illustration of Renewal History and Estimated Renewal Needs

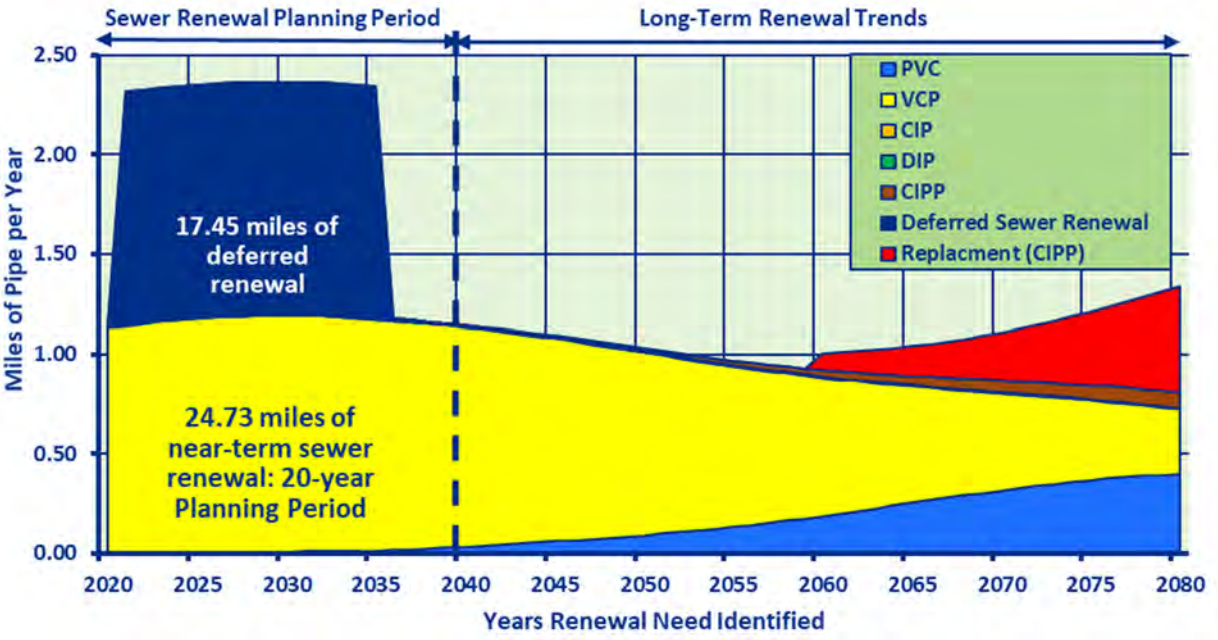


Figure 2-5. Example Illustration of Post 2019 Sewer Renewal Needs

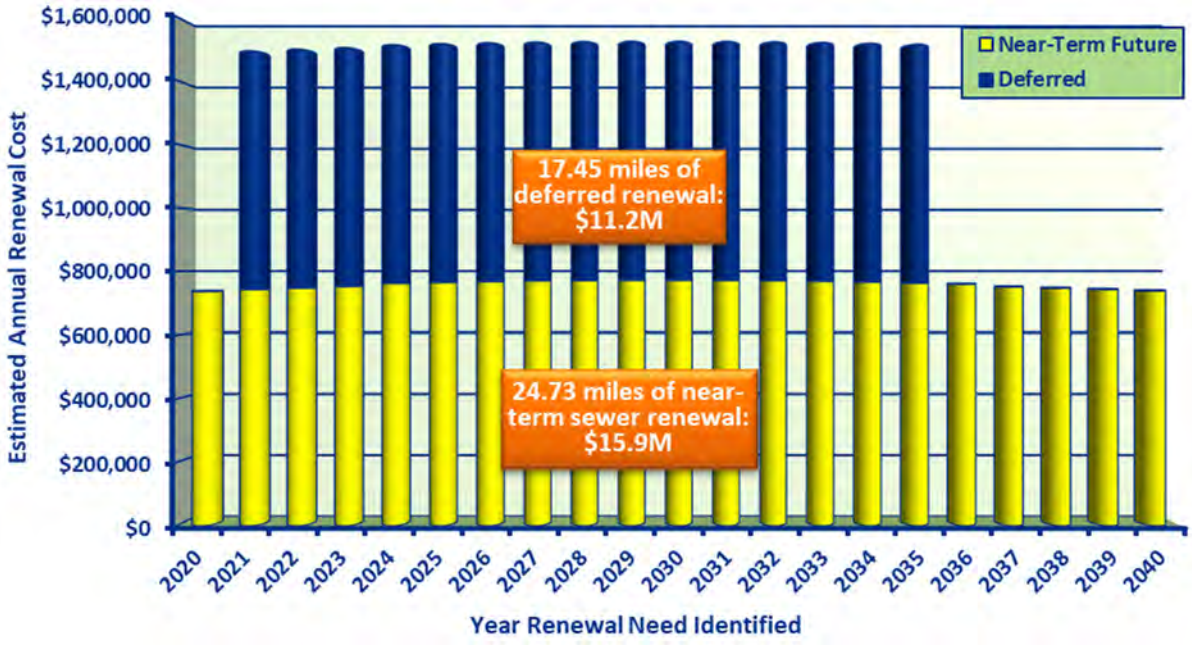


Figure 2-6. Example Illustration of Annual Near-Term Renewal Costs

Section 3

MetroConnects System Renewal Needs

The Metropolitan Sewer Subdistrict (MetroConnects) is one of seven special purpose districts providing wastewater collection services in Greenville County. This section characterizes the sewer system based on information provided by MetroConnects, summarizes historic assessment and renewal practices, highlights key assumptions specific to the MetroConnects system, estimates deferred system renewal, and defines anticipated future system renewal needs.

For this evaluation, system renewal is defined as measures that restore the full structural integrity of the sewer, achieved either by full pipe replacement or CIPP lining of the gravity sewer main and a portion of the associated sewer manholes and laterals. Point repairs do not fully renew a gravity main and are not accounted for in this evaluation.

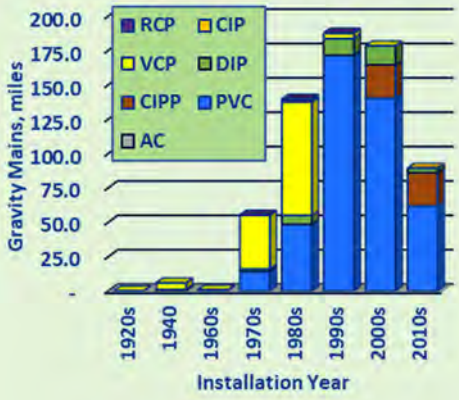
Key Facts:

Metropolitan Sewer Subdistrict

Service Area: 158 sq. mi.
Customers Served: 46,000

Gravity Sewer Mains

Total Length: 3,492,209 ft. (661.4 miles)
Renewal to date: 359,808 ft. (68.1 miles)
Number of Manholes: 19,170
Average Spacing: 182 ft per manhole



Laterals (Main to Property Line)

Active: 44,575 Inactive: 4,794
Average Spacing: 71 ft per lateral
Ownership/Maintenance: MetroConnects

Pump Stations and Force Mains

8 pump stations, total capacity=3,355 gpm
Length of Force Main: 44,244 ft. (8.4 miles)

System Characteristics

Area and Customers Served

MetroConnects provides wastewater collection to approximately 46,000 customers throughout a 158 sq. mi. service area within unincorporated portions of metropolitan Greenville County.

Gravity Mains and Manholes

MetroConnects operates 3,492,209 ft. (661.4 miles) of 6-inch through 21-inch diameter gravity main[1], largely built of polyvinyl chloride (PVC) pipe in the 1990's and 2000's. Approximately 10 percent of the gravity mains have been rehabilitated through 2019 with either a CIPP liner or a replacement pipe to address structural deterioration, I&I, and/or root intrusion. MetroConnects also has performed renewal on 120 manholes in association with sewer renewal projects, either replaced or lined with cementitious or epoxy based on location, need and H2S environment.

Laterals and Service Connections

MetroConnects is responsible for lateral maintenance from the main to the property line and its customers are responsible from the property line to the building. MetroConnects reports that they have renewed the publicly owned portion of 3,411 laterals (main to property line) via open cut replacement or CIPP lining, with the renewal approach determined based on cost (depth, location, length, bends, etc.). MetroConnects reports that 4,794 laterals are inactive – they were

[1] Based upon responses to questionnaire completed to support this study.

installed at each existing parcel during the installation of the gravity mains in anticipation of properties coming off septic and connecting to public sewer. Inactive laterals remain connected and are repaired as necessary during a CIPP renewal project.

Pump Stations and Force Mains

MetroConnects operates 8 pump stations (total capacity of 3,355 gpm) and 44,244 ft of force main, all built between 1994 and 2007. No pump station or force main renewal is included in this evaluation since these systems are relatively new and MetroConnects is systematically eliminating pump stations as its gravity sewer mains are extended.

System Assessment and Renewal History

MetroConnects is on an 8-year system assessment cycle of gravity sewer mains, manholes, and laterals using either CCTV, SL-RAT, or both; and typically budget $2-$2.5M for renewal through annual funding (not bonded). System areas with I&I and capacity concerns are given priority. Traditionally, MetroConnects has used a Targeted Renewal Approach consisting of three separate projects (SSES, Point Repair, and CIPP), targeting the oldest (typically clay) portion of MetroConnects' system that has not yet been renewed. Renewal is scheduled where significant root intrusion, structural deterioration, and/or I&I is discovered, and manholes are identified for renewal based on structural integrity and I&I. MetroConnects is now utilizing a Find-n-Fix approach that targets an area and is all inclusive, where the Contractor performs SSES for the consulting Engineer to review and issue work orders for immediate repair and CIPP installation.

Anticipated Renewal Needs

Methodology for Estimating Sewer Main Renewal Needs

Future gravity main renewal requirements for MetroConnects were determined in the following manner:

- Sewer pipeline/main service life relationships (i.e., the estimated service life of a pipe material type) were determined using industry experience and historic local/regional data relating pipe age to observed structural deterioration, as described in Section 2 of this report. (It is important to keep in mind that pipe age and material service life relationships may not fully address infiltration/inflow control needs.)
- Sewer lengths within each pipe material/age category are based on the information provided by MetroConnects, as summarized earlier in this section. Pipe footage assigned to a certain decade was equally distributed over the 10-year period.
- The age of sewers replaced or rehabilitated with CIPP liner over the past 20 years were adjusted to the estimated date of renewal. Sewers receiving point repairs are not considered to be fully renewed and their ages are based on their original installation date/material.
- The actual sewer age/material was compared to the sewer service life relationships to determine the approximate date when renewal of the sewer main is projected to be needed.

Methodology for Estimating Manhole and Lateral Renewal Needs

- For each segment of gravity sewer main scheduled for renewal each year, renewal is projected for 25 percent of the manholes (i.e., one in four) and 40 percent of the laterals (i.e., four in ten) associated with that gravity main section.

- The remaining manholes (75%) and laterals (60%) will need renewal at some point in the future, anticipated to be beyond the 20-Year Planning period used for financial projections.
- The number of manholes and laterals along a gravity sewer main segment are estimated based upon the systemwide average length of sewer mainline per manhole and per lateral.
- Past gravity sewer main renewal is assumed to have included needed manhole renewal.
- For past mainline renewal that did not include lateral renewal, 40% of laterals assumed to be located on that length of mainline are counted as deferred laterals.

Methodology for Estimating Renewal Costs

The following per-unit sewer renewal costs were used to estimate total renewal needs over the planning period: See Section 2 for details on unit cost development.

- *Gravity Sewer Main Renewal*: an average cost of $93.00 per foot, (which is a blended rate of CIPP lining, pipe bursting, and pipe replacement projects).
- *Manhole Renewal*: an average cost of $3,300 per manhole for full cementitious lining/coating.
- *Lateral Renewal (from main to property line): an average cost of* $5,200 per lateral, largely based on replacement costs.

These unit costs are based upon the actual cost of renewal projects in South Carolina using a blend of technologies (i.e.,) and site conditions and the following assumptions:

- Unit construction costs include costs for installation, mobilization, pavement removal/ replacement, erosion and sediment control, bypass pumping, initial CCTV assessments, testing, and a 10% construction contingency.
- Professional services during design (12% of construction costs), construction (5% of construction costs), and general administrative/legal costs (4% of construction costs).

Estimated Collection System Renewal Needs

The status of sewer renewal for MetroConnects in 2019 and projected future system renewal needs were determined according to the evaluation methodology summarized in the previous section. Projected system renewal needs are estimated and graphed each year by pipe material. Projected renewal needs increase as pipe inventory ages, diminish as renewal occurs, and typically increase again to represent the next cycle of system renewal.

Figure 3-1 "looks back" at past projected system renewal needs compared with actual system renewal achieved. **Figure 3-2** "looks forward" to near-term projected renewal needs during a 20-year planning period (i.e., FY2020 through FY2040) and continuing until 2080 to reveal long-term sewer renewal trends. Deferred renewal needs (as calculated in Figure 3-1) are shown in Figure 3-2 in addition to the projected annual renewal, spread across a 15-year time period starting in 2021. The following conclusions are drawn from this evaluation:

Figure 3-1. Metro Renewal History and Estimated Needs

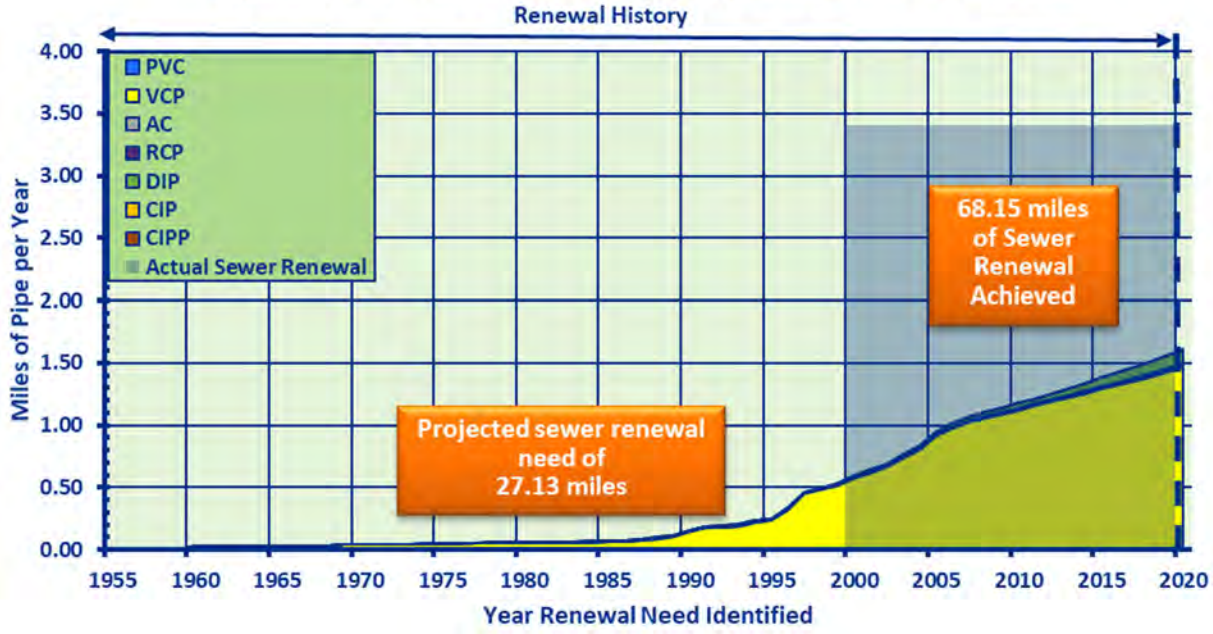
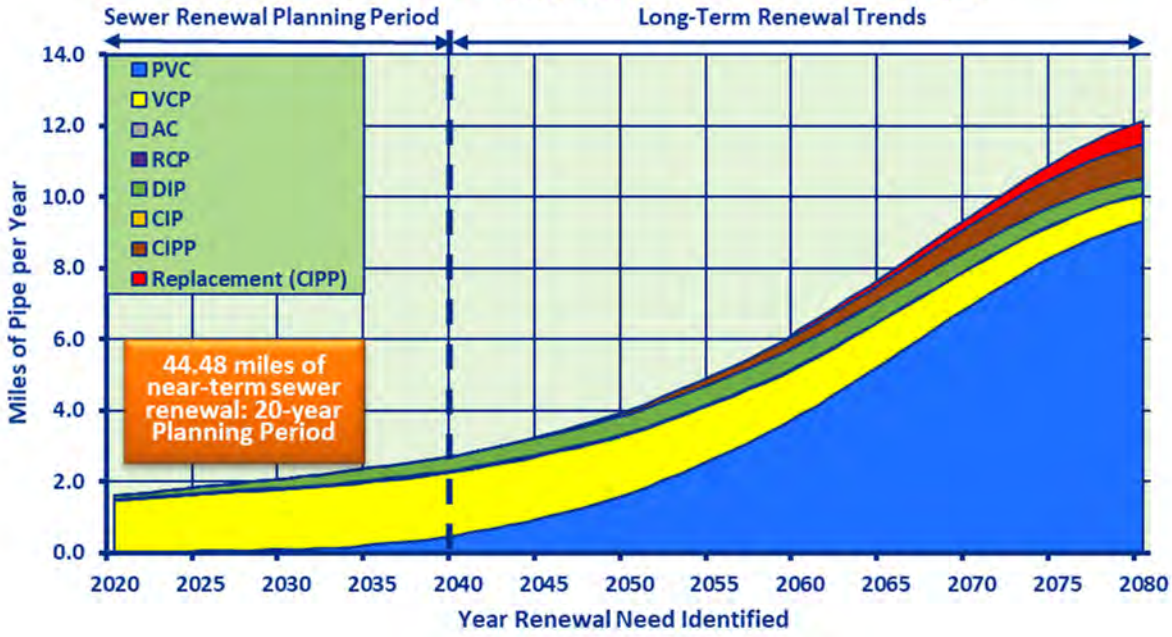


Figure 3-2. Metro Sewer Renewal Needs - Post 2019

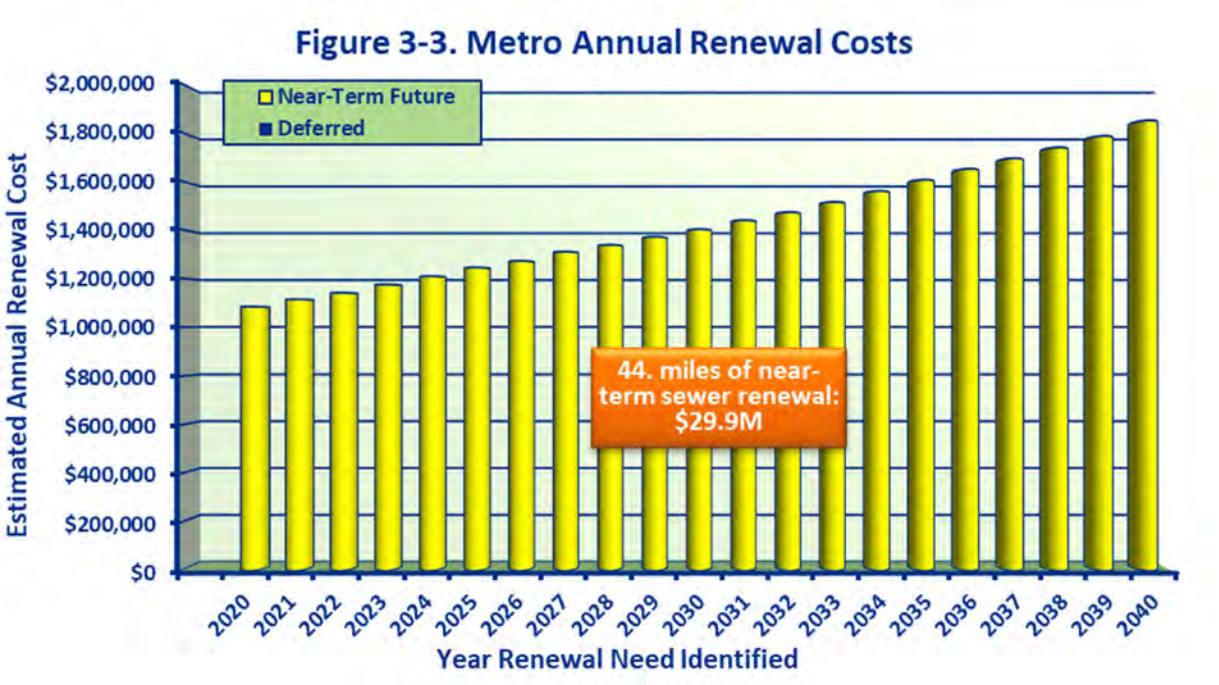


- **System Renewal Status.** The "look back" estimate depicted on Figure 3-1 projects system renewal needs of 27.13 miles, calculated as the sum of each year's projected renewal needs from inception through 2019. The blue shaded area on Figure 3-1 represents the 68.15 miles of gravity sewer renewal that MetroConnects has implemented since 2000, indicating that MetroConnects renewed more sewer than projected and has not deferred any projected gravity sewer renewal.

- **Projected Near-Term Renewal Needs.** Figure 3-2 shows that 44.48 miles of gravity sewer renewal is likely to be needed in the near-term (i.e., during a 20-year planning period from FY2020 through FY2040), increasing from 1.8 miles per year in 2020 to 2.6 miles per year in 2040. No deferred sewer renewal is projected in the near-term.
- **Projected Long-Term Renewal Trends.** Annual sewer renewal needs increase throughout the next 60-years, peaking somewhat after 2080 at over 12 miles per year.
- **Estimated Cost of Sewer Renewal**. **Figure 3-3** indicates that the estimated total renewal costs across the 20-year planning period are $29.9M in today's dollars. No deferred sewer renewal costs are projected, nor are costs to renew manholes/laterals not addressed under previous sewer renewal projects. Projected annual pipe lengths are shown in the graphs.

