City of Florence, South Carolina

Stormwater Master Plan

October 2024

FULL LIFE. FULL FORWARD.
FLORENCE
SOUTH CAROLINA

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Executive Summary

This Stormwater Master Plan (SWMP)[1] for the City of Florence (City), South Carolina, serves as a comprehensive guide for stormwater management and flood mitigation that will enable the City to be better prepared for future storm events. It is also a tool the City can use to promote collaboration between responsible parties and stakeholders. Stormwater infrastructure within the City has evolved over the years, resulting in multiple parties responsible for the management and maintenance of the utility. The four main responsible parties for stormwater infrastructure within the City are the City of Florence, the South Carolina Department of Transportation (SCDOT), Florence County, and private property owners. This multifaceted responsibility underscores the importance of collaboration. The City does not have direct influence over all the stormwater management within the City. Therefore, all responsible parties must work together for the overall betterment of the stormwater utility and its impact on stakeholders.

As a Municipal Separate Storm Sewer System (MS4) community, the City of Florence has been proactive in its approach to managing stormwater. The City's MS4 designation requires compliance with federal and state regulations, including the National Pollutant Discharge Elimination System (NPDES) program. As part of its MS4 responsibilities, the City already conducts public education and outreach, encourages public participation and involvement, detects and eliminates illicit discharges, controls runoff from construction sites, manages post-construction site runoff, and implements pollution prevention and good housekeeping practices. These efforts are a testament to Florence's proactive stance on environmental stewardship and regulatory compliance.

The SWMP integrates all existing components of the City's Stormwater Program into a cohesive strategy. This strategy is designed to provide functional and cost-effective stormwater solutions, and takes into account community growth, climate change, and long-term viability. The SWMP is a living document and serves as guidance for prioritizing projects over the next 20 years. It is intended to be revisited frequently, at least every five years, to ensure that it remains relevant and effective. This plan should not be viewed as a final product but rather as a roadmap for future planning and as a reference tool for City leaders.

The SWMP is based on information gained from the City's development of its asset management activities, including infrastructure mapping and condition assessments, into a formal program. Input from the public as well as guidance from City staff helped refine the focus for managing and budgeting the City's stormwater assets. The proper operation of a stormwater utility depends upon effective asset management. Utility function and revenue were key considerations in the development of the SWMP to ensure that adequate funding would be available for both project implementation and long-term maintenance.

1 It is important to note that there is an existing Stormwater Management Plan (SWMP) for the City of Florence, which shares the same acronym as the Stormwater Master Plan (SWMP). The Stormwater Management Plan was last updated in 2017 and defines how the City will comply with the NPDES MS4 Permit. The Stormwater Master Plan does not supersede the existing Stormwater Management Plan. Rather, the Stormwater Master Plan serves as an overarching guidance document that complements the existing Stormwater Management Plan. The two plans should be used together to make better-informed decisions about the management of stormwater quantity and quality within the City.

In addition to asset management, the key drivers of the SWMP are:

- **Stormwater Infrastructure Design:** The design of stormwater infrastructure is a cornerstone of the SWMP, ensuring systems across the City are resilient, functional, and adaptable to future demands. Effective design ties directly to the plan's broader goals of flood mitigation, water quality improvement, and climate resilience. The SWMP links proposed stormwater improvement projects to the asset management database, ensuring a data-driven approach to identifying, prioritizing, and maintaining critical infrastructure.
- **Ecological Restoration:** From the existing tree preservation ordinance to the environmental considerations included in the establishment of the Unified Development Ordinance, Florence is a leader in South Carolina when it comes to environmental preservation and addressing water quality concerns for the betterment of the community. Water quality is a key component of this SWMP, which aims to achieve both a community benefit and regulatory compliance. The City's water quality goals are incorporated into this SWMP.
- **National Pollutant Discharge Elimination System (NPDES) Stormwater Compliance:** Watershed planning is an essential element of the SWMP, and its success is grounded in proper floodplain management, water quality and quantity control, and adherence to construction practices that meet state and federal regulations for stormwater control. Since 2003, AECOM has collaborated with the City to ensure compliance with NPDES permitting requirements (often exceeding those requirements).

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Acronyms and Abbreviations

1-D	One-Dimensional
AECOM	AECOM Technical Services
BCA	Benefit-Cost Analysis
BRIC	Building Resilient Infrastructure and Communities
CDBG-MIT	Community Development Block Grant – Mitigation
CIP	Capital Improvement Program
City	City of Florence
CN	Curve Number
DEM	Digital Elevation Model
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
ft/sec	Feet Per Second
GIS	Geographic Information System
H&H	Hydrologic and Hydraulic
HGL	Hydraulic Grade Line
HMGP	Hazard Mitigation Grant Program
HUD	U.S. Department of Housing and Urban Development
LiDAR	Light Detection and Ranging
LMI	Low-to-Moderate Income
MS4	Municipal Separate Storm Sewer System
NAVD 88	North American Vertical Datum of 1988
NCSS	National Cooperative Soil Survey
NLCD	National Land Cover Database
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
Ordinance	Unified Development Ordinance
PTC	Potential Tropical Cyclone
SC DES	South Carolina Department of Environmental Services
SCDOT	South Carolina Department of Transportation
SCEMD	South Carolina Emergency Management Division
SCOR	South Carolina Office of Resilience
SSURGO	Soil Survey Geographic Database
SWMP	Stormwater Master Plan
t_c	Time of Concentration
USACE	U.S. Army Corps of Engineers
USGS	United States Geological Survey
WBP	Watershed-Based Plan

1 Introduction and Project Objective

1.1 Introduction

The City of Florence (City), South Carolina is the county seat of Florence County, which is located in the Pee Dee Region in the northeastern part of the state. It is uniquely located at the intersections of Interstate 20 and Interstate 95 and is the eastern terminus of