Estimated Renewal Costs between 2020 and 2040

Asset Type	Deferred Sewer Renewal		Near-Term Sewer Renewal	
	Quantity	Estimated Cost	Quantity	Estimated Cost
Gravity Sewers	0.00 miles	$0	44.48 miles	$21,840,000
Manholes	manholes	$0	335 manholes	$1,106,000
Laterals	laterals	$0	1,346 laterals	$7,000,000
Total		**$0**		**$29,946,000**



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Section 4

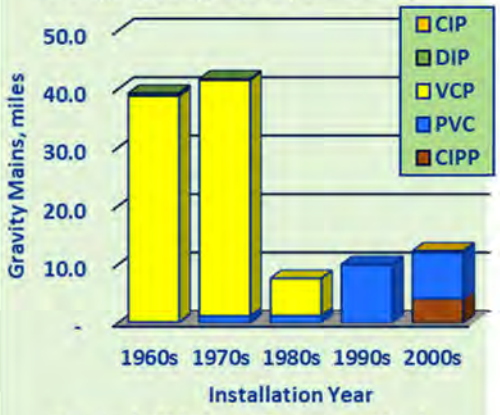
Berea Public Service District

The Berea Public Service District (Berea District) is one of seven special purpose districts providing wastewater collection services in Greenville County. This section characterizes the sewer system based on information provided by the Berea District, summarizes historic assessment and renewal practices, highlights key assumptions specific to the Berea District system, estimates deferred system renewal, and defines anticipated future system renewal needs.

For this evaluation, system renewal is defined as measures that restore the full structural integrity of the sewer, achieved either by full pipe replacement or CIPP lining of the gravity sewer main and a portion of the associated sewer manholes and laterals. Point repairs do not fully renew a gravity main and are not accounted for in this evaluation.

Key Facts:
Berea Public Service District
Service Area: 18.5 sq. mi.
Customers Served: 22,000

Gravity Sewer Mains
Total Length: 596,774 ft. (113.0 miles)
Renewal to date: 48,576 ft. (9.20 miles)
Number of Manholes: 2,931
Average Spacing: 204 ft per manhole



Laterals (Main to Property Line)
Active: 6,782 Inactive: >78
Average Spacing: 87 ft per lateral
Ownership/Maintenance: Berea PSD

Pump Stations and Force Mains
One pump station, total capacity = 38 gpm
Length of Force Main: 450 ft.

System Characteristics

Area and Customers Served

The Berea District provides wastewater collection to approximately 22,000 customers within an 18.5 sq. mi. service area within the unincorporated Berea area located in western Greenville County.

Gravity Mains and Manholes

The Berea District operates 596,774 ft. (113.0 mi) of predominantly 8-inch diameter gravity main[2], largely built of vitrified clay pipe (VCP) in the 1970's when sewer service was first established. Approximately 8 percent of the gravity mains have been rehabilitated since 2000 with a CIPP liner to address structural deterioration and/or address root intrusion. In addition, renewal measures ranging from bench repair to full cementitious lining have been performed on 31 manholes.

Laterals and Service Connections

The Berea District is responsible for lateral maintenance from the main to the property line, and its customers are responsible from the property line to the building. The Berea District reports that they have renewed the publicly owned portion of 414 laterals (main to property line) via open cut replacement and installation of a cleanout. The Berea District reports that more than 78 laterals are inactive – they were installed based on parcel delineation ahead of construction.

[2] Based upon responses to questionnaire completed to support this study.

Pump Stations and Force Mains

The Berea District operates one pump station (total capacity of 38 gpm) and 450 ft of force main, built in 2017. No pump station or force main renewal is included in this evaluation since these systems are relatively new.

System Assessment and Renewal History

The Berea District has performed a CCTV inspection on their entire gravity sewer system over the past 10 years. Approximately 70 percent of the inspections are performed proactively for condition assessment and/or I&I identification, with the remaining inspections in response to service requests. Root intrusion is treated with Dukes, followed with hydraulic cutting. Chronic problem areas are CIPP-lined based on SSES annual reports. Renewal projects are programmed into the District's CIP based upon these condition and maintenance inspections.

Anticipated Renewal Needs

Methodology for Estimating Sewer Main Renewal Needs

Future gravity main renewal requirements for the Berea District were determined in the following manner:

- Sewer pipeline/main service life relationships (i.e. the estimated service life of a pipe material type) were determined using industry experience and historic local/regional data relating pipe age to observed structural deterioration, as described in Section 2 of this report. (It is important to keep in mind that pipe age and material service life relationships may not fully address infiltration/inflow control needs.)
- Sewer lengths within each pipe material/age category are based on the information provided by the Berea District, as summarized earlier in this section. Pipe footage assigned to a certain decade was equally distributed over the 10-year period.
- The age of sewers replaced or rehabilitated with CIPP liner over the past 20 years were adjusted to the estimated date of renewal. Sewers receiving point repairs are not considered to be fully renewed and their ages are based on their original installation date/material.
- The actual sewer age/material was compared to the sewer service life relationships to determine the approximate date when renewal of the sewer main is projected to be needed.

Methodology for Estimating Manhole and Lateral Renewal Needs

- For each segment of gravity sewer main scheduled for renewal each year, renewal is projected for 25 percent of the manholes (i.e., one in four) and 40 percent of the laterals (i.e., four in ten) associated with that gravity main section.
- The remaining manholes (75%) and laterals (60%) will need renewal at some point in the future, anticipated to be beyond the 20-Year Planning period used for financial projections.
- The number of manholes and laterals along a gravity sewer main segment are estimated based upon the systemwide average length of sewer mainline per manhole and per lateral.
- Past gravity sewer main renewal is assumed to have included needed manhole renewal.

- For past mainline renewal that did not include lateral renewal, 40% of laterals assumed to be located on that length of mainline are counted as deferred laterals.

Methodology for Estimating Renewal Costs

The following per-unit sewer renewal costs were used to estimate total renewal needs over the planning period: See Section 2 for details on unit cost development.

- *Gravity Sewer Main Renewal*: an average cost of $93.00 per foot, (which is a blended rate of CIPP lining, pipe bursting, and pipe replacement projects).
- *Manhole Renewal*: an average cost of $3,300 per manhole for full cementitious lining/coating.
- *Lateral Renewal (from main to property line): an average cost of* $5,200 per lateral, largely based on replacement costs.

These unit costs are based upon the actual cost of renewal projects in South Carolina using a blend of technologies (i.e.,) and site conditions and the following assumptions:

- Unit construction costs include costs for installation, mobilization, pavement removal/ replacement, erosion and sediment control, bypass pumping, initial CCTV assessments, testing, and a 10% construction contingency.
- Professional services during design (12% of construction costs), construction (5% of construction costs), and general administrative/legal costs (4% of construction costs).

Estimated Collection System Renewal Needs

The status of sewer renewal for the Berea District in 2019 and projected future system renewal needs were determined according to the evaluation methodology summarized in the previous section. Projected system renewal needs are estimated and graphed each year by pipe material, with projected renewal needs increasing as pipe inventory ages, diminishing as renewal occurs, and typically increasing again to represent the next cycle of system renewal.

Figure 4-1 "looks back" at past projected system renewal needs compared with actual system renewal achieved. **Figure 4-2** "looks forward" to near-term projected renewal needs during a 20-year planning period (i.e., FY2020 through FY2040) and continuing until 2080 to reveal long-term sewer renewal trends. Deferred renewal needs (as calculated in Figure 4-1) are shown in Figure 4-2 in addition to the projected annual renewal, spread across a 15-year time period starting in 2021. The following conclusions are drawn from this evaluation:

- **System Renewal Status.** The "look back" estimate depicted on Figure 4-1 projects system renewal needs of 26.85 miles, calculated as the sum of each year's projected renewal needs from inception through 2019. The blue bar on Figure 4-1 represents the 9.20 miles of gravity sewer renewal that the Berea District has implemented since 2000. The difference of 17.45 miles is the projected gravity sewer renewal that has been deferred.

Figure 4.1 Berea PSD Renewal History and Estimated Needs

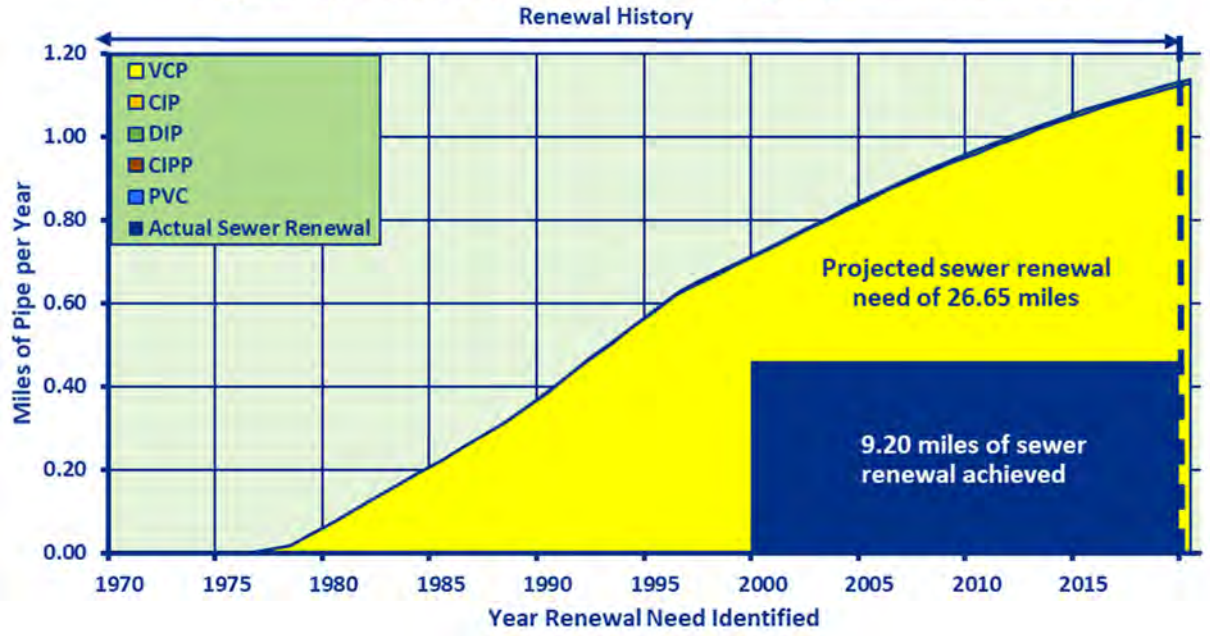
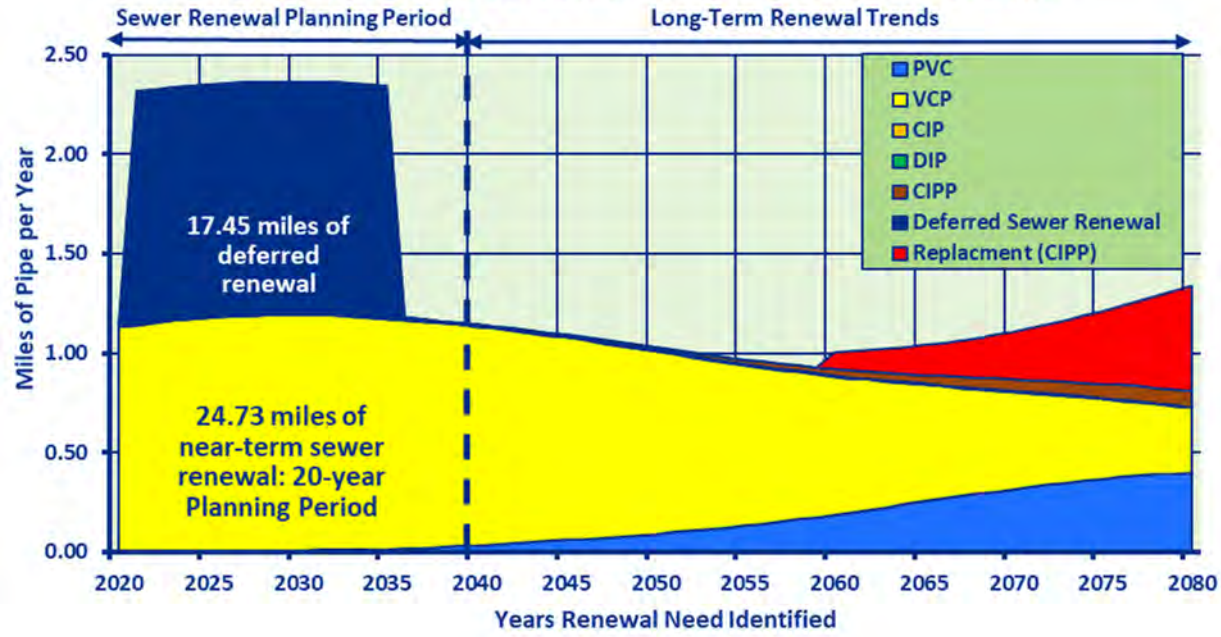


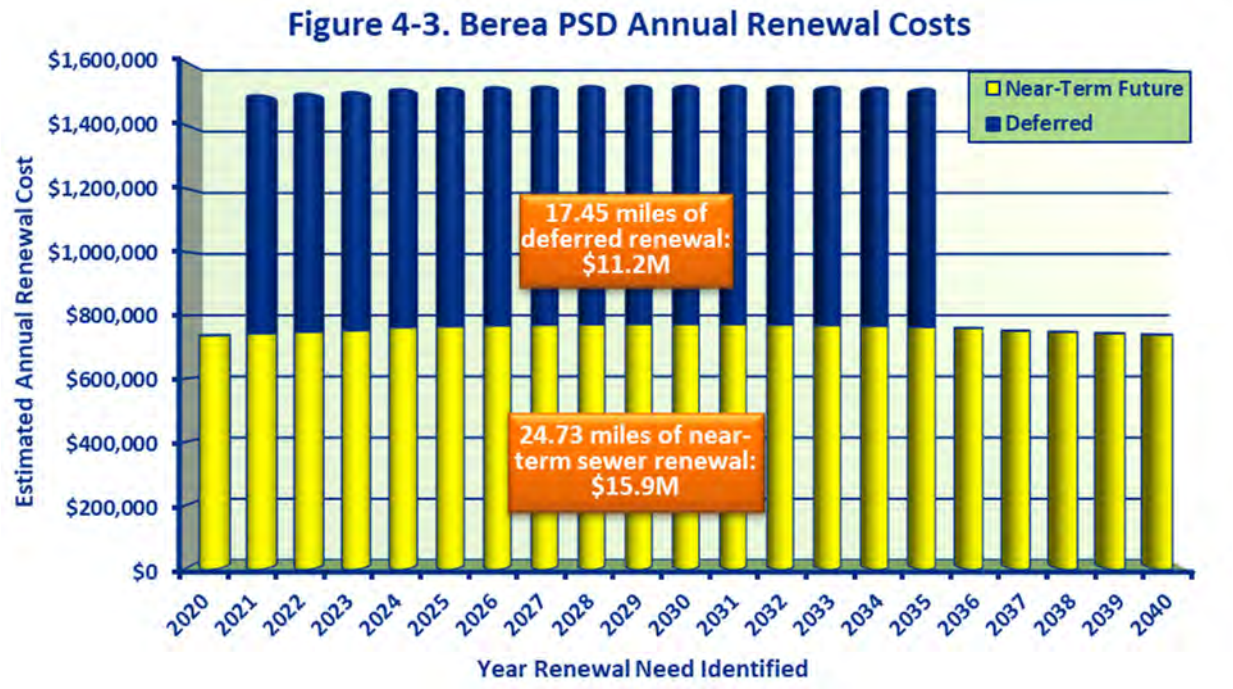
Figure 4.2 Berea PSD Sewer Renewal Needs - Post 2019



- **Projected Near-Term Renewal Needs.** Figure 4-2 shows that 24.73 miles of gravity sewer renewal is likely to be needed in the near-term (i.e., during a 20-year planning period from FY2020 through FY2040), peaking in 2030 at approximately 1.2 miles annually. If the 17.45 miles of deferred renewal is spread out over a 15-year period, an additional 1.2 miles of sewer renewal is required annually to "catch up".
- **Projected Long-Term Renewal Trends.** Annual sewer renewal needs decline between 2030 and 2060 to about 1.0 miles per year, then increase again between 2060 and beyond for the next cycle of system renewal.
- **Estimated Cost of Sewer Renewal**. **Figure 4-3** indicates that the estimated total renewal costs across the 20-Year Planning period are $27.2 M in today's dollars, inclusive of deferred sewer renewal costs, the cost to renew manholes/laterals not addressed under previous sewer renewal projects, and projected future sewer renewal costs. Projected annual pipe lengths are shown in the graphs. Deferred sewer renewal does not include any laterals that were not addressed on past pipeline renewal projects.

Estimated Renewal Costs between 2020 and 2040

Asset Type	Deferred Sewer Renewal		Near-Term Sewer Renewal	
	Quantity	Estimated Cost	Quantity	Estimated Cost
Gravity Sewers	17.45 miles	$8,569,000	24.73 miles	$12,146,000
Manholes	120 manholes	$396,000	168 manholes	$555,000
Laterals	435 laterals	$2,262,000	622 laterals	$3,235,000
Total		**$11,227,000**		**$15,936,000**



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Section 5

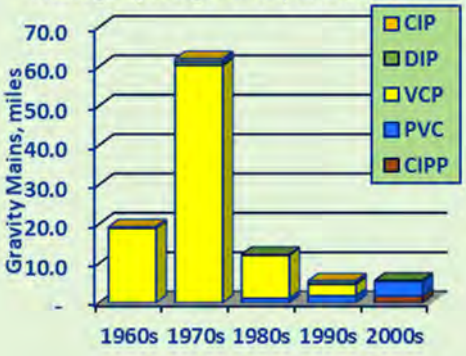
Gantt Fire, Police and Sewer District

The Gantt Fire, Police and Sewer District (Gantt District) is one of seven special purpose districts providing wastewater collection services in Greenville County. This section characterizes the sewer system based on information provided by the Gantt District, summarizes historic assessment and renewal practices, highlights key assumptions specific to the Gantt District system, estimates deferred system renewal, and defines anticipated future system renewal needs.

For this evaluation, system renewal is defined as measures that restore the full structural integrity of the sewer, achieved either by full pipe replacement or CIPP lining of the gravity sewer main and a portion of the associated sewer manholes and laterals. Point repairs do not fully renew a gravity main and are not accounted for in this evaluation.

Key Facts:
Gantt FPS District
Service Area: 14.8 sq. mi.
Customers Served: 14,500

Gravity Sewer Mains
Total Length: 551,970 ft. (104.5 miles)
Renewal to date: 23,375 ft. (4.4 miles)
Number of Manholes: 2,886
Average Spacing: 191 ft per manhole



Laterals (Main to Property Line)
Active: ~5,500 Inactive: 0
Average Spacing: 100 ft per lateral
Ownership/Maintenance: Customer

Pump Stations and Force Mains
No pump stations, total capacity = 0 gpm
Length of Force Main: 0 ft.

System Characteristics

Area and Customers Served

The Gantt District provides wastewater collection to approximately 14,500 customers within a 14.8 sq. mi. service area within the unincorporated Gantt area located in west-central Greenville County.

Gravity Mains and Manholes

The Gantt District operates 551,970 ft. (104.5 miles) of predominantly 8-inch diameter gravity main[3], largely built of vitrified clay pipe (VCP) in the 1960's and 1970's when sewer service was first established. Approximately 4 percent of the gravity mains have been rehabilitated since 2000 with a replacement sewer or a CIPP liner to address structural deterioration and/or address root intrusion. In addition, the Gantt District has replaced approximately 120 manholes to address renewal needs.

Laterals and Service Connections

Customers of the Gantt District are responsible for lateral maintenance from the main to the property line as well as from the property line to the building. The Gantt District reports that they have renewed approximately 30 laterals over the past 20 years for expedience during sewer renewal projects. The Gantt District did not report any inactive laterals but did state that multiple

[3] Based upon responses to questionnaire completed to support this study.

approaches are used during lateral installation, including front foot assessments, property owner/contractor-negotiated installation, and developer installation within new subdivisions.

Pump Stations and Force Mains

The Gantt District does not own or operate any pump stations or force mains.

System Assessment and Renewal History

The Gantt District has performed a combined SL-RAT/CCTV inspection on 60 percent of their gravity sewer system over the past 10 years. Nearly 90 percent of the inspections are performed proactively for condition assessment and/or I&I identification, with the remaining inspections in response to service requests. Root intrusion is mitigated with mechanical root cutting and Dukes root treatment, with CIPP used to maintain root intrusion. System renewal projects are prioritized based upon threat to public health or negative environmental impact, structural integrity, recurring Sanitary Sewer Overflows, excessive I&I, and reduction of normal flow capacity due to root intrusion. The current 10-year CIP, which extends to FY 2029, is designed to address all Priorities 1 – 2 (and manholes). The Gantt District is currently self-funding the Capital Rehabilitation Program and utilizes resources received from the annual Sewer Rehabilitation Fee. The Gantt District currently performs smoke testing for condition assessment of laterals and notifies the customer to repair or replace these defects.

Anticipated Renewal Needs

Methodology for Estimating Sewer Main Renewal Needs

Future gravity main renewal requirements for the Gantt District were determined in the following manner:

- Sewer pipeline/main service life relationships (i.e., the estimated service life of a pipe material type) were determined using industry experience and historic local/regional data relating pipe age to observed structural deterioration, as described in Section 2 of this report. (It is important to keep in mind that pipe age and material service life relationships may not fully address infiltration/inflow control needs.)
- Sewer lengths within each pipe material/age category are based on the information provided by the Gantt District, as summarized earlier in this section. Pipe footage assigned to a certain decade was equally distributed over the 10-year period.
- The age of sewers replaced or rehabilitated with CIPP liner over the past 20 years were adjusted to the estimated date of renewal. Sewers receiving point repairs are not considered to be fully renewed and their ages are based on their original installation date/material.
- The actual sewer age/material was compared to the sewer service life relationships to determine the approximate date when renewal of the sewer main is projected to be needed.

Methodology for Estimating Manhole and Lateral Renewal Needs

- For each segment of gravity sewer main scheduled for renewal each year, renewal is projected for 25 percent of the manholes (i.e., one in four) and 40 percent of the laterals (i.e., four in ten) associated with that gravity main section.

- The remaining manholes (75%) and laterals (60%) will need renewal at some point in the future, anticipated to be beyond the 20-Year Planning period used for financial projections.
- The number of manholes and laterals along a gravity sewer main segment are estimated based upon the systemwide average length of sewer mainline per manhole and per lateral.
- Past gravity sewer main renewal is assumed to have included needed manhole renewal.
- For past mainline renewal that did not include lateral renewal, 40% of laterals assumed to be located on that length of mainline are counted as deferred laterals.

Methodology for Estimating Renewal Costs

The following per-unit sewer renewal costs were used to estimate total renewal needs over the planning period: See Section 2 for details on unit cost development.

- *Gravity Sewer Main Renewal*: an average cost of $93.00 per foot, (which is a blended rate of CIPP lining, pipe bursting, and pipe replacement projects).
- *Manhole Renewal*: an average cost of $3,300 per manhole for full cementitious lining/coating.
- *Lateral Renewal (from main to property line): an average cost of* $5,200 per lateral, largely based on replacement costs.

These unit costs are based upon the actual cost of renewal projects in South Carolina using a blend of technologies (i.e.,) and site conditions and the following assumptions:

- Unit construction costs include costs for installation, mobilization, pavement removal/ replacement, erosion and sediment control, bypass pumping, initial CCTV assessments, testing, and a 10% construction contingency.
- Professional services during design (12% of construction costs), construction (5% of construction costs), and general administrative/legal costs (4% of construction costs).

Estimated Collection System Renewal Needs

The status of sewer renewal for the Gantt District in 2019 and projected future system renewal needs were determined according to the evaluation methodology summarized in the previous section. Projected system renewal needs are estimated and graphed each year by pipe material, with projected renewal needs increasing as pipe inventory ages, diminishing as renewal occurs, and typically increasing again to represent the next cycle of system renewal.

Figure 5-1 "looks back" at past projected system renewal needs compared with actual system renewal achieved. **Figure 5-2** "looks forward" to near-term projected renewal needs during a 20-year planning period (i.e., FY2020 through FY2040) and continuing until 2080 to reveal long-term sewer renewal trends. Deferred renewal needs (as calculated in Figure 5-1) are shown in Figure 5-2 in addition to the projected annual renewal, spread across a 15-year time period starting in 2021. The following conclusions are drawn from this evaluation:

Figure 5-1. Gantt FSPD Annual Sewer Renewal Needs

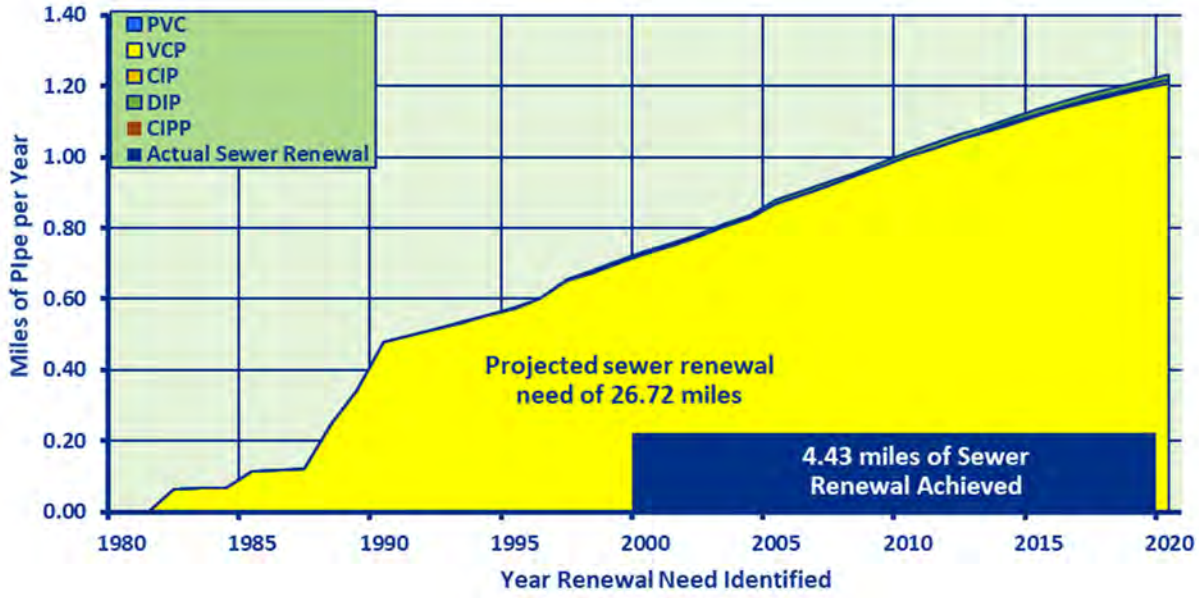
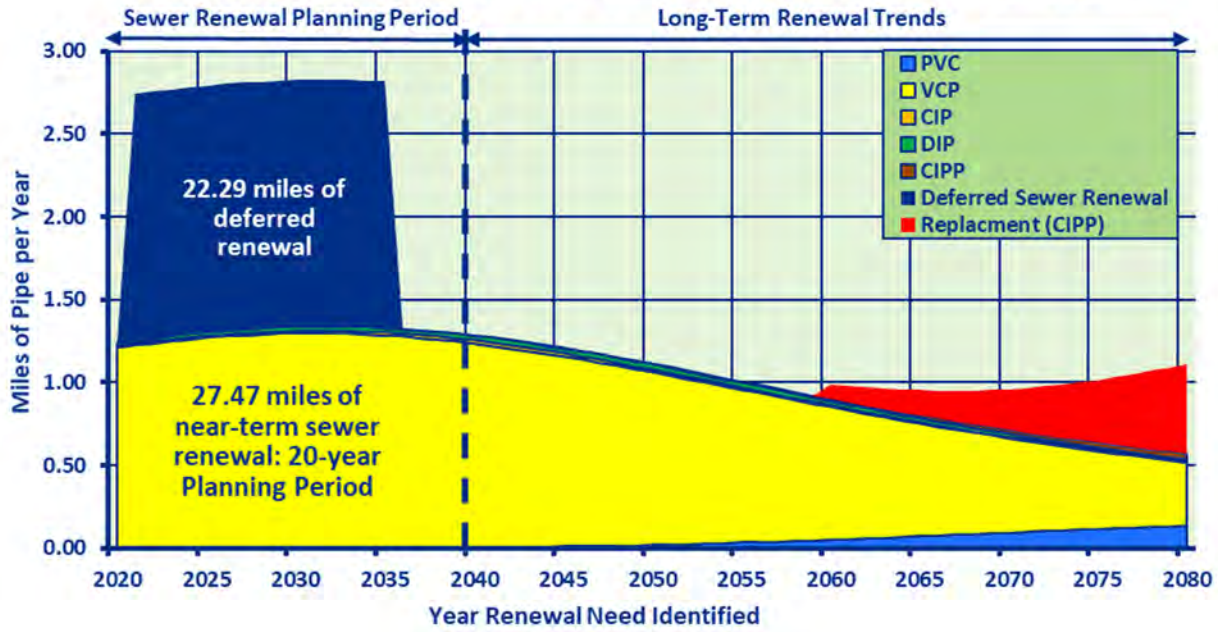


Figure 5-2. Gantt FSPD Sewer Renewal Needs - Post 2019

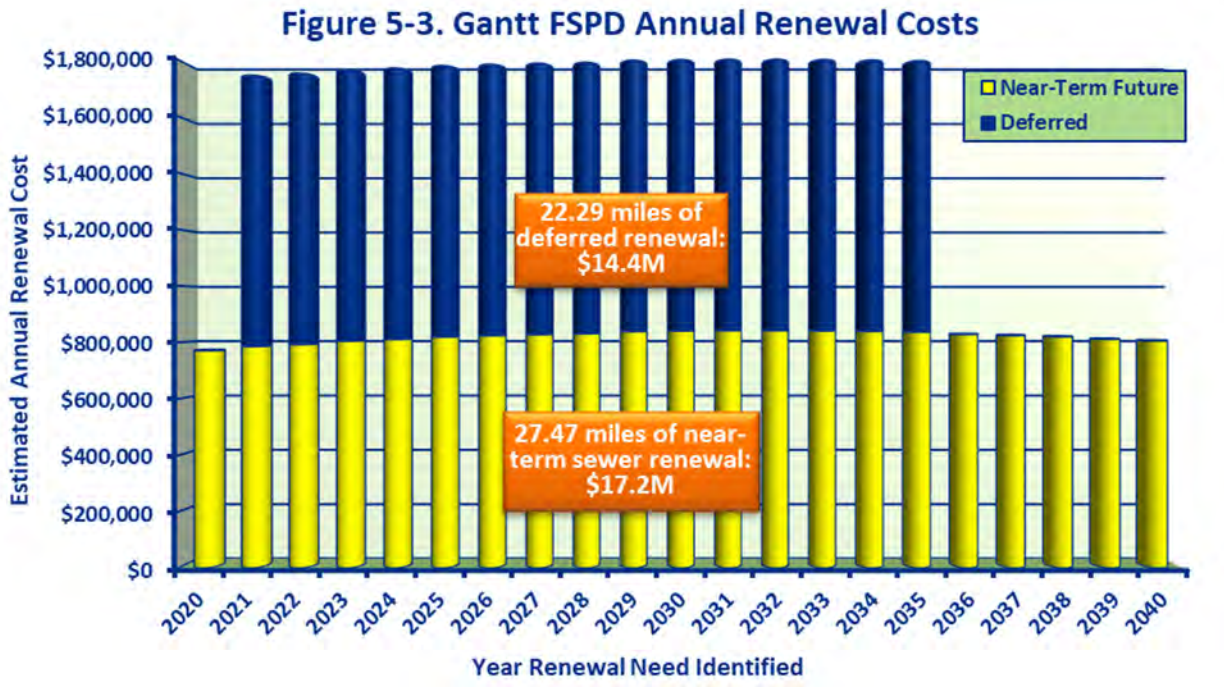


- **System Renewal Status.** The "look back" estimate depicted on Figure 5-1 projects system renewal needs of 26.72 miles, calculated as the sum of each year's projected renewal needs from inception through 2019. The blue bar on Figure 5-1 represents the 4.43 miles of gravity sewer renewal that the Gantt District has implemented since 2000. The difference of 22.29 miles is the projected gravity sewer renewal that has been deferred.

- **Projected Near-Term Renewal Needs.** Figure 5-2 shows that 27.47 miles of gravity sewer renewal is likely to be needed in the near-term (i.e., during a 20-year planning period from FY2020 through FY2040), peaking in 2032 at approximately 1.3 miles annually. If the 22.29 miles of deferred renewal is spread out over a 15-year period, an additional 1.5 miles of sewer renewal is required annually to "catch up".
- **Projected Long-Term Renewal Trends.** Annual sewer renewal needs decline between 2040 and 2060 to about 1.0 miles per year, then increase again between 2060 and beyond for the next cycle of system renewal.
- **Estimated Cost of Sewer Renewal**. **Figure 5-3** indicates that the estimated total renewal costs across the 20-Year Planning period are $31.6M in today's dollars, inclusive of deferred sewer renewal costs, the cost to renew manholes/laterals not addressed under previous sewer renewal projects, and projected future sewer renewal costs. Projected annual pipe lengths are shown in the graphs. Deferred sewer renewal includes 75 laterals that were not addressed on past pipeline renewal projects.

Estimated Renewal Costs between 2020 and 2040

Asset Type	Deferred Sewer Renewal		Near-Term Sewer Renewal	
	Quantity	Estimated Cost	Quantity	Estimated Cost
Gravity Sewers	22.29 miles	$10,947,000	27.47 miles	$13,491,000
Manholes	165 manholes	$545,000	203 manholes	$670,000
Laterals	555 laterals	$2,886,000	591 laterals	$3.074,000
Total		**$14,378,000**		**$17,235,000**



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Section 6

Marietta Fire and Sewer District

The Marietta Fire and Sewer District (Marietta District) is one of seven special purpose districts providing wastewater collection services in Greenville County. This section characterizes the sewer system based on information provided by the Marietta District, summarizes historic assessment and renewal practices, highlights key assumptions specific to the Marietta District system, estimates deferred system renewal, and defines anticipated future system renewal needs.

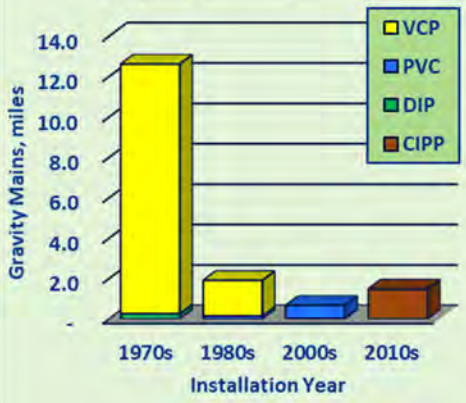
For this evaluation, system renewal is defined as measures that restore the full structural integrity of the sewer, achieved either by full pipe replacement or CIPP lining of the gravity sewer main and a portion of the associated sewer manholes and laterals. Point repairs do not fully renew a gravity main and are not accounted for in this evaluation.

Key Facts:
Marietta Fire and Sewer District

Service Area: 4.3 sq. mi.
Customers Served: 530

Gravity Sewer Mains

Total Length: 88,259 ft. (16.7 miles)
Renewal to date: 8,124 ft. (1.5 miles)
Number of Manholes: 426
Average Spacing: 207 ft per manhole



Laterals (Main to Property Line)

Active: 530 Inactive: ~50
Average Spacing: 152 ft per lateral
Ownership/Maintenance: Customer

Pump Stations and Force Mains

No pump stations, total capacity = 0 gpm
Length of Force Main: 0 ft.

System Characteristics

Area and Customers Served

The Marietta District provides wastewater collection to approximately 530 customers within a 4.3 sq. mi. service area within the unincorporated Slater-Marietta area located in northern Greenville County.

Gravity Mains and Manholes

The Marietta District operates 88,259 ft. (16.7 mi) of 8-inch diameter gravity main[4], largely built of vitrified clay pipe (VCP) in the 1970's when sewer service was first established. Approximately 9 percent of the gravity mains have been rehabilitated since 2008 with a CIPP liner to address structural deterioration and/or address root intrusion. In addition, renewal measures ranging from bench repair to full cementitious lining have been performed on 21 percent of the 426 manholes.

Laterals and Service Connections

The Marietta District did not provide an estimate of active laterals – it is estimated that there is currently one active lateral for each of the 530 existing customers. Most laterals were installed when the collection system was built in the 1970's, and a few new customers have installed laterals using hammer taps (before 1990). Marietta District staff estimates that 50 laterals are inactive – inactive laterals remain connected unless removed during a CIPP renewal project. Currently, the customers are responsible for lateral maintenance from the main to the property

[4] Based upon a tabulation provided by Billy Humphries based on takeoffs from as-built drawings.

line as well as from the property line to the building. The Marietta District does not perform condition assessment or renewal on laterals.

Pump Stations and Force Mains

The Marietta District does not own or operate any pump stations or force mains.

System Assessment and Renewal History

The Marietta District has performed a CCTV inspection on approximately 66 percent of their gravity mains since 2008. Sewers are primarily televised as part of an annual effort to assess approximately 1/15th of the system per year. Renewal is scheduled where significant root intrusion, structural deterioration, and/or infiltration/inflow is discovered. The Marietta District intends to continue annual assessment of 1/15th of its system per year and prompt renewal where needed.

Anticipated Renewal Needs

Methodology for Estimating Sewer Main Renewal Needs

Future gravity main renewal requirements for the Marietta District were determined in the following manner:

- Sewer pipeline/main service life relationships (i.e., the estimated service life of a pipe material type) were determined using industry experience and historic local/regional data relating pipe age to observed structural deterioration, as described in Section 2 of this report. (It is important to keep in mind that pipe age and material service life relationships may not fully address infiltration/inflow control needs.)
- Sewer lengths within each pipe material/age category are based on the information provided by the Marietta District, as summarized earlier in this section. Pipe footage assigned to a certain decade was equally distributed over the 10-year period.
- The age of sewers replaced or rehabilitated with CIPP liner over the past 20 years were adjusted to the estimated date of renewal. Sewers receiving point repairs are not considered to be fully renewed and their ages are based on their original installation date/material.
- The actual sewer age/material was compared to the sewer service life relationships to determine the approximate date when renewal of the sewer main is projected to be needed.

Methodology for Estimating Manhole and Lateral Renewal Needs

- For each segment of gravity sewer main scheduled for renewal each year, renewal is projected for 25 percent of the manholes (i.e., one in four) and 40 percent of the laterals (i.e., four in ten) associated with that gravity main section.
- The remaining manholes (75%) and laterals (60%) will need renewal at some point in the future, anticipated to be beyond the 20-Year Planning period used for financial projections.
- The number of manholes and laterals along a gravity sewer main segment are estimated based upon the systemwide average length of sewer mainline per manhole and per lateral.
- Past gravity sewer main renewal is assumed to have included needed manhole renewal.

- For past mainline renewal that did not include lateral renewal, 40% of laterals assumed to be located on that length of mainline are counted as deferred laterals.

Methodology for Estimating Renewal Costs

The following per-unit sewer renewal costs were used to estimate total renewal needs over the planning period: See Section 2 for details on unit cost development.

- *Gravity Sewer Main Renewal*: an average cost of $93.00 per foot, (which is a blended rate of CIPP lining, pipe bursting, and pipe replacement projects).
- *Manhole Renewal*: an average cost of $3,300 per manhole for full cementitious lining/coating.
- *Lateral Renewal (from main to property line): an average cost of* $5,200 per lateral, largely based on replacement costs.

These unit costs are based upon the actual cost of renewal projects in South Carolina using a blend of technologies (i.e.,) and site conditions and the following assumptions:

- Unit construction costs include costs for installation, mobilization, pavement removal/ replacement, erosion and sediment control, bypass pumping, initial CCTV assessments, testing, and a 10% construction contingency.
- Professional services during design (12% of construction costs), construction (5% of construction costs), and general administrative/legal costs (4% of construction costs).

Estimated Collection System Renewal Needs

The status of sewer renewal for the Marietta District in 2019 and projected future system renewal needs were determined according to the evaluation methodology summarized in the previous section. Projected system renewal needs are estimated and graphed each year by pipe material, with projected renewal needs increasing as pipe inventory ages, diminishing as renewal occurs, and typically increasing again to represent the next cycle of system renewal.

Figure 6-1 "looks back" at past projected system renewal needs compared with actual system renewal achieved. **Figure 6-2** "looks forward" to near-term projected renewal needs during a 20-year planning period (i.e., FY2020 through FY2040) and continuing until 2080 to reveal long-term sewer renewal trends. Deferred renewal needs (as calculated in Figure 6-1) are shown in Figure 6-2 in addition to the projected annual renewal, spread across a 15-year time period starting in 2021. The following conclusions are drawn from this evaluation:

- **System Renewal Status.** The "look back" estimate depicted on Figure 6-1 projects system renewal needs of 3.61 miles, calculated as the sum of each year's projected renewal needs from inception through 2019. The blue bars on Figure 6-1 represent the 1.59 miles of gravity sewer renewal that the Marietta District has implemented since 2002. The difference of 2.02 miles is the projected gravity sewer renewal that has been deferred.

Figure 6-1. Marietta Renewal History and Estimated Needs

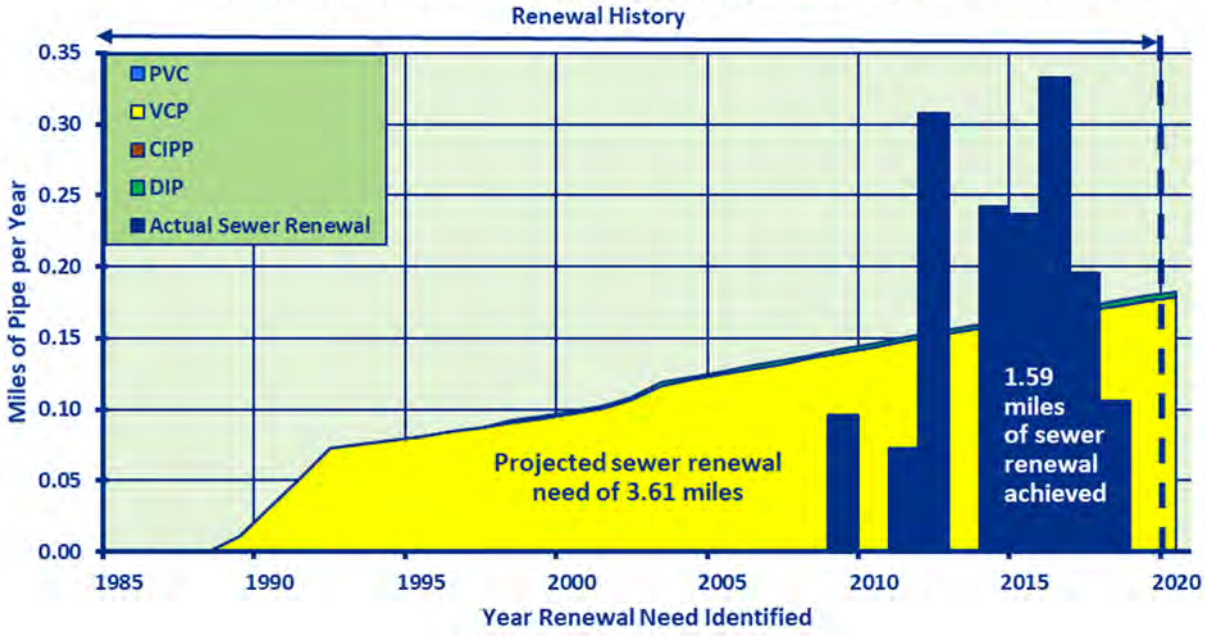
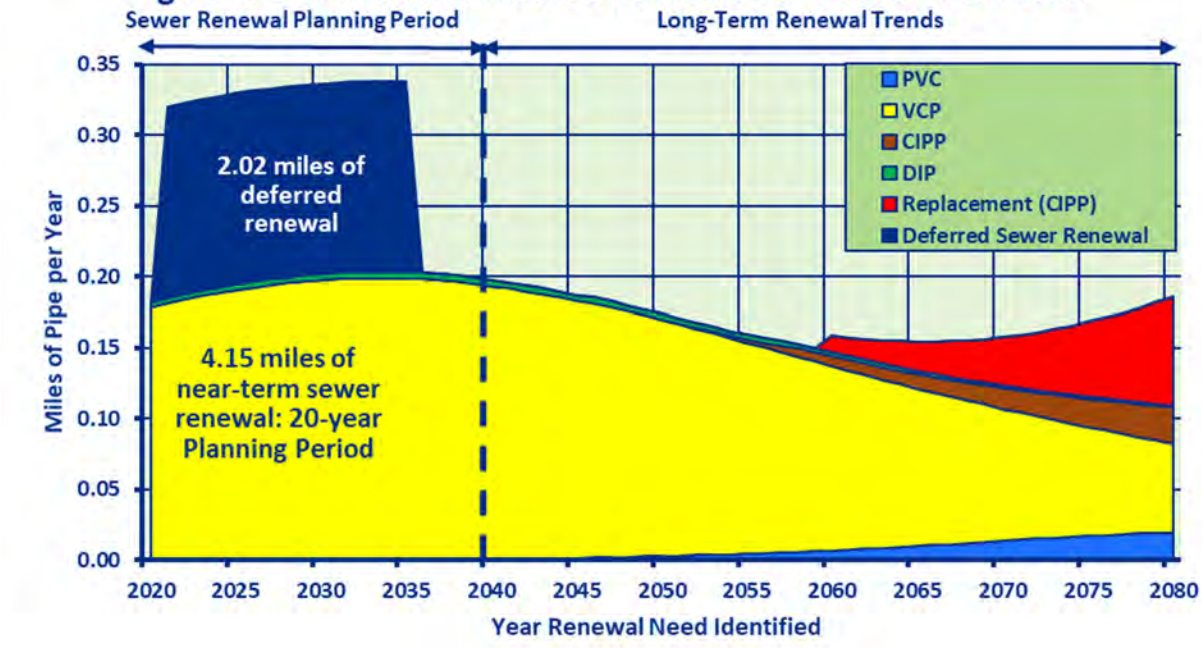


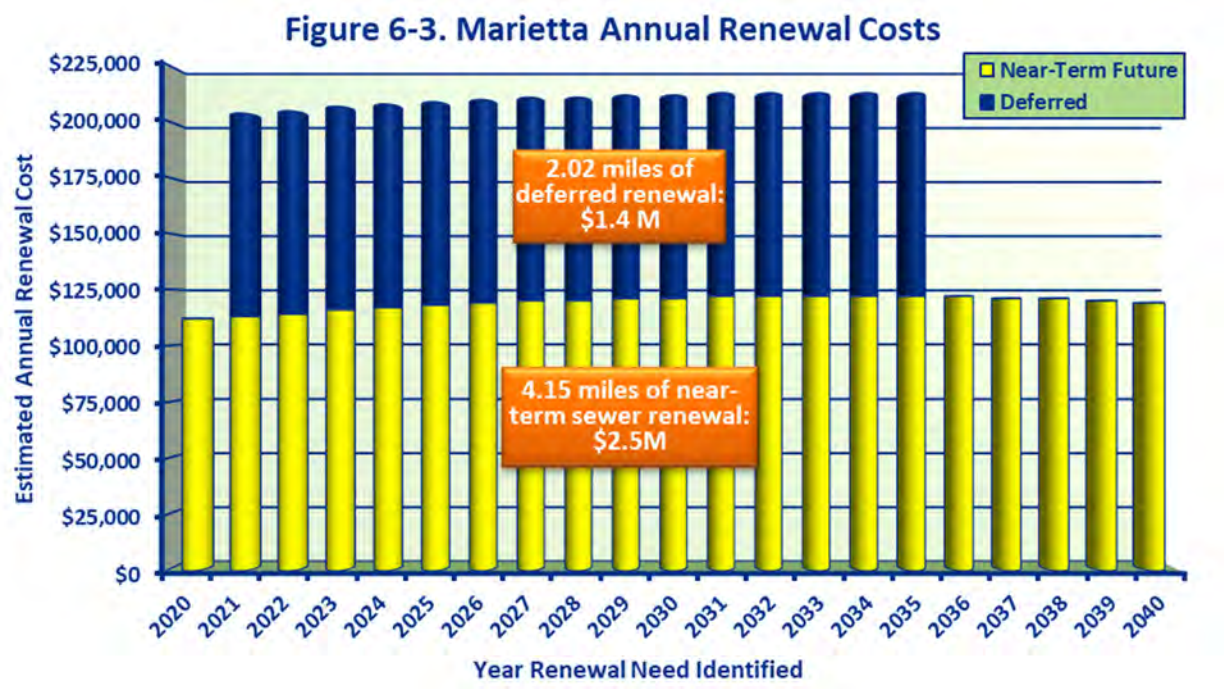
Figure 6-2. Marietta Annual Sewer Renewal Needs - Post 2019



- **Projected Near-Term Renewal Needs.** Figure 6-2 shows that 4.15 miles of gravity sewer renewal is likely to be needed in the near-term (i.e., during a 20-year planning period from FY2020 through FY2040), peaking in 2033 at approximately 0.20 miles annually. If the 2.02 miles of deferred renewal is spread out over a 15-year period, an additional 0.14 miles of sewer renewal is required annually to "catch up".
- **Projected Long-Term Renewal Trends.** Annual sewer renewal needs decline between 2040 and 2060 to about 0.15 miles per year, then increase again between 2060 and beyond for the next cycle of system renewal.
- **Estimated Cost of Sewer Renewal**. **Figure 6-3** indicates that the estimated total renewal costs across the 20-Year Planning period are $3.9M in today's dollars, inclusive of deferred sewer renewal costs, the cost to renew manholes/laterals not addressed under previous sewer renewal projects, and projected future sewer renewal costs. Projected annual pipe lengths are shown in the graphs. Deferred sewer renewal includes 30 laterals that were not addressed on past pipeline renewal projects.

Estimated Renewal Costs between 2020 and 2040

Asset Type	Deferred Sewer Renewal		Near-Term Sewer Renewal	
	Quantity	Estimated Cost	Quantity	Estimated Cost
Gravity Sewers	2.02 miles	$994,000	4.15 miles	$2,037,000
Manholes	15 manholes	$49.500	42 manholes	$139,000
Laterals	60 laterals	$312,000	63 laterals	$328,000
Total		**$1,355,500**		**$2,504,000**



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Section 7

Parker Fire and Sewer Subdistrict

The Parker Fire and Sewer Subdistrict (Parker Subdistrict) is one of seven special purpose districts providing wastewater collection services in Greenville County. This section characterizes the sewer system based on information provided by the Parker Subdistrict, summarizes historic assessment and renewal practices, highlights key assumptions specific to the Parker Subdistrict system, estimates deferred system renewal, and defines anticipated future system renewal needs.

For this evaluation, system renewal is defined as measures that restore the full structural integrity of the sewer, achieved either by full pipe replacement or CIPP lining of the gravity sewer main and a portion of the associated sewer manholes and laterals. Point repairs do not fully renew a gravity main and are not accounted for in this evaluation.

System Characteristics

Area Served

The Parker Subdistrict provides wastewater collection to customers within a 23 sq. mi. service area within the unincorporated Parker area located in west-central Greenville County.

Gravity Mains and Manholes

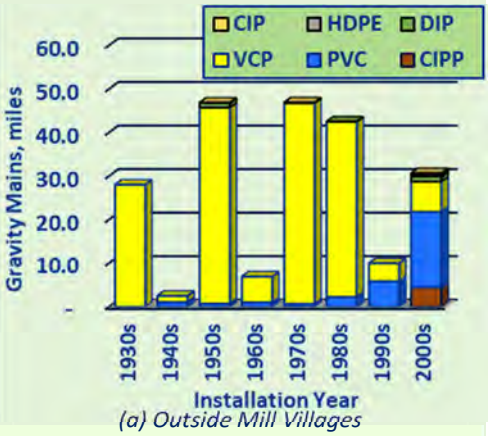
The Parker Subdistrict operates 1,395,636 ft. (264.3 mi) of 6-inch to 15-inch diameter gravity main. Eighteen percent of their gravity mains lie within Mill Village areas. The gravity mains are largely built of vitrified clay pipe (VCP) in the 1920's through 1980's, and largely polyvinyl chloride (PVC) pipe constructed since then. Approximately 28.6 miles (11 percent) of the gravity mains have been renewed since 2000 with a CIPP liner (11.05 miles) or a replacement sewer (17.50 miles) to address structural deterioration. Parker Subdistrict staff reports that 60 percent of the gravity sewers renewed using CIPP are located in the Mill Village areas, and the rest outside of Mill Villages. Also, 593 manholes have been identified for renewal.

Key Facts:
Parker Fire and Sewer Subdistrict

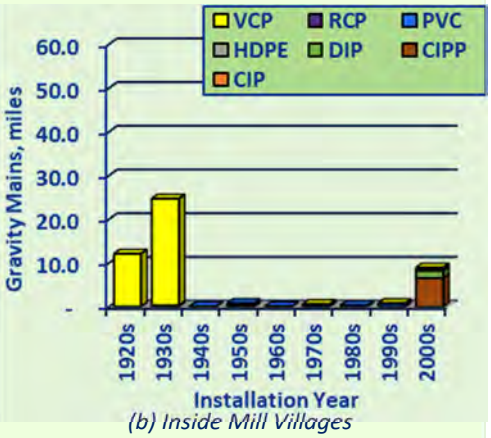
Service Area: 23 sq. mi.
Customers Served: N/A

Gravity Sewer Mains

Total Length: 1,395,636 ft. (264.3 miles)
Renewal to date: 150,789 ft. (28.6 miles)
Number of Manholes: 7,602
Average Spacing: 184 ft per manhole



(a) Outside Mill Villages



(b) Inside Mill Villages

Laterals (Main to ROW)

Active: 15,393 Inactive: 3,444
Average Spacing: 74 ft per lateral
Ownership/Maintenance: Customer

Pump Stations and Force Mains

Six pump stations, total capacity = 339 gpm
Length of Force Main: 6,912 ft.

Laterals and Service Connections

Customers of the Parker Subdistrict are responsible for lateral maintenance from the main to the property line as well as from the property line to the building. The Parker Subdistrict reports that they have renewed approximately 673 laterals over the past 20 years. The Parker Subdistrict reports that 3,444 laterals are inactive, installed to undeveloped parcels in the anticipation of possible future use.

Pump Stations and Force Mains

The Parker Subdistrict operates six pump stations (total capacity of 339 gpm) and 6,912 ft of force main, all but one built after 1999. No pump station or force main renewal is included in this evaluation since these systems are relatively new.

System Assessment and Renewal History

The Parker Subdistrict has performed a CCTV inspection on approximately 80 percent of their gravity mains over the past 10 years. Sewers are televised in response to a maintenance request, as part of a proactive condition assessment, or to identify infiltration/inflow. Root intrusion is addressed by hydraulic cleaning and root treatment. Nearly 80 percent of the sewer system in the Parker Subdistrict is reported to be in fair to poor operating condition.

Anticipated Renewal Needs

Methodology for Estimating Renewal Needs Inside Mill Villages

Sewers associated with Mill Villages are generally older and often located outside roadway rights-of-way (e.g., in alleys, on private property, etc.) As such, the entire system within the Mill Village area is targeted for replacement during the near-term (20-year) planning period. The following methodology and assumptions were used:

- Boundaries of Mill Villages provided by MetroConnects and/or the Parker Subdistrict were superimposed on the gravity sewer main alignments provided in the Parker Subdistrict GIS.
- Gravity sewer mains within each Mill Village boundary were assumed to be associated with the Mill Village and separated from the remaining gravity sewer mains.
- The new gravity sewer system inside the Mill Villages is assumed to require 85 percent of the existing gravity sewer main length based on actual metrics of gravity sewer mains recently replaced by MetroConnects within two Mill Villages.
- New manholes will be installed along the entire length of the replacement gravity main, assumed to be located at the same average spacing as the existing system.
- New laterals will be installed from the gravity main to the property line for every active customer along the entire length of the replacement gravity main. In addition, laterals will be extended from the property line to the building for 50 percent of the properties where a new lateral alignment is required to connect to the relocated gravity main.

Methodology for Estimating Sewer Main Renewal Needs Outside Mill Villages

Future gravity main renewal outside of Mill Village areas within the Parker Subdistrict was determined in the following manner:

- Sewer pipeline/main service life relationships (i.e., the estimated service life of a pipe material type) were determined using industry experience and historic local/regional data

relating pipe age to observed structural deterioration, as described in Section 2 of this report. (It is important to keep in mind that pipe age and material service life relationships may not fully address infiltration/inflow control needs.)

- Sewer lengths within each pipe material/age category are based on the information provided by the Parker Subdistrict, as summarized earlier in this section. Pipes built in the 1920's were assumed to lie in the Mill Villages, and pipes built in other decades were distributed proportionately throughout the system. Pipe footage assigned to a certain decade was equally distributed over the 10-year period. Pipes with an unknown age were distributed to match age distributions of pipe material types.
- The age of sewers renewed with CIPP liner over the past 20 years were adjusted to the estimated date of renewal (assumed to be all pipes built in 1935 or earlier in Mill Villages). Sewers receiving point repairs are not considered to be fully renewed and their ages are based on their original installation date/material.
- The actual sewer age/material was compared to the sewer service life relationships to determine the approximate date when renewal of the sewer main is projected to be needed.

Methodology for Estimating Manhole/Lateral Renewal Needs Outside Mill Villages

- For each segment of gravity sewer main scheduled for renewal each year outside of Mill Villages, renewal is projected for 25 percent of the manholes (i.e., one in four) and 40 percent of the laterals (i.e., four in ten) associated with that gravity main section.
- The remaining manholes (75%) and laterals (60%) will need renewal at some point in the future, anticipated to be beyond the 20-Year Planning period used for financial projections.
- The number of manholes and laterals along a gravity sewer main segment are estimated based upon the systemwide average length of sewer mainline per manhole and per lateral.
- Past gravity sewer main renewal is assumed to have included needed manhole renewal.
- For past mainline renewal that did not include lateral renewal, 40% of laterals assumed to be located on that length of mainline are counted as deferred laterals.

Methodology for Estimating Renewal Costs

The following per-unit sewer renewal costs were used to estimate total renewal needs over the planning period: See Section 2 for details on unit cost development.

- *Gravity Sewer Main Renewal (outside Mill Villages)*: an average cost of $93.00 per foot, (which is a blended rate of CIPP lining, pipe bursting, and pipe replacement projects)
- *Gravity Sewer Main Replacement (inside Mill Villages)*: an average cost of $210.00 per foot, (which is a representative rate for pipe replacement projects, assuming 12-foot wide pavement replacement, 25 percent of sewer within an SCDOT roadway that requires flowable fill as a backfill material, and 20 percent requiring curb and gutter replacement).
- *Manhole Renewal*: an average cost of $3,300 per manhole for full cementitious lining/coating, or an average cost of $4,000 per manhole for replacement in Mill Villages.
- *Lateral Renewal (from main to property line)*: an average cost of $5,200 per lateral, largely based on replacement costs.

- *Lateral Renewal (from property line to building)*: an average cost of $5,200 per lateral, inclusive of lateral installation and necessary re-plumbing inside the building.

These unit costs are based upon the actual cost of renewal projects in South Carolina using a blend of technologies (i.e.,) and site conditions and the following assumptions:

- Unit construction costs include costs for installation, mobilization, pavement removal/ replacement, erosion and sediment control, bypass pumping, initial CCTV assessments, testing, and a 10% construction contingency.
- Professional services during design (12% of construction costs), construction (5% of construction costs), and general administrative/legal costs (4% of construction costs).

Estimated Collection System Renewal Needs Outside Mill Villages

The status of sewer renewal for the Parker Subdistrict in 2019 and projected future system renewal needs were determined outside Mill Villages according to the evaluation methodology summarized in the previous section. Projected system renewal needs are estimated and graphed each year by pipe material, with projected renewal needs increasing as pipe inventory ages, diminishing as renewal occurs, and typically increasing again to represent the next cycle of system renewal.

Figure 7-1 "looks back" at past projected system renewal needs compared with actual system renewal achieved. **Figure 7-2** "looks forward" to near-term projected renewal needs during a 20-year planning period (i.e., FY2020 through FY2040) and continuing until 2080 to reveal long-term sewer renewal trends. Deferred renewal needs (as calculated in Figure 7-1) are shown in Figure 7-2 in addition to the projected annual renewal, spread across a 15-year time period starting in 2021. The following conclusions are drawn from this evaluation:

- **System Renewal Status.** The "look back" estimate depicted on Figure 7-1 projects system renewal needs of 66.67 miles outside Mill Villages, calculated as the sum of each year's projected renewal needs from inception through 2019. The blue bar on Figure 7-1 represents the 21.92 miles of gravity sewer renewal that the Parker Subdistrict has implemented since 2000 outside Mill Villages. The difference of 44.75 miles outside Mill Villages is the projected gravity sewer renewal that has been deferred.
- **Projected Future Renewal Needs.** Figure 7-2 shows that 45.24 miles of gravity sewer renewal outside Mill Villages is likely to be needed in the near-term (i.e., during a 20-year planning period from FY2020 through FY2040), peaking in 2028 at approximately 2.2 miles annually. If the 44.75 miles of deferred renewal is spread out over a 15-year period, an additional 3.0 miles of sewer renewal is required annually to "catch up".
- **Projected Long-Term Renewal Trends.** Annual sewer renewal needs decline between 2030 and 2060 to about 1.6 miles per year, then increase again between 2060 and beyond for the next cycle of system renewal.

Figure 7.1 Parker FSD Renewal History/Estimated Needs

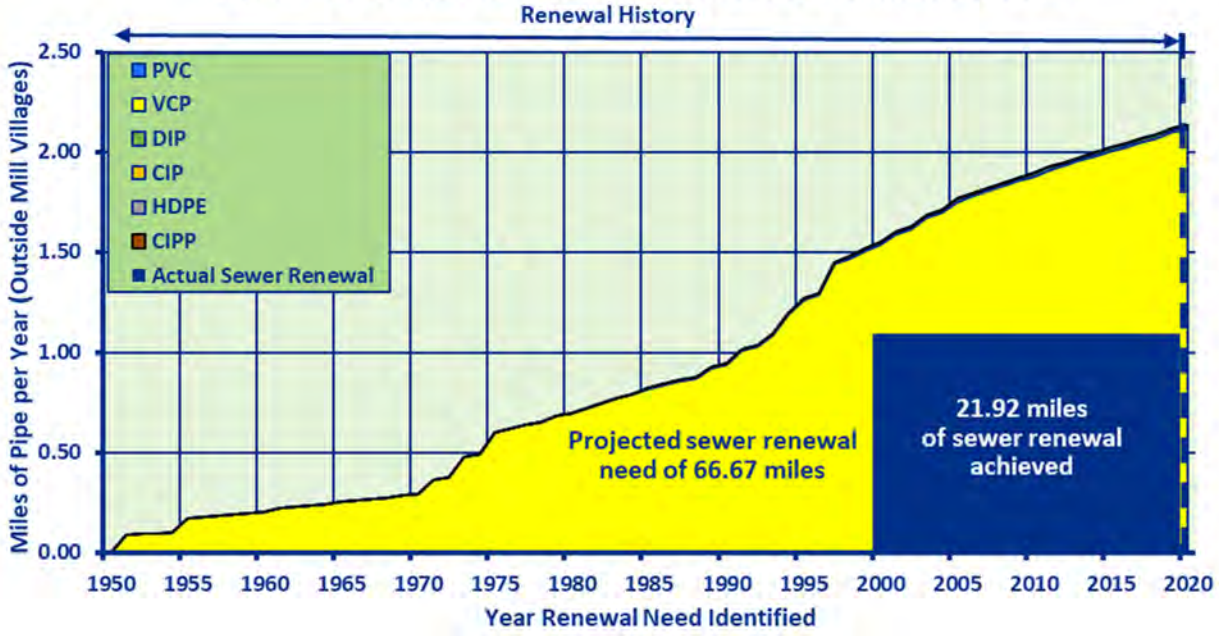
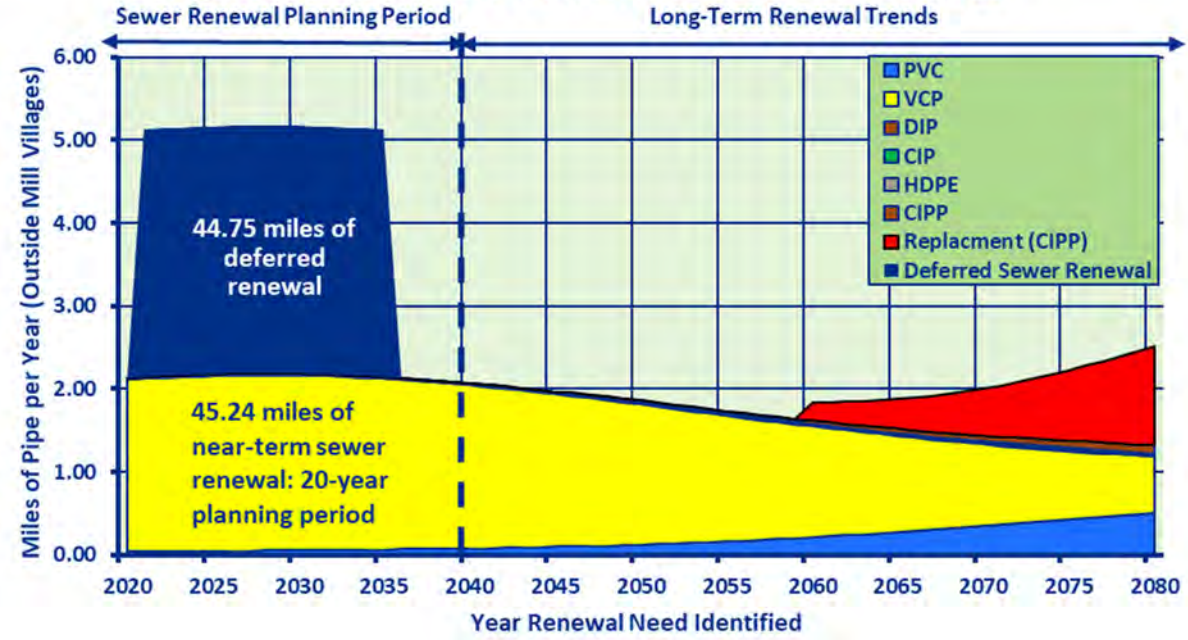


Figure 7.2 Parker FSD Sewer Renewal Needs-Post 2019



Estimated Collection System Renewal Needs Inside Mill Villages

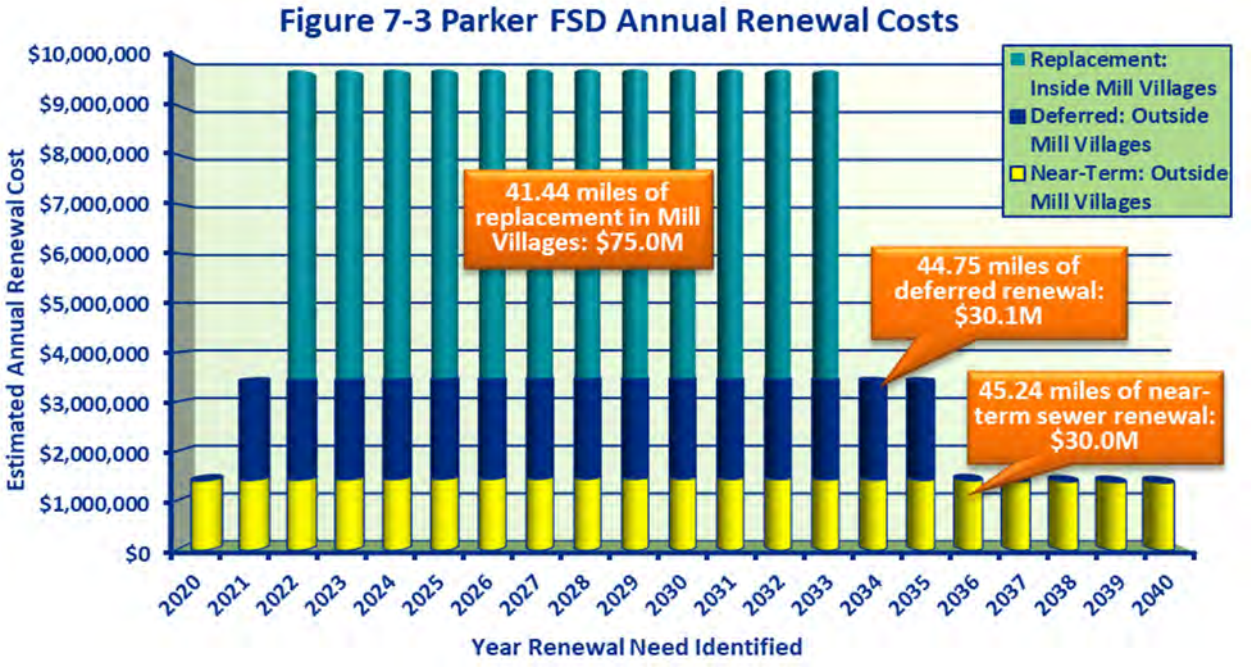
All 48.75 miles of existing gravity mains within Mill Villages are scheduled for replacement during the near-term planning period of 2020 through 2040. These pipes were largely built of VCP during the 1920's and 1930's and are generally reaching projected service life expectations. This study assumes that all existing pipes (including the 6.63 miles of gravity main renewed with CIPP liner over the past 20 years) will be abandoned in place and relocated within road rights-of-ways or to dedicated easements. This proposed alignment is expected to reduce the length of the relocated gravity main by 15 percent (to 41.44 miles) and will facilitate long-term maintenance requirements. In addition, all existing manholes will be relocated/rebuilt, all active laterals from the main to the property line will be replaced, and 50 percent of the active laterals will be extended to the building along different alignments, with each building re-plumbed as necessary.

Estimated Cost of Sewer Renewal

Figure 7-3 indicates that the estimated total renewal costs across the 20-Year Planning period are $135.1M in today's dollars, inclusive of deferred sewer renewal costs, the cost to renew manholes/laterals not addressed under previous sewer renewal projects, and projected future sewer renewal costs. Projected annual pipe lengths are shown in the graphs. Deferred sewer renewal includes 90 laterals that were not addressed on past pipeline renewal projects.

Estimated Renewal Costs between 2020 and 2040

Asset Type	Deferred Sewer Renewal Outside Mill Villages		Near-Term Sewer Renewal Outside Mill Villages		Sewer Replacement Inside Mill Villages	
	Quantity	Estimated Cost	Quantity	Estimated Cost	Quantity	Estimated Cost
Gravity Sewers	44.75 miles	$21,972,000	45.24 miles	$22,213,000	41.44 miles	$45,857,000
Manholes	330 manholes	$1,089,000	333 manholes	$ 1,099,000	1,292 manholes	$5,168,000
Laterals	1,350 laterals	$7,020,000	1,283 laterals	$6,672,000	3,202 laterals	$24,016,000
Total		**$30,081,000**		**$29,984,000**		**$75,041,000**



Section 8
Taylors Fire and Sewer District

The Taylors Fire and Sewer District (Taylors District) is one of seven special purpose districts providing wastewater collection services in Greenville County. This section characterizes the sewer system based on information provided by the Taylors District, summarizes historic assessment and renewal practices, highlights key assumptions specific to the Taylors District system, estimates deferred system renewal, and defines anticipated future system renewal needs.

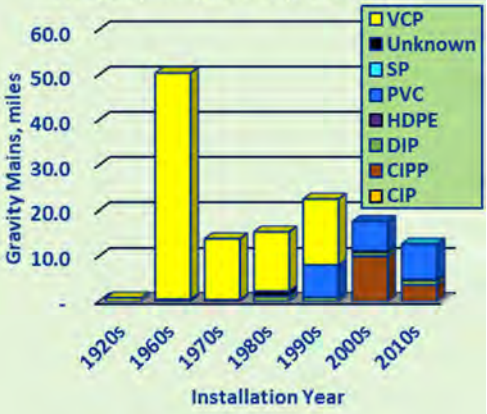
For this evaluation, system renewal is defined as measures that restore the full structural integrity of the sewer, achieved either by full pipe replacement or CIPP lining of the gravity sewer main and a portion of the associated sewer manholes and laterals. Point repairs do not fully renew a gravity main and are not accounted for in this evaluation.

Key Facts:
Taylors Fire and Sewer District

Service Area: 16.21 sq. mi.
Customers Served: 28,368

Gravity Sewer Mains

Total Length: 703,678 ft. (133.3 miles)
Renewal to date: 85,762 ft. (16.2 miles)
Number of Manholes: 3,720
Average Spacing: 189 ft per manhole



Laterals (Main to Property Line)

Active: 9,022 Inactive: 2,378
Average Spacing: 62 ft per lateral
Ownership/Maintenance:
- No Cleanout: Customer
- Cleanout: Taylors FSD

Pump Stations and Force Mains

3 pump stations, total capacity = 345 gpm
Length of Force Main: 4,942 ft.

System Characteristics

Area and Customers Served

The Taylors District provides wastewater collection to approximately 28,3689 customers within a 16.21 sq. mi. service area within the unincorporated Taylors area located in east-central Greenville County.

Gravity Mains and Manholes

The Taylors District operates 703,678 ft. (133.3 miles) of 6-inch to 16-inch diameter gravity main[5], largely built of vitrified clay pipe (VCP) in the 1960's through 1990's when sewer service was first established. Approximately 12 percent of the gravity mains have been renewed since 2000 with a CIPP liner or a replacement sewer to address structural deterioration and/or address root intrusion. In addition, 193 manholes have been renewed based on above and below ground manhole inspections, done both in-house and by contractors conducting SSES sweeps.

Laterals and Service Connections

The Taylors District is responsible for lateral maintenance from the main to the property line only if a cleanout exists at the property line. Otherwise, its customers are responsible for lateral maintenance from the main to the property line and from the property line to the building. The Taylors District reports that they have renewed the publicly owned portion of 266 laterals (main to property line) via CIPP lining plus an

[5] Based upon responses to questionnaire completed to support this study.

additional 3,562 ft of lateral via open cut replacement or other means. The Taylors District reports that 2,378 laterals are inactive – they were installed to every property for recent subdivisions and some vacant properties in older subdivisions.

Pump Stations and Force Mains

The Taylors District operates three pump stations (total capacity of 345 gpm) and 4,942 ft of force main, built between 1992 and 1998. No pump station or force main renewal is included in this evaluation since these systems are relatively new.

System Assessment and Renewal History

The Taylors District has performed a CCTV inspection on their entire gravity sewer system over the past 10 years. Approximately 55 percent of the inspections are performed proactively for condition assessment, with the remaining inspections in response to service requests or pre/post-renewal acceptance testing. When heavy roots are discovered, in-house crews use hydraulic root cutters and/or Bulldog nozzles to remove roots. The Taylors District's current CIP planning is guided by the Intergovernmental Agreement with ReWa, and renewal is prioritized by severity. CCTV inspections are reviewed to determine condition of pipe and whether or what type of maintenance or rehab is needed. The FY2020 budget allows for $3 million in renewal work.

Anticipated Renewal Needs

Methodology for Estimating Sewer Main Renewal Needs

Future gravity main renewal requirements for the Taylors District were determined in the following manner:

- Sewer pipeline/main service life relationships (i.e., the estimated service life of a pipe material type) were determined using industry experience and historic local/regional data relating pipe age to observed structural deterioration, as described in Section 2 of this report. (It is important to keep in mind that pipe age and material service life relationships may not fully address infiltration/inflow control needs.)
- Sewer lengths within each pipe material/age category are based on the information provided by the Taylors District, as summarized earlier in this section. Pipe footage assigned to a certain decade was equally distributed over the 10-year period.
- The age of sewers replaced or rehabilitated with CIPP liner over the past 20 years were adjusted to the estimated date of renewal. Sewers receiving point repairs are not considered to be fully renewed and their ages are based on their original installation date/material.
- The actual sewer age/material was compared to the sewer service life relationships to determine the approximate date when renewal of the sewer main is projected to be needed.

Methodology for Estimating Manhole and Lateral Renewal Needs

- For each segment of gravity sewer main scheduled for renewal each year, renewal is projected for 25 percent of the manholes (i.e., one in four) and 40 percent of the laterals (i.e., four in ten) associated with that gravity main section.
- The remaining manholes (75%) and laterals (60%) will need renewal at some point in the future, anticipated to be beyond the 20-Year Planning period used for financial projections.

- The number of manholes and laterals along a gravity sewer main segment are estimated based upon the systemwide average length of sewer mainline per manhole and per lateral.
- Past gravity sewer main renewal is assumed to have included needed manhole renewal.
- For past mainline renewal that did not include lateral renewal, 40% of laterals assumed to be located on that length of mainline are counted as deferred laterals.

Methodology for Estimating Renewal Costs

The following per-unit sewer renewal costs were used to estimate total renewal needs over the planning period: See Section 2 for details on unit cost development.

- *Gravity Sewer Main Renewal*: an average cost of $93.00 per foot, (which is a blended rate of CIPP lining, pipe bursting, and pipe replacement projects).
- *Manhole Renewal*: an average cost of $3,300 per manhole for full cementitious lining/coating.
- *Lateral Renewal (from main to property line): an average cost of* $5,200 per lateral, largely based on replacement costs.

These unit costs are based upon the actual cost of renewal projects in South Carolina using a blend of technologies (i.e.,) and site conditions and the following assumptions:

- Unit construction costs include costs for installation, mobilization, pavement removal/ replacement, erosion and sediment control, bypass pumping, initial CCTV assessments, testing, and a 10% construction contingency.
- Professional services during design (12% of construction costs), construction (5% of construction costs), and general administrative/legal costs (4% of construction costs).

Estimated Collection System Renewal Needs

The status of sewer renewal for the Taylors District in 2019 and projected future system renewal needs were determined according to the evaluation methodology summarized in the previous section. Projected system renewal needs are estimated and graphed each year by pipe material, with projected renewal needs increasing as pipe inventory ages, diminishing as renewal occurs, and typically increasing again to represent the next cycle of system renewal.

Figure 8-1 "looks back" at past projected system renewal needs compared with actual system renewal achieved. **Figure 8-2** "looks forward" to near-term projected renewal needs during a 20-year planning period (i.e., FY2020 through FY2040) and continuing until 2080 to reveal long-term sewer renewal trends. Deferred renewal needs (as calculated in Figure 8-1) are shown in Figure 8-2 in addition to the projected annual renewal, spread across a 15-year time period starting in 2021. The following conclusions are drawn from this evaluation:

- **System Renewal Status.** The "look back" estimate depicted on Figure 8-1 projects system renewal needs of 26.34 miles, calculated as the sum of each year's projected renewal needs from inception through 2019. The blue bar on Figure 8-1 represents the 16.24 miles of gravity sewer renewal that the Taylors District has implemented since 2000. The difference of 10.09 miles is the projected gravity sewer renewal that has been deferred.

Figure 8-1. Taylors FSD Renewal History and Estimated Needs

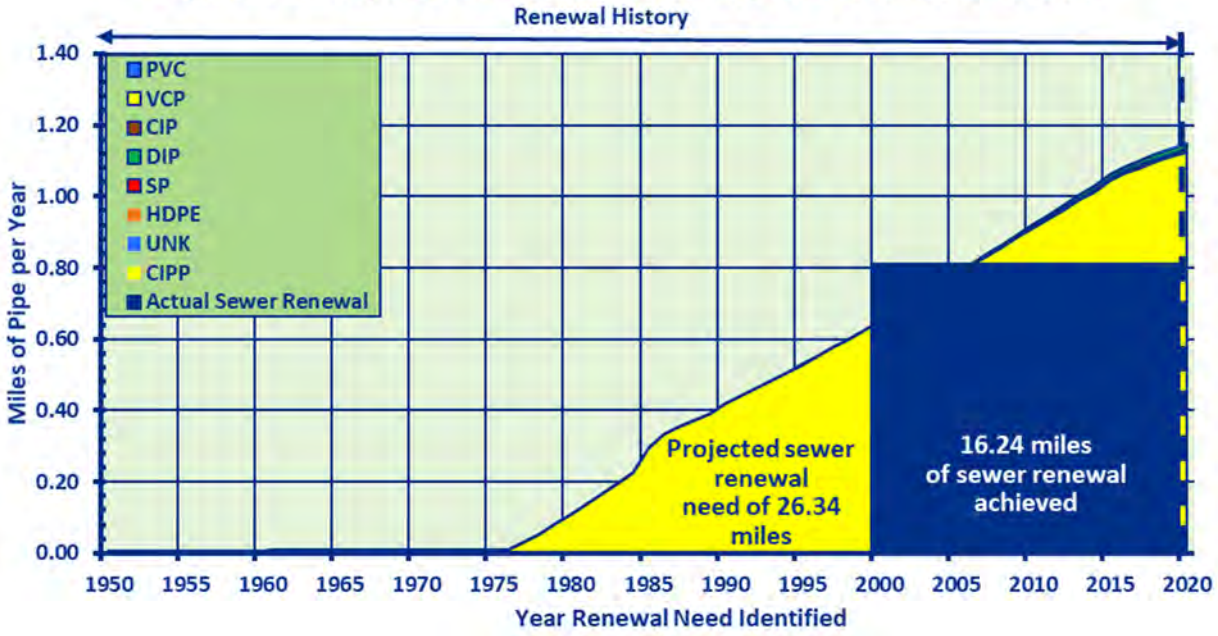
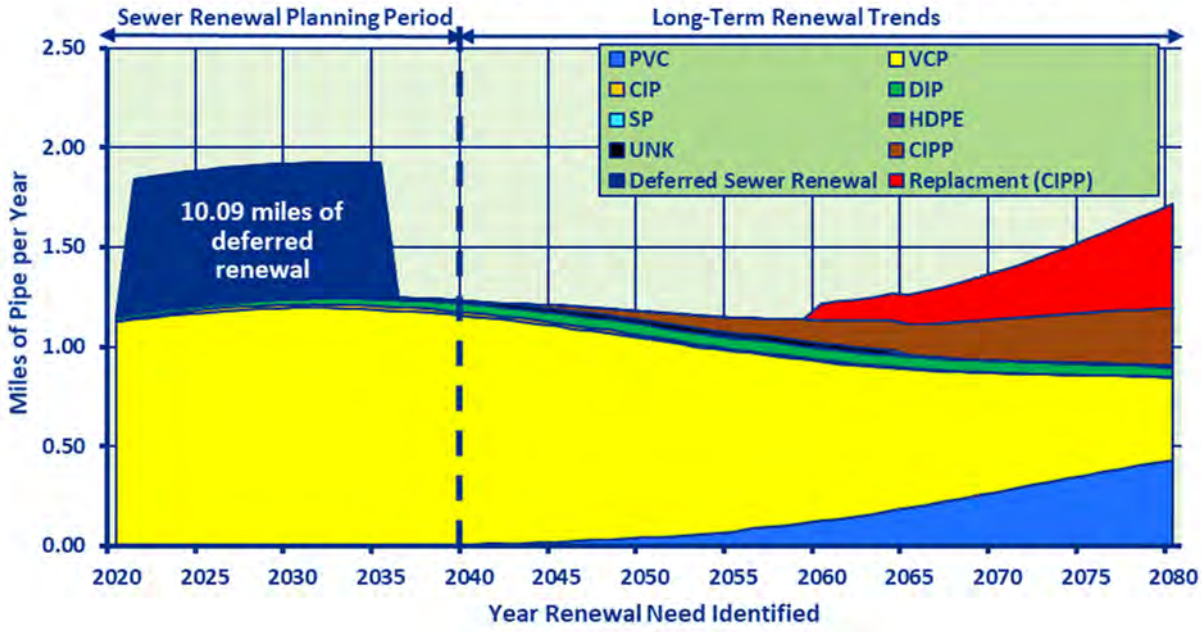


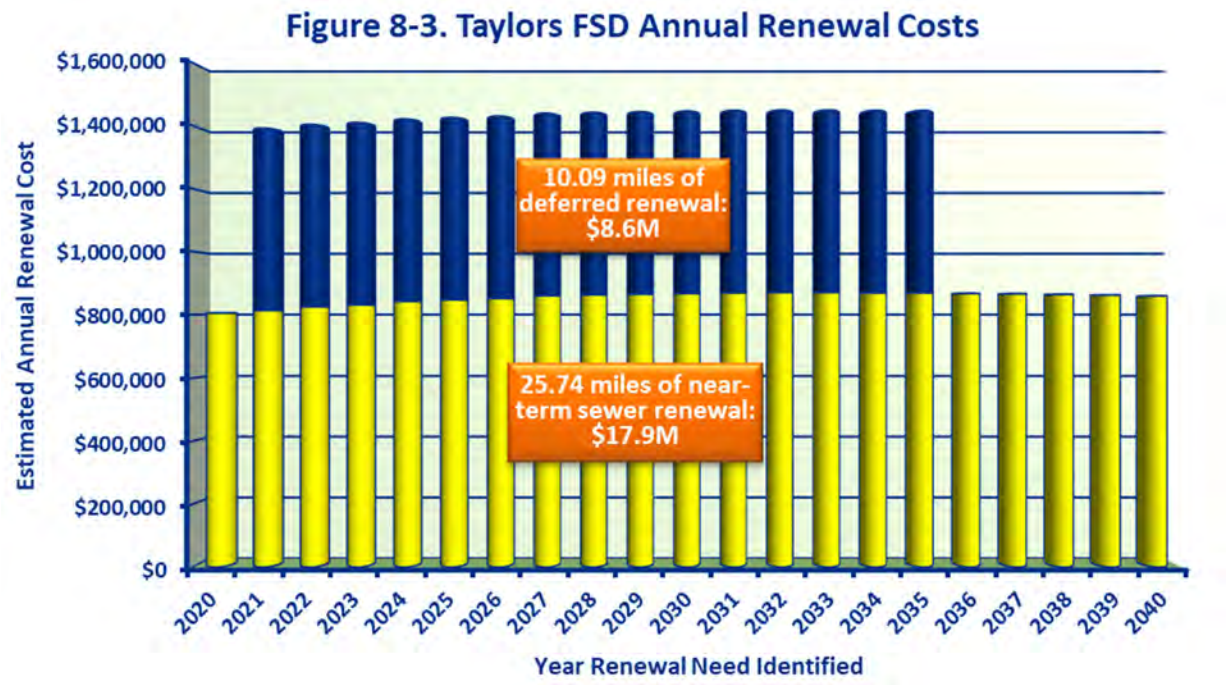
Figure 8-2. Taylors FSD Sewer Renewal Needs - Post 2019



- **Projected Future Renewal Needs.** Figure 8-2 shows that 25.74 miles of gravity sewer renewal is likely to be needed in the near-term (i.e., during a 20-year planning period from FY2020 through FY2040), peaking in 2036 at approximately 1.2 miles annually. If the 10.09 miles of deferred renewal is spread out over a 15-year period, an additional 0.7 miles of sewer renewal is required annually to "catch up".
- **Projected Long-Term Renewal Trends.** Annual sewer renewal needs decline between 2040 and 2060 to about 1.0 mile per year, then increase again between 2060 and beyond for the next cycle of system renewal.
- **Estimated Cost of Sewer Renewal**. **Figure 8-3** indicates that the estimated total renewal costs across the 20-Year Planning period are $26.5M in today's dollars, inclusive of deferred sewer renewal costs, the cost to renew manholes/laterals not addressed under previous sewer renewal projects, and projected future sewer renewal costs. Projected annual pipe lengths are shown in the graphs. Deferred sewer renewal includes 300 laterals that were not addressed on past pipeline renewal projects.

Estimated Renewal Costs between 2020 and 2040

Asset Type	Deferred Sewer Renewal		Near-Term Sewer Renewal	
	Quantity	Estimated Cost	Quantity	Estimated Cost
Gravity Sewers	10.09 miles	$4,957,000	25.74 miles	$12,639,000
Manholes	75 manholes	$248,000	189 manholes	$624,000
Laterals	660 laterals	$3,432,000	890 laterals	$4,628,000
Total		**$8,637,000**		**$17,891,000**



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Section 9

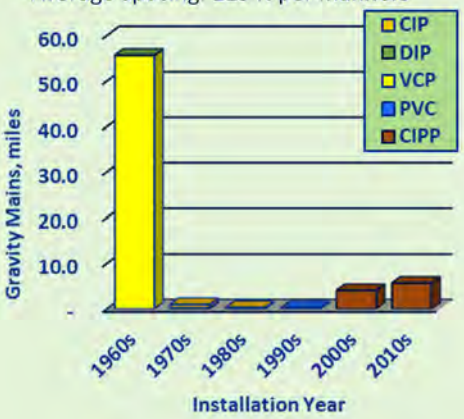
Wade Hampton Fire and Sewer District

The Wade Hampton Fire and Sewer District (Wade Hampton District) is one of seven special purpose districts providing wastewater collection services in Greenville County. This section characterizes the sewer system based on information provided by the Wade Hampton District, summarizes historic assessment and renewal practices, highlights key assumptions specific to the Wade Hampton District system, estimates deferred system renewal, and defines anticipated future system renewal needs.

For this evaluation, system renewal is defined as measures that restore the full structural integrity of the sewer, achieved either by full pipe replacement or CIPP lining of the gravity sewer main and a portion of the associated sewer manholes and laterals. Point repairs do not fully renew a gravity main and are not accounted for in this evaluation.

Key Facts:
Wade Hampton FSD
Service Area: 6.05 sq. mi.
Customers Served: 5,739

Gravity Sewer Mains
Total Length: 353,746 ft. (67.0 miles)
Renewal to date: 51,502 ft. (9.8 miles)
Number of Manholes: 1,644
Average Spacing: 215 ft per manhole



Laterals (Main to Property Line)
Active: 5,739 Inactive: 0
Average Spacing: 62 ft per lateral
Ownership/Maintenance: Customer

Pump Stations and Force Mains
No pump stations, total capacity = 0 gpm
Length of Force Main: 0 ft.

System Characteristics

Area and Customers Served

The Wade Hampton District provides wastewater collection to approximately 5,739 customers within a 6.05 sq. mi. service area within unincorporated Greenville County immediately northeast of the City of Greenville.

Gravity Mains and Manholes

The Wade Hampton District operates 353,746 ft. (67.0 mi) of predominantly 8-inch diameter gravity main[6], largely built of vitrified clay pipe (VCP) in the 1960's when sewer service was first established. Approximately 15 percent of the gravity mains have been rehabilitated since 2000 with a CIPP liner based on proactive condition assessments of structural condition and root intrusion. In addition, 1,048 manholes have been renewed through seal coating applied to interior walls from table to ring.

Laterals and Service Connections

Customers of the Wade Hampton District are responsible for lateral maintenance from the main to the property line as well as from the property line to the building. The Wade Hampton District did not report any lateral renewal over the past 20 years. The Wade Hampton District reports

[6] Based upon responses to questionnaire completed to support this study.

that laterals are installed for requesting property owners, and no undeveloped parcels were provided laterals.

Pump Stations and Force Mains

The Wade Hampton District does not own or operate any pump stations or force mains.

System Assessment and Renewal History

The Wade Hampton District has performed proactive CCTV inspections at least once on approximately 75 percent of their gravity mains over the past 10 years, with sewer renewal via CIPP or point repair based upon condition assessments. Root intrusion is mitigated with chemical treatment and CIPP.

Anticipated Renewal Needs

Methodology for Estimating Sewer Main Renewal Needs

Future gravity main renewal requirements for the Wade Hampton District were determined in the following manner:

- Sewer pipeline/main service life relationships (i.e., the estimated service life of a pipe material type) were determined using industry experience and historic local/regional data relating pipe age to observed structural deterioration, as described in Section 2 of this report. (It is important to keep in mind that pipe age and material service life relationships may not fully address infiltration/inflow control needs.)
- Sewer lengths within each pipe material/age category are based on the information provided by the Marietta District, as summarized earlier in this section. Pipe footage assigned to a certain decade was equally distributed over the 10-year period.
- The age of sewers replaced or rehabilitated with CIPP liner over the past 20 years were adjusted to the estimated date of renewal. Sewers receiving point repairs are not considered to be fully renewed and their ages are based on their original installation date/material.
- The actual sewer age/material was compared to the sewer service life relationships to determine the approximate date when renewal of the sewer main is projected to be needed.

Methodology for Estimating Manhole and Lateral Renewal Needs

- For each segment of gravity sewer main scheduled for renewal each year, renewal is projected for 25 percent of the manholes (i.e., one in four) and 40 percent of the laterals (i.e., four in ten) associated with that gravity main section.
- The remaining manholes (75%) and laterals (60%) will need renewal at some point in the future, anticipated to be beyond the 20-Year Planning period used for financial projections.
- The number of manholes and laterals along a gravity sewer main segment are estimated based upon the systemwide average length of sewer mainline per manhole and per lateral.
- Past gravity sewer main renewal is assumed to have included needed manhole renewal.
- For past mainline renewal that did not include lateral renewal, 40% of laterals assumed to be located on that length of mainline are counted as deferred laterals.

Methodology for Estimating Renewal Costs

The following per-unit sewer renewal costs were used to estimate total renewal needs over the planning period: See Section 2 for details on unit cost development.

- *Gravity Sewer Main Renewal*: an average cost of $93.00 per foot, (which is a blended rate of CIPP lining, pipe bursting, and pipe replacement projects).
- *Manhole Renewal*: an average cost of $3,300 per manhole for full cementitious lining/coating.
- *Lateral Renewal (from main to property line): an average cost of* $5,200 per lateral, largely based on replacement costs.

These unit costs are based upon the actual cost of renewal projects in South Carolina using a blend of technologies (i.e.,) and site conditions and the following assumptions:

- Unit construction costs include costs for installation, mobilization, pavement removal/ replacement, erosion and sediment control, bypass pumping, initial CCTV assessments, testing, and a 10% construction contingency.
- Professional services during design (12% of construction costs), construction (5% of construction costs), and general administrative/legal costs (4% of construction costs).

Estimated Collection System Renewal Needs

The status of sewer renewal for the Wade Hampton District in 2019 and projected future system renewal needs were determined according to the evaluation methodology summarized in the previous section. Projected system renewal needs are estimated and graphed each year by pipe material, with projected renewal needs increasing as pipe inventory ages, diminishing as renewal occurs, and typically increasing again to represent the next cycle of system renewal.

Figure 9-1 "looks back" at past projected system renewal needs compared with actual system renewal achieved. **Figure 9-2** "looks forward" to near-term projected renewal needs during a 20-year planning period (i.e., FY2020 through FY2040) and continuing until 2080 to reveal long-term sewer renewal trends. Deferred renewal needs (as calculated in Figure 9-1) are shown in Figure 9-2 in addition to the projected annual renewal, spread across a 15-year time period starting in 2021. The following conclusions are drawn from this evaluation:

- **System Renewal Status.** The "look back" estimate depicted on Figure 9-1 projects system renewal needs of 21.47 miles, calculated as the sum of each year's projected renewal needs from inception through 2019. The blue bar on Figure 9-1 represent the 9.75 miles of gravity sewer renewal that the Wade Hampton District has implemented since 2000. The difference of 21.95 miles is the projected gravity sewer renewal that has been deferred.

Figure 9-1. Wade Hampton Renewal History/Estimated Needs

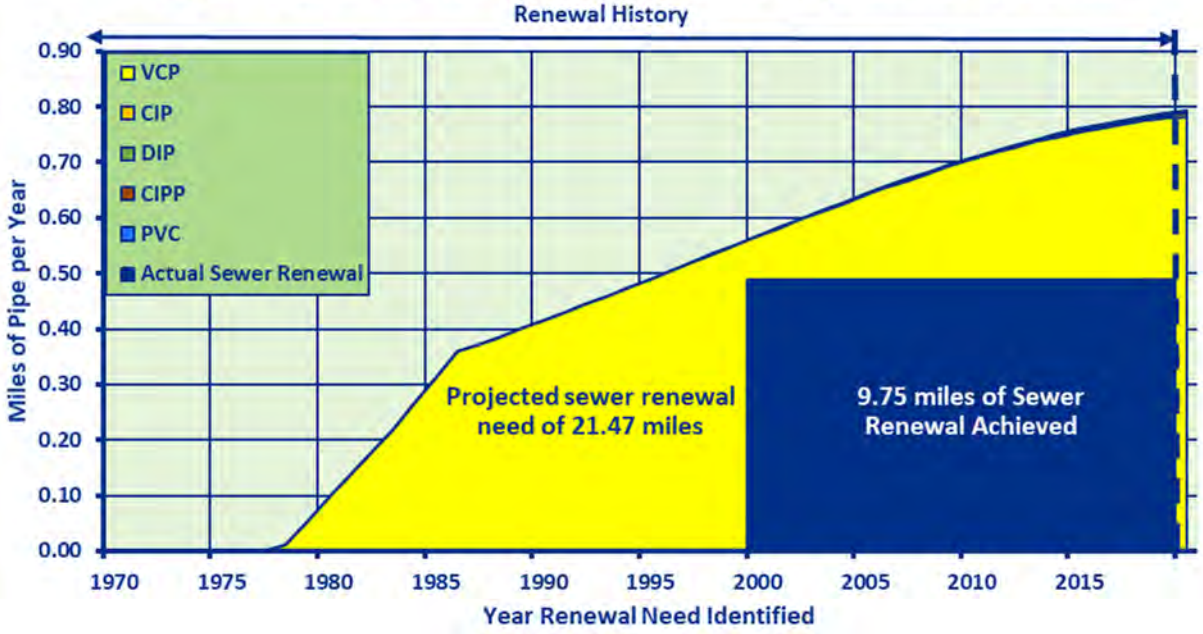
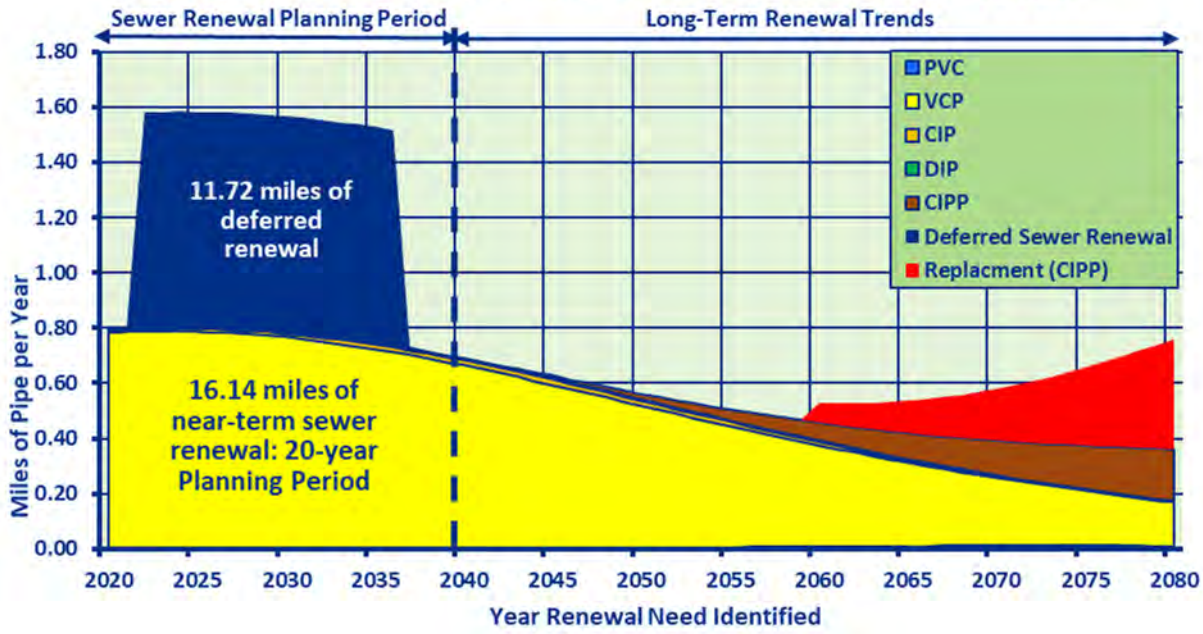


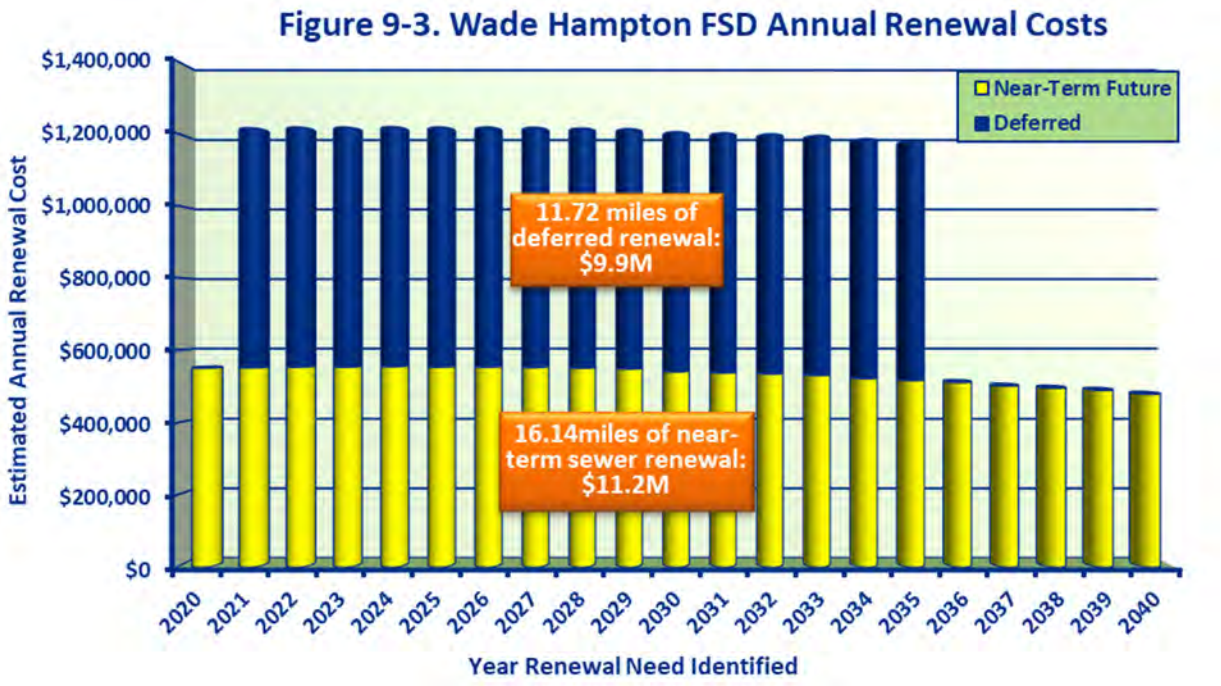
Figure 9-2. Wade Hampton Sewer Renewal Needs - Post 2019



- **Projected Future Renewal Needs.** Figure 9-2 shows that 16.14 miles of gravity sewer renewal is likely to be needed in the near-term (i.e., during a 20-year planning period from FY2020 through FY2040), peaking in 2025 at approximately 0.8 miles annually. If the 11.72 miles of deferred renewal is spread out over a 15-year period, an additional 0.8 miles of sewer renewal is required annually to "catch up".
- **Projected Long-Term Renewal Trends.** Annual sewer renewal needs decline between 2040 and 2060 to about 0.5 miles per year, then increase again between 2060 and beyond for the next cycle of system renewal.
- **Estimated Cost of Sewer Renewal**. **Figure 9-3** indicates that the estimated total renewal costs across the 20-Year Planning period are $21.1M in today's dollars, inclusive of deferred sewer renewal costs, the cost to renew manholes/laterals not addressed under previous sewer renewal projects, and projected future sewer renewal costs. Projected annual pipe lengths are shown in the graphs. Deferred sewer renewal includes 345 laterals that were not addressed on past pipeline renewal projects.

Estimated Renewal Costs between 2020 and 2040

Asset Type	Deferred Sewer Renewal		Near-Term Sewer Renewal	
	Quantity	Estimated Cost	Quantity	Estimated Cost
Gravity Sewers	11.72 miles	$5,755,000	16.14 miles	$7,926,000
Manholes	75 manholes	$248,000	105 manholes	$347,000
Laterals	750 laterals	$3,900,000	565 laterals	$2,938,000
Total		**$9,903,000**		**$11,211,000**



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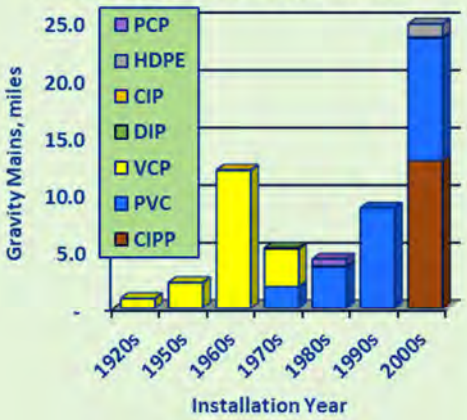
Section 10
City of Fountain Inn

The City of Fountain Inn is one of three participating municipalities providing wastewater collection services in Greenville County. This section characterizes the sewer system based on information provided by Fountain Inn, summarizes historic assessment and renewal practices, highlights key assumptions specific to the Fountain Inn system, estimates deferred system renewal, and defines anticipated future system renewal needs.

For this evaluation, system renewal is defined as measures that restore the full structural integrity of the sewer, achieved either by full pipe replacement or CIPP lining of the gravity sewer main and a portion of the associated sewer manholes and laterals. Point repairs do not fully renew a gravity main and are not accounted for in this evaluation.

Key Facts:
City of Fountain Inn
Service Area: 6.0 sq. mi.
Customers Served: 4,020

Gravity Sewer Mains
Total Length: 305,933 ft. (58.0 miles)
Renewal to date: 75,292 ft. (14.3 miles)
Number of Manholes: 1,413
Average Spacing: 217 ft per manhole



Laterals (Main to ROW)
Active: 4,020 Inactive: 200
Average Spacing: 76 ft per lateral
Ownership/Maintenance: Customer

Pump Stations and Force Mains
1 pump station, total capacity = 275 gpm
Length of Force Main: 3,500 ft.

System Characteristics

Area and Customers Served

Fountain Inn provides wastewater collection to approximately 4,020 customers within a 6.0 sq. mi. service area, located along I-385 in south-eastern Greenville County.

Gravity Mains and Manholes

Fountain Inn operates 305,933 ft. (58.0 miles) of 6-inch to 12-inch diameter gravity main[7], largely built of vitrified clay pipe (VCP) in the 1950's to 1970's and polyvinyl-chloride pipe (PVC) from the 1970's to today. Approximately 25 percent of the gravity mains have been renewed over the past two decades, largely with a CIPP liner to address infiltration/inflow and/or address root intrusion. In addition, 14 percent of the 1,413 manholes have been renewed under renewal contracts, as determined by manhole inspections.

Laterals and Service Connections

Fountain Inn estimates that there is one active lateral for each customer and 200 inactive laterals. Property owners are responsible for lateral maintenance from the main to the property line as well as from the property line to the building. Fountain Inn has not inspected or performed renewal on any laterals but replaces service tees that affect the main sewer.

[7] Based upon responses to questionnaire completed to support this study.

Pump Stations and Force Mains

Fountain Inn owns 1 pump station (capacity = 275 gpm) and 3,500 ft of associated force main.

System Assessment and Renewal History

Fountain Inn has performed CCTV inspection on over 30 percent of their gravity mains during the past 10 years. Of the gravity mains inspected in the past 10 years, approximately 60 percent of the sewers are televised to identify infiltration/ inflow, with an additional 30 percent of inspections focused on proactive condition assessment. Renewal performed to date focuses on older vitrified clay pipes, with PVC pipe generally found to be in good condition. Fountain Inn is currently developing a Capital Improvement Plan.

Anticipated Renewal Needs

Methodology for Estimating Sewer Main Renewal Needs

Future gravity main renewal requirements for Fountain Inn were determined in the following manner:

- Sewer pipeline/main service life relationships (i.e., the estimated service life of a pipe material type) were determined using industry experience and historic local/regional data relating pipe age to observed structural deterioration, as described in Section 2 of this report. (It is important to keep in mind that pipe age and material service life relationships may not fully address infiltration/inflow control needs.)
- Sewer lengths within each pipe material/age category are based on the information provided by Fountain Inn, as summarized earlier in this section. Pipe footage assigned to a certain decade was equally distributed over the 10-year period.
- The age of sewers replaced or rehabilitated with CIPP liner over the past 20 years were adjusted to the estimated date of renewal. Sewers receiving point repairs are not considered to be fully renewed and their ages are based on their original installation date/material.
- The actual sewer age/material was compared to the sewer service life relationships to determine the approximate date when renewal of the sewer main is projected to be needed.

Methodology for Estimating Manhole and Lateral Renewal Needs

- For each segment of gravity sewer main scheduled for renewal each year, renewal is projected for 25 percent of the manholes (i.e., one in four) and 40 percent of the laterals (i.e., four in ten) associated with that gravity main section.
- The remaining manholes (75%) and laterals (60%) will need renewal at some point in the future, anticipated to be beyond the 20-Year Planning period used for financial projections.
- The number of manholes and laterals along a gravity sewer main segment are estimated based upon the systemwide average length of sewer mainline per manhole and per lateral.
- Past gravity sewer main renewal is assumed to have included needed manhole renewal.
- For Past mainline renewal that did not include lateral renewal, 40% of laterals assumed to be located on that length of mainline are counted as deferred laterals.

Methodology for Estimating Renewal Costs

The following per-unit sewer renewal costs were used to estimate total renewal needs over the planning period: See Section 2 for details on unit cost development.

- *Gravity Sewer Main Renewal*: an average cost of $93.00 per foot, (which is a blended rate of CIPP lining, pipe bursting, and pipe replacement projects).
- *Manhole Renewal*: an average cost of $3,300 per manhole for full cementitious lining/coating.
- *Lateral Renewal (from main to property line): an average cost of* $5,200 per lateral, largely based on replacement costs.

These unit costs are based upon the actual cost of renewal projects in South Carolina using a blend of technologies (i.e.,) and site conditions and the following assumptions:

- Unit construction costs include costs for installation, mobilization, pavement removal/ replacement, erosion and sediment control, bypass pumping, initial CCTV assessments, testing, and a 10% construction contingency.
- Professional services during design (12% of construction costs), construction (5% of construction costs), and general administrative/legal costs (4% of construction costs).

Estimated Collection System Renewal Needs

The status of sewer renewal for Fountain Inn in 2019 and projected future system renewal needs were determined according to the evaluation methodology summarized in the previous section. Projected system renewal needs are estimated and graphed each year by pipe material. Projected renewal needs increase as pipe inventory ages, diminish as renewal occurs, and typically increase again to represent the next cycle of system renewal.

Figure 10-1 "looks back" at past projected system renewal needs compared with actual system renewal achieved. **Figure 10-2** "looks forward" to near-term projected renewal needs during a 20-year planning period (i.e., FY2020 through FY2040) and continuing until 2080 to reveal long-term sewer renewal trends. Deferred renewal needs (as calculated in Figure 10-1) are shown in Figure 10-2 in addition to the projected annual renewal, spread across a 15-year time period starting in 2021. The following conclusions are drawn from this evaluation:

- **System Renewal Status.** The "look back" estimate depicted on Figure 10-1 projects system renewal needs of 13.06 miles, calculated as the sum of each year's projected renewal needs from inception through 2019. The blue shaded area on Figure 10-1 represents the 14.26 miles of gravity sewer renewal that Fountain Inn has implemented since 2000, indicating that Fountain Inn renewed more sewer than projected and has not deferred any projected gravity main line sewer renewal.
- **Projected Near-Term Renewal Needs.** Figure 10-2 shows that 8.78 miles of gravity sewer renewal is likely to be needed in the near-term (i.e., during a 20-year planning period from FY2020 through FY2040), increasing from 0.41 miles per year in 2020 to 0.42 miles per year in 2027. No deferred sewer renewal is projected in the near-term, however 390 laterals along previously renewed sewers should be renewed over the next 15 years to "catch up".

Figure 10-1. Fountain Inn Annual Sewer Renewal Needs

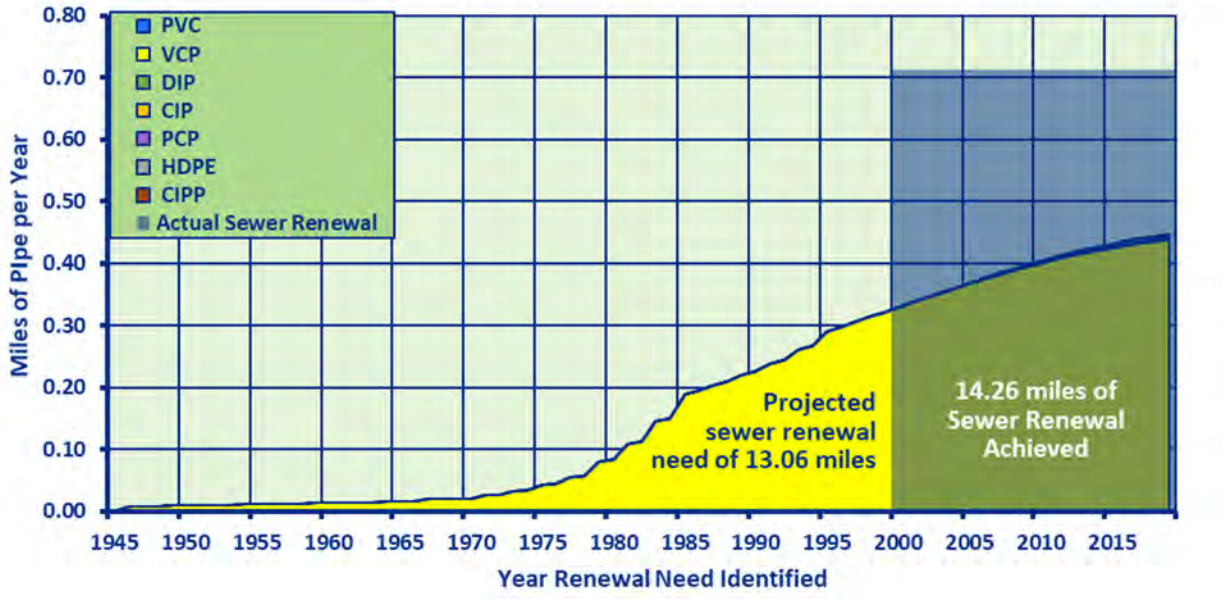
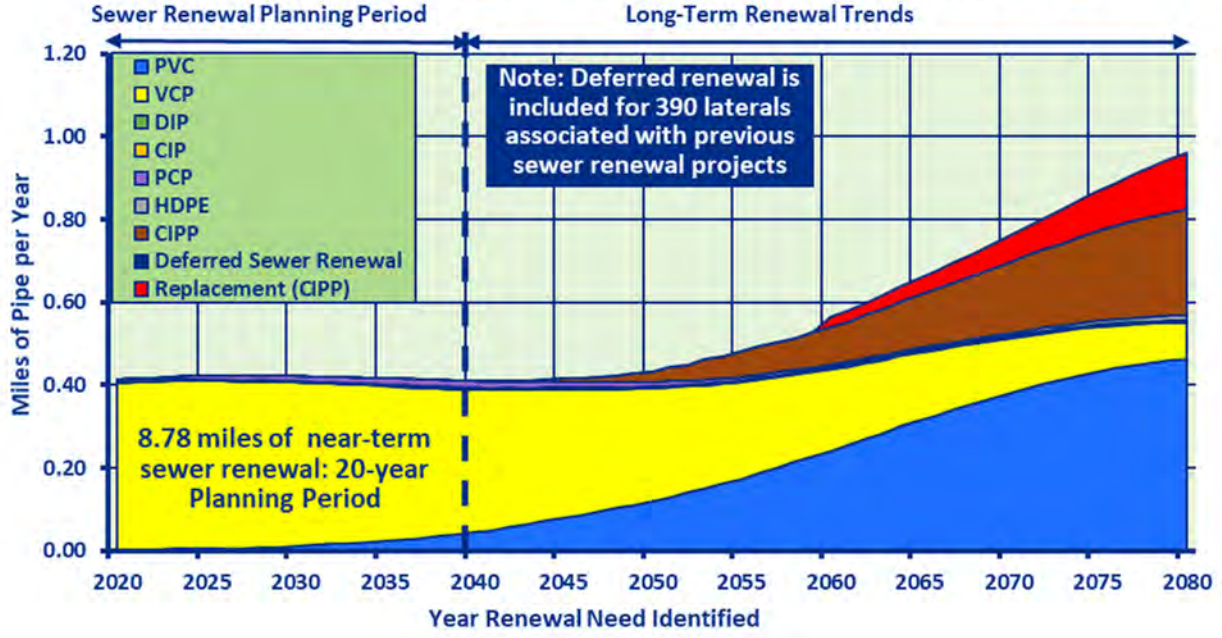


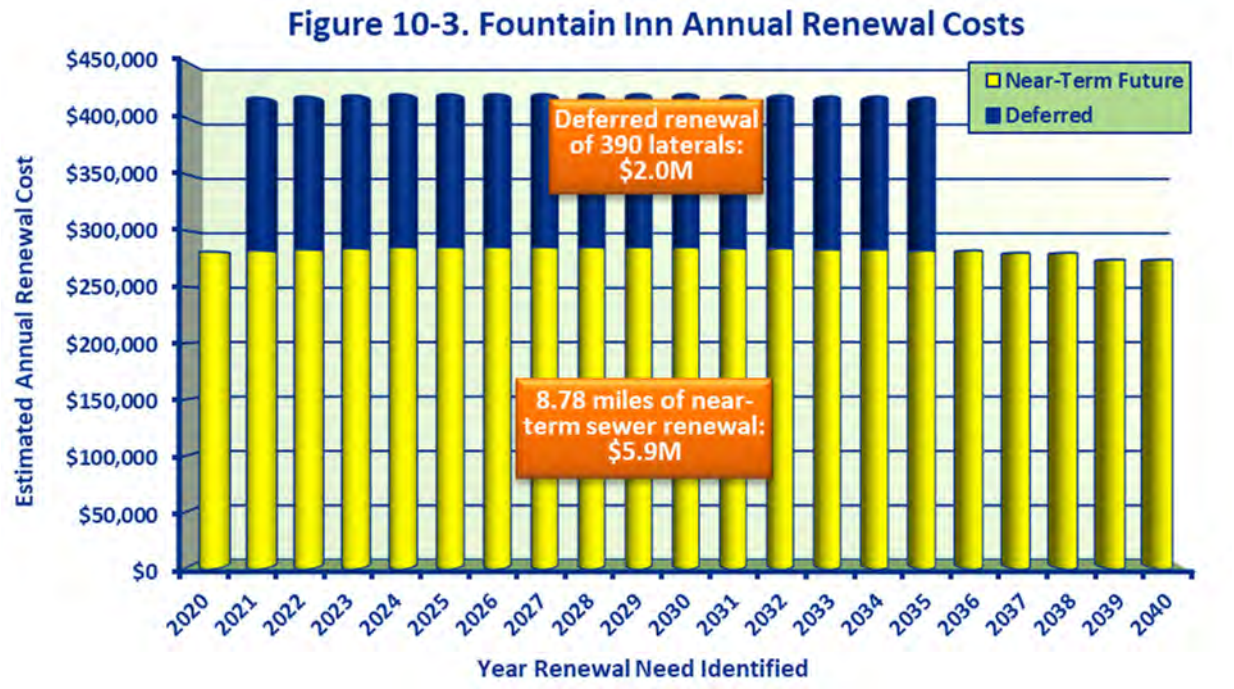
Figure 10-2. Fountain Inn Annual Sewer Renewal Needs



- **Projected Long-Term Renewal Trends.** Annual sewer renewal needs increase throughout the next 60-years, peaking somewhat after 2080 at 1.1 miles per year.
- **Estimated Cost of Sewer Renewal**. **Figure 10-3** indicates that the estimated total renewal costs across the 20-year planning period are $7.9M in today's dollars, inclusive of the cost to renew laterals not addressed under previous sewer renewal projects and projected future sewer renewal costs. Projected annual pipe lengths are shown in the graphs.

Estimated Renewal Costs between 2020 and 2040

Asset Type	Deferred Sewer Renewal		Future Sewer Renewal	
	Quantity	Estimated Cost	Quantity	Estimated Cost
Gravity Sewers	0.00 miles	$0	8.78 miles	$4,313,000
Manholes	- manholes	$0	63 manholes	$208,000
Laterals	390 laterals	$2,028,000	271 laterals	$1,410,000
Total		**$2,028,000**		**$5,931,000**



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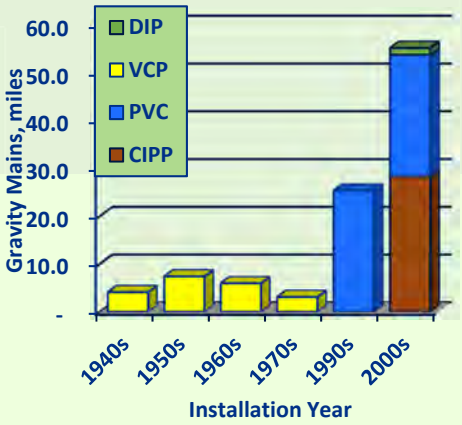
Section 11
City of Simpsonville

The City of Simpsonville is one of three participating municipalities providing wastewater collection services in Greenville County. This section characterizes the sewer system based on information provided by Simpsonville, summarizes historic assessment and renewal practices, highlights key assumptions specific to the Simpsonville system, estimates deferred system renewal, and defines anticipated future system renewal needs.

For this evaluation, system renewal is defined as measures that restore the full structural integrity of the sewer, achieved either by full pipe replacement or CIPP lining of the gravity sewer main and a portion of the associated sewer manholes and laterals. Point repairs do not fully renew a gravity main and are not accounted for in this evaluation.

Key Facts:
City of Simpsonville
Service Area: 9.0 sq. mi.
Customers Served: 7,150

Gravity Sewer Mains
Total Length: 533,798 ft. (101.1 miles)
Renewal to date: 171,746 ft. (32.5 miles)
Number of Manholes: 2,479
Average Spacing: 215 ft per manhole



Laterals (Main to ROW)
Active: 7,150 Inactive: 350
Average Spacing: 75 ft per lateral
Ownership/Maintenance: Customer

Pump Stations and Force Mains
No pump stations, total capacity = 0 gpm
Length of Force Main: 0 ft.

System Characteristics

Area and Customers Served

Simpsonville provides wastewater collection to approximately 7,150 customers within a 9.0 sq. mi. service area, located along I-385 in south-eastern Greenville County.

Gravity Mains and Manholes

Simpsonville operates 533,798 ft. (101.1 miles) of 6-inch to 12-inch diameter gravity main[8], largely built of vitrified clay pipe (VCP) before 1980 and polyvinyl-chloride pipe (PVC) since 1990. Approximately 32 percent of the gravity mains have been renewed over the past two decades, largely with a CIPP liner to address infiltration/inflow and/or address maintenance issues (i.e., sags, roots, etc). In addition, 5 percent of the 2,479 manholes have been renewed as deemed necessary through manhole inspections under rehabilitation contracts.

Laterals and Service Connections

Simpsonville estimates that there is one active lateral for each customer and 350 inactive laterals. Property owners are responsible for lateral maintenance from the main to the property line as well as from the property line to the building. Except for a few rare conditions, all lateral maintenance has been the obligation of the property owner.

[8] Based upon responses to questionnaire completed to support this study.

Pump Stations and Force Mains

Simpsonville does not own or operate any pump stations or force mains.

System Assessment and Renewal History

Simpsonville has maintained an annual 'find and fix' contract for the last several years to proactively identifying potential issues. Under these contracts, Simpsonville has performed CCTV inspection on over 75 percent of their gravity mains during the past 10 years. Of the gravity mains inspected in the past 10 years, approximately 60 percent of the sewers are televised to identify infiltration/ inflow, with an additional 30 percent of inspections focused on proactive condition assessment. Renewal performed to date focuses on older vitrified clay pipes, with PVC pipe generally found to be in good condition. Roots are cut out with routine cleaning and then lined under rehabilitation contracts.

Anticipated Renewal Needs

Methodology for Estimating Sewer Main Renewal Needs

Future gravity main renewal requirements for Simpsonville were determined in the following manner:

- Sewer pipeline/main service life relationships (i.e., the estimated service life of a pipe material type) were determined using industry experience and historic local/regional data relating pipe age to observed structural deterioration, as described in Section 2 of this report. (It is important to keep in mind that pipe age and material service life relationships may not fully address infiltration/inflow control needs.)
- Sewer lengths within each pipe material/age category are based on the information provided by Simpsonville, as summarized earlier in this section. Pipe footage assigned to a certain decade was equally distributed over the 10-year period.
- The age of sewers replaced or rehabilitated with CIPP liner over the past 20 years were adjusted to the estimated date of renewal. Sewers receiving point repairs are not considered to be fully renewed and their ages are based on their original installation date/material.
- The actual sewer age/material was compared to the sewer service life relationships to determine the approximate date when renewal of the sewer main is projected to be needed.

Methodology for Estimating Manhole and Lateral Renewal Needs

- For each segment of gravity sewer main scheduled for renewal each year, renewal is projected for 25 percent of the manholes (i.e., one in four) and 40 percent of the laterals (i.e., four in ten) associated with that gravity main section.
- The remaining manholes (75%) and laterals (60%) will need renewal at some point in the future, anticipated to be beyond the 20-Year Planning period used for financial projections.
- The number of manholes and laterals along a gravity sewer main segment are estimated based upon the systemwide average length of sewer mainline per manhole and per lateral.
- Past gravity sewer main renewal is assumed to have included needed manhole renewal.

- For Past mainline renewal that did not include lateral renewal, 40% of laterals assumed to be located on that length of mainline are counted as deferred laterals.

Methodology for Estimating Renewal Costs

The following per-unit sewer renewal costs were used to estimate total renewal needs over the planning period: See Section 2 for details on unit cost development.

- *Gravity Sewer Main Renewal*: an average cost of $93.00 per foot, (which is a blended rate of CIPP lining, pipe bursting, and pipe replacement projects).
- *Manhole Renewal*: an average cost of $3,300 per manhole for full cementitious lining/coating.
- *Lateral Renewal (from main to property line): an average cost of* $5,200 per lateral, largely based on replacement costs.

These unit costs are based upon the actual cost of renewal projects in South Carolina using a blend of technologies (i.e.,) and site conditions and the following assumptions:

- Unit construction costs include costs for installation, mobilization, pavement removal/ replacement, erosion and sediment control, bypass pumping, initial CCTV assessments, testing, and a 10% construction contingency.
- Professional services during design (12% of construction costs), construction (5% of construction costs), and general administrative/legal costs (4% of construction costs).

Estimated Collection System Renewal Needs

The status of sewer renewal for Simpsonville in 2019 and projected future system renewal needs were determined according to the evaluation methodology summarized in the previous section. Projected system renewal needs are estimated and graphed each year by pipe material. Projected renewal needs increase as pipe inventory ages, diminish as renewal occurs, and typically increase again to represent the next cycle of system renewal.

Figure 11-1 "looks back" at past projected system renewal needs compared with actual system renewal achieved. **Figure 11-2** "looks forward" to near-term projected renewal needs during a 20-year planning period (i.e., FY2020 through FY2040) and continuing until 2080 to reveal long-term sewer renewal trends. Deferred renewal needs (as calculated in Figure 11-1) are shown in Figure 11-2 in addition to the projected annual renewal, spread across a 15-year time period starting in 2021. The following conclusions are drawn from this evaluation:

- **System Renewal Status.** The "look back" estimate depicted on Figure 11-1 projects system renewal needs of 25.25 miles, calculated as the sum of each year's projected renewal needs from inception through 2019. The blue shaded area on Figure 11-1 represents the 32.53 miles of gravity sewer renewal that Simpsonville has implemented since 2000, indicating that Simpsonville renewed more sewer than projected and has not deferred any projected gravity main line sewer renewal.

Figure 11-1. Simpsonville Annual Sewer Renewal Needs

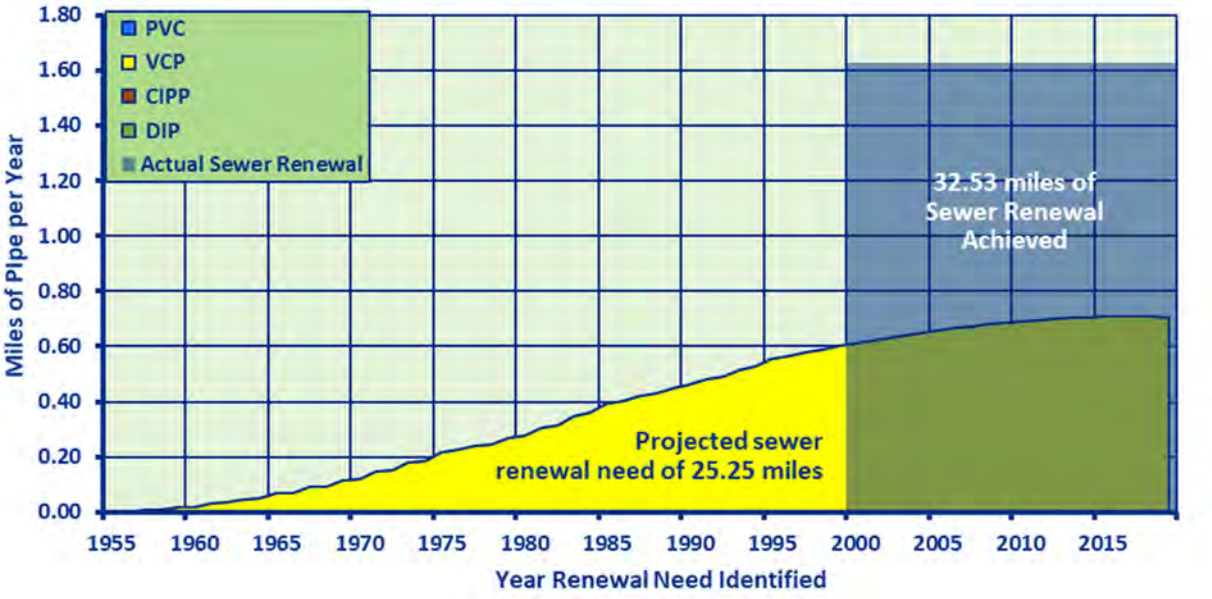
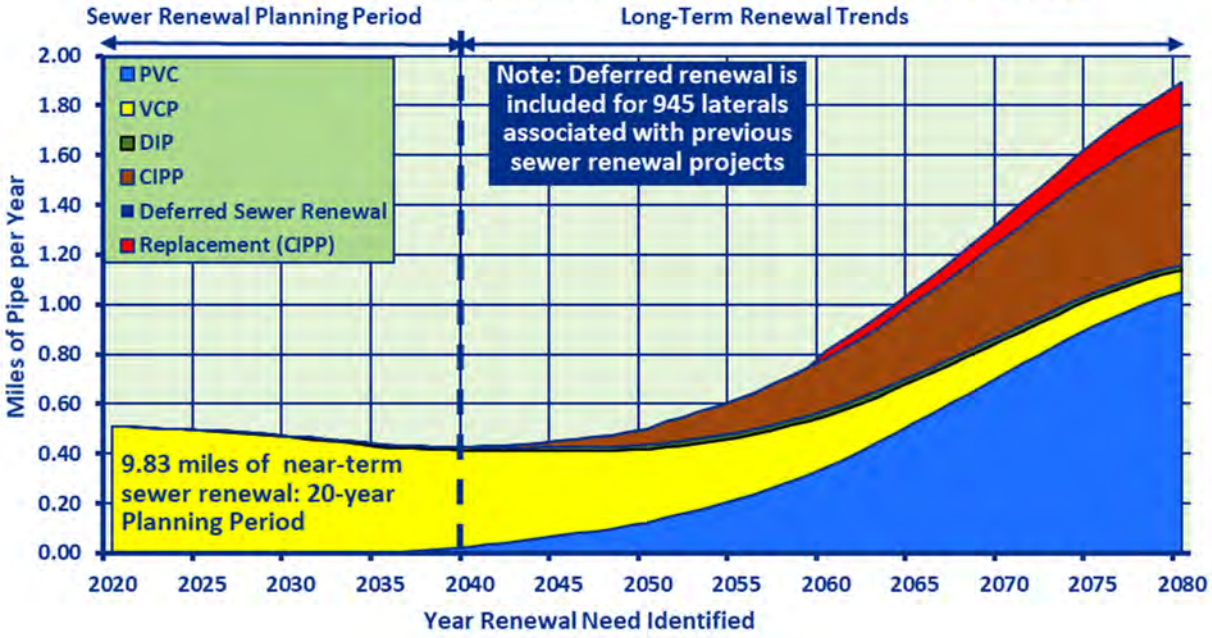


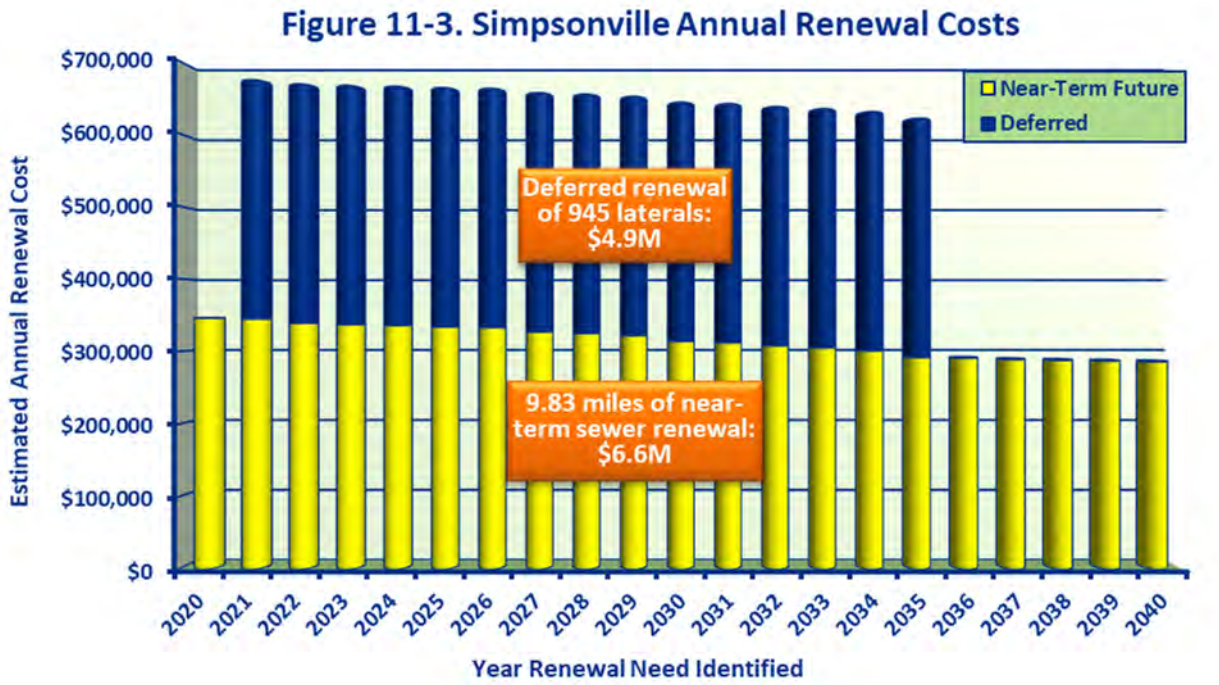
Figure 11-2. Simpsonville Annual Sewer Renewal Needs



- **Projected Near-Term Renewal Needs.** Figure 11-2 shows that 9.83 miles of gravity sewer renewal is likely to be needed in the near-term (i.e., during a 20-year planning period from FY2020 through FY2040), decreasing from 0.51 miles per year in 2020 to 0.43 miles per year in 2040, then increasing through 2040 and beyond. No deferred sewer renewal is projected in the near-term, however 945 laterals along previously renewed sewers should be renewed over the next 15 years to "catch up".
- **Projected Long-Term Renewal Trends.** Annual sewer renewal needs increase throughout the next 60-years, peaking somewhat after 2080 at over 2.1 miles per year.
- **Estimated Cost of Sewer Renewal**. **Figure 11-3** indicates that the estimated total renewal costs across the 20-year planning period are $11.5M in today's dollars, inclusive of the cost to renew laterals not addressed under previous sewer renewal projects and projected future sewer renewal costs. Projected annual pipe lengths are shown in the graphs.

Estimated Renewal Costs between 2020 and 2040

Asset Type	Deferred Sewer Renewal		Future Sewer Renewal	
	Quantity	Estimated Cost	Quantity	Estimated Cost
Gravity Sewers	0.00 miles	$0	9.83 miles	$4,827,000
Manholes	- manholes	$0	70 manholes	$231,000
Laterals	945 laterals	$4,914,000	300 laterals	$1,560,000
Total		**$4,914,000**		**$6,618,000**



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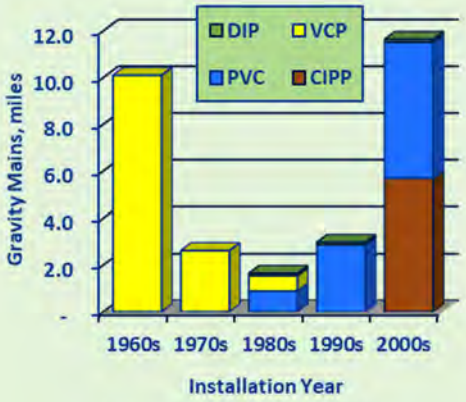
Section 12
City of Travelers Rest

The City of Travelers Rest is one of three participating municipalities providing wastewater collection services in Greenville County. This section characterizes the sewer system based on information provided by Travelers Rest, summarizes historic assessment and renewal practices, highlights key assumptions specific to the Travelers Rest system, estimates deferred system renewal, and defines anticipated future system renewal needs.

For this evaluation, system renewal is defined as measures that restore the full structural integrity of the sewer, achieved either by full pipe replacement or CIPP lining of the gravity sewer main and a portion of the associated sewer manholes and laterals. Point repairs do not fully renew a gravity main and are not accounted for in this evaluation.

Key Facts:
City of Travelers Rest
Service Area: 4.6 sq. mi.
Customers Served: 1,500

Gravity Sewer Mains
Total Length: 152,902 ft. (29.0 miles)
Renewal to date: 30,000 ft. (5.7 miles)
Number of Manholes: 802
Average Spacing: 191 ft per manhole



Laterals (Main to ROW)
Active: 1,600 Inactive: 80
Average Spacing: 102 ft per lateral
Ownership/Maintenance: Customer

Pump Stations and Force Mains
1 pump station, total capacity = 208 gpm
Length of Force Main: 13,200 ft.

System Characteristics

Area and Customers Served

Travelers Rest provides wastewater collection to approximately 1,500 customers within a 4.6 sq. mi. service area, located north of the City of Greenville in central Greenville County.

Gravity Mains and Manholes

Travelers Rest operates 152,902 ft. (29.0 miles) of 6-inch to 8-inch diameter gravity main[9], largely built of vitrified clay pipe (VCP) in the 1960's and 1970's and polyvinyl-chloride pipe (PVC) from the 1980's to today. Approximately 20 percent of the gravity mains have been renewed over the past two decades with a CIPP liner to address roots, fractures, sages, and infiltration/inflow. In addition, 19 percent of the 802 manholes have been renewed to address major defects and repair block manholes connecting to sewer mains with CIPP liners installed.

Laterals and Service Connections

Travelers Rest estimates that there are 1,600 active laterals and 80 inactive laterals, installed to serve specific lots/properties as the sewer was installed. Property owners are responsible for lateral maintenance from the main to the property line as well as from the property line to the

[9] Based upon responses to questionnaire completed to support this study.

building. Travelers Rest has replaced or renewed 80 percent of laterals associated with prior gravity main sewer renewal projects.

Pump Stations and Force Mains

Travelers Rest owns 1 pump station (capacity = 208 gpm) and 13,200 ft of associated force main.

System Assessment and Renewal History

Travelers Rest has performed CCTV inspection on over 30 percent of their gravity mains during the past 10 years, primarily for proactive condition assessment. Renewal performed to date focuses on older vitrified clay pipes, with PVC pipe generally found to be in good condition. Root intrusion is believed to affect the structural integrity and/or hydraulic capacity of 30 percent of Travelers Rest collection system.

Anticipated Renewal Needs

Methodology for Estimating Sewer Main Renewal Needs

Future gravity main renewal requirements for Travelers Rest were determined in the following manner:

- Sewer pipeline/main service life relationships (i.e., the estimated service life of a pipe material type) were determined using industry experience and historic local/regional data relating pipe age to observed structural deterioration, as described in Section 2 of this report. (It is important to keep in mind that pipe age and material service life relationships may not fully address infiltration/inflow control needs.)
- Sewer lengths within each pipe material/age category are based on the information provided by Travelers Rest, as summarized earlier in this section. Pipe footage assigned to a certain decade was equally distributed over the 10-year period.
- The age of sewers replaced or rehabilitated with CIPP liner over the past 20 years were adjusted to the estimated date of renewal. Sewers receiving point repairs are not considered to be fully renewed and their ages are based on their original installation date/material.
- The actual sewer age/material was compared to the sewer service life relationships to determine the approximate date when renewal of the sewer main is projected to be needed.

Methodology for Estimating Manhole and Lateral Renewal Needs

- For each segment of gravity sewer main scheduled for renewal each year, renewal is projected for 25 percent of the manholes (i.e., one in four) and 40 percent of the laterals (i.e., four in ten) associated with that gravity main section.
- The remaining manholes (75%) and laterals (60%) will need renewal at some point in the future, anticipated to be beyond the 20-Year Planning period used for financial projections.
- The number of manholes and laterals along a gravity sewer main segment are estimated based upon the systemwide average length of sewer mainline per manhole and per lateral.
- Past gravity sewer main renewal is assumed to have included needed manhole renewal.
- For Past mainline renewal that did not include lateral renewal, 40% of laterals assumed to be located on that length of mainline are counted as deferred laterals.

Methodology for Estimating Renewal Costs

The following per-unit sewer renewal costs were used to estimate total renewal needs over the planning period: See Section 2 for details on unit cost development.

- *Gravity Sewer Main Renewal*: an average cost of $93.00 per foot, (which is a blended rate of CIPP lining, pipe bursting, and pipe replacement projects).
- *Manhole Renewal*: an average cost of $3,300 per manhole for full cementitious lining/coating.
- *Lateral Renewal (from main to property line): an average cost of* $5,200 per lateral, largely based on replacement costs.

These unit costs are based upon the actual cost of renewal projects in South Carolina using a blend of technologies (i.e.,) and site conditions and the following assumptions:

- Unit construction costs include costs for installation, mobilization, pavement removal/ replacement, erosion and sediment control, bypass pumping, initial CCTV assessments, testing, and a 10% construction contingency.
- Professional services during design (12% of construction costs), construction (5% of construction costs), and general administrative/legal costs (4% of construction costs).

Estimated Collection System Renewal Needs

The status of sewer renewal for Travelers Rest in 2019 and projected future system renewal needs were determined according to the evaluation methodology summarized in the previous section. Projected system renewal needs are estimated and graphed each year by pipe material. Projected renewal needs increase as pipe inventory ages, diminish as renewal occurs, and typically increase again to represent the next cycle of system renewal.

Figure 12-1 "looks back" at past projected system renewal needs compared with actual system renewal achieved. **Figure 12-2** "looks forward" to near-term projected renewal needs during a 20-year planning period (i.e., FY2020 through FY2040) and continuing until 2080 to reveal long-term sewer renewal trends. Deferred renewal needs (as calculated in Figure 12-1) are shown in Figure 12-2 in addition to the projected annual renewal, spread across a 15-year time period starting in 2021. The following conclusions are drawn from this evaluation:

- **System Renewal Status.** The "look back" estimate depicted on Figure 12-1 projects system renewal needs of 6.65 miles, calculated as the sum of each year's projected renewal needs from inception through 2019. The blue shaded area on Figure 12-1 represents the 5.68 miles of gravity sewer renewal that Travelers Rest has implemented since 2000. The difference of 0.98 miles is the projected gravity sewer renewal that has been deferred.
- **Projected Near-Term Renewal Needs.** Figure 12-2 shows that 5.49 miles of gravity sewer renewal is likely to be needed in the near-term (i.e., during a 20-year planning period from FY2020 through FY2040), increasing from 0.26 miles per year in 2020 to 0.27 miles per year in 2026, then decreasing to 0.23 miles per year in 2049. If the 0.98 miles of deferred renewal is spread out over a 15-year period, an additional 0.07 miles of sewer renewal is required annually to "catch up".

Figure 12-1. Travelers Rest Annual Sewer Renewal Needs

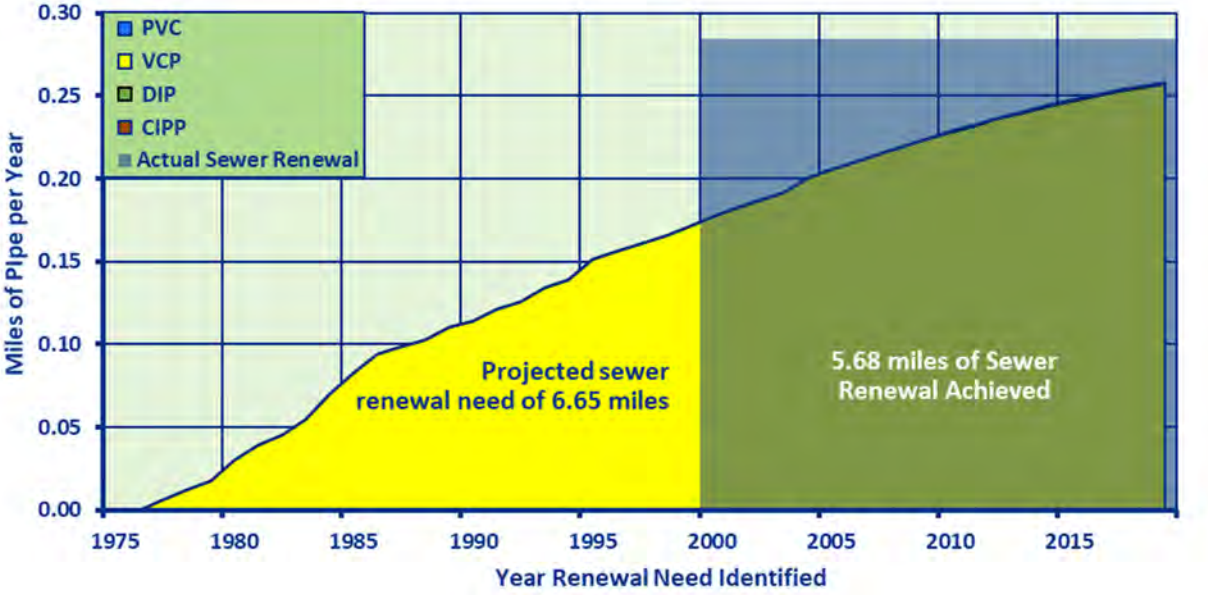
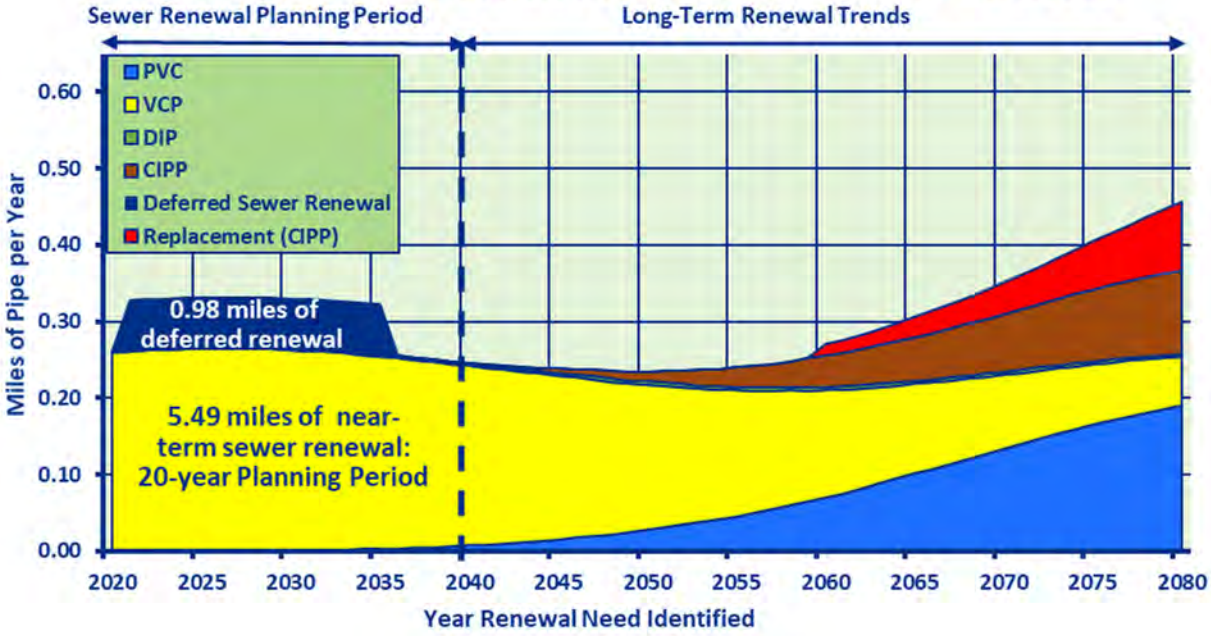


Figure 12-2. Travelers Rest Annual Sewer Renewal Needs



- **Projected Long-Term Renewal Trends.** After 2049, annual sewer renewal needs, peaking somewhat after 2080 at over 0.5 miles per year.
- **Estimated Cost of Sewer Renewal**. **Figure 12-3** indicates that the estimated total renewal costs across the 20-year planning period are $4.3M in today's dollars, inclusive of projected future sewer renewal costs. No additional lateral renewal is needed along previously renewed gravity mains. Projected annual pipe lengths are shown in the graphs.

Estimated Renewal Costs between 2020 and 2040

Asset Type	Deferred Sewer Renewal		Future Sewer Renewal	
	Quantity	Estimated Cost	Quantity	Estimated Cost
Gravity Sewers	0.98 miles	$481,000	5.47 miles	$2,688,000
Manholes	15 manholes	$50,000	42 manholes	$139,000
Laterals	30 laterals	$156,000	141 laterals	$734,000
Total		**$687,000**		**$3,561,000**

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Section 13

Renewable Water Resources (ReWa)

In developing this study, requests were made by several participating entities to include Renewable Water Resources (ReWa). ReWa is a regional provider of trunk mains and wastewater treatment plants that collects, consolidates, and treats wastewater in Greenville County from the other entities listed in this report.

ReWa owns and maintains a portion of recently acquired local collection system pipe networks within the north eastern part of Anderson County and in northern Greenville County. Unlike other entities, this is a small portion of their overall system (currently 12.4 percent of gravity sewer lines). The majority of ReWa's conveyance system is larger infrastructure consisting of regional trunk mains.

The ReWa system could not be analyzed in a similar approach to that used for these other entities and therefore is not included in this Study's summary tables and charts. The reasons for this include:

- Historically, ReWa's primary function has been to transport and treat wastewater. The makeup of the infrastructure is vastly different from a local collection system.
- The mortality curves for larger diameter pipe vary from the curves developed for the small diameter pipe (typically 8-12 inch).
- A portion of ReWa's local collection system assets have been obtained in recent years from other entities. Information necessary to include these assets in the same study approach was not possible as the year of installation could not be approximated.

ReWa's FY2020 Capital Improvement Plan includes significant percentages devoted to capacity enhancement of existing pipelines and pump station facilities. This project type does not typically represent a major percentage of the other wastewater collection systems included in this study. Capacity enhancement projects can accomplish asset renewal when replacing an existing pipe with a new pipe. Relocation projects also accomplish asset renewal by abandoning the use of existing pipelines. In the period from 2004 through 2019, ReWa's conveyance projects consisted primarily of pump station upgrades and renewal, pipeline upgrades, and pipeline renewal. A breakdown of the capital invested (rounded to the nearest million) in these projects during that time period are:

- Pump Station Upgrade and Renewal - $31,000,000
- Pipeline Upgrades and Relocations - $59,000,000
- Pipeline Renewal - $46,000,000

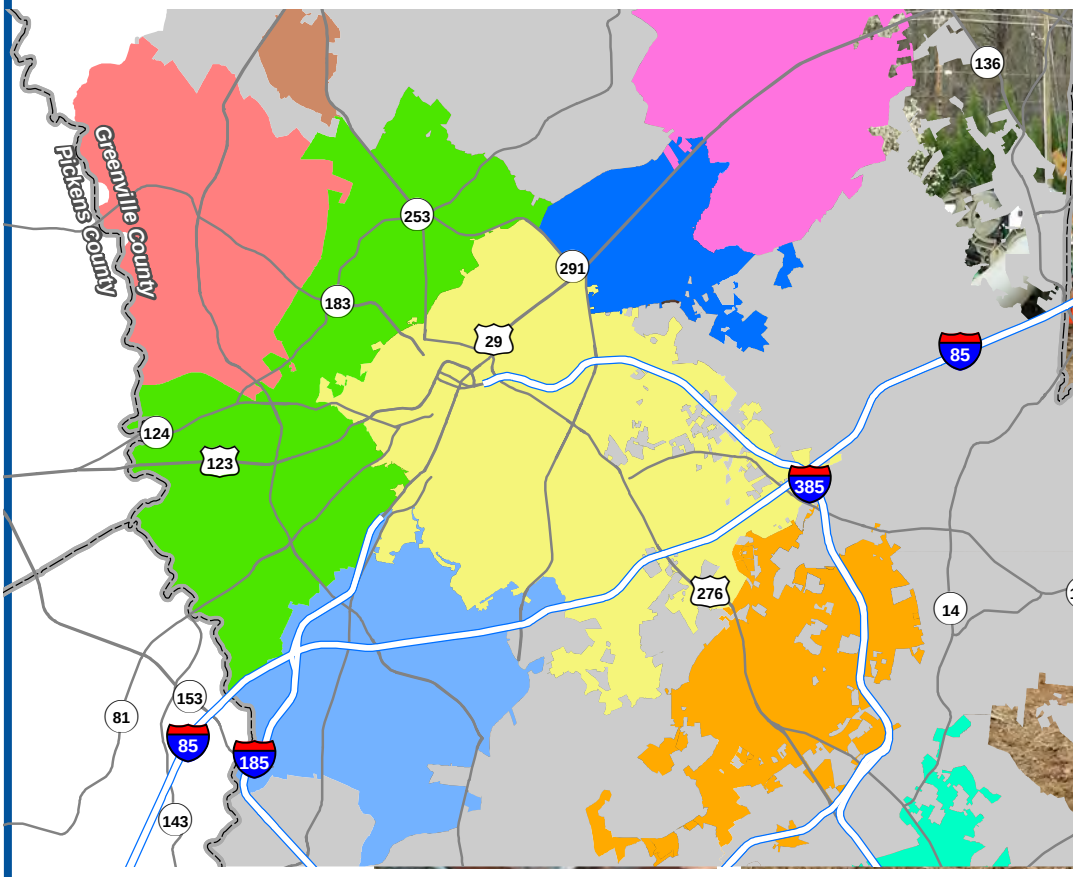
The portion of the pipeline upgrades that either replaced or abandoned existing lines is $25,000,000. The total invested in the 16-year period is $136,000,000 or $8,500,000 per year. Of this total it is estimated that $133,000,000 was spent in Greenville County.

To present the most current forward-looking information from ReWa that relates to this study's efforts, staff provided a portion of the near-term CIP plan. The numbers below represent the next 5 years of the current CIP from FY20 through FY24 and include estimates for capacity enhancing projects as well as rehabilitation. Projects within ReWa's system that are located outside of Greenville County have not been included. It is estimated that approximately half of the budget for Capacity Enhancement projects will provide the opportunity to remove or abandon in-place existing infrastructure.

Please note that ReWa is undergoing major planning through it's Wet Weather Program. Therefore, these values are likely to evolve as planning detail progresses.

Table 13-1. Summary of ReWa's Planned Capital Improvements for Collection Systems in Greenville Count during FY2020 through FY2024

Project Category	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	Total
Capacity Enhancement Projects						
Gravity Pipelines	$39,600,000	$13,700,000	$1.500,000	$7,100,000	$2,400,000	**$64,300,000**
Pump Station and Force Main	$300,000	$5,300,000	$4,600,000	$7,200,000	$14,900,000	**$32,300,000**
Rehabilitation Projects						
Gravity Pipelines	$2,800,000	$4,400,000	$4,200,000	$4,500,000	$3,400,000	**$19,300,000**
Pump Station and Force Main	$1,400,000	$3,300,000	$5,900,000	$1,900,000	$1,300,000	**$13,800,000**
Local Collection Systems	$300,000	$900,000	$2,000,000	$0	$0	**$3,200,000**



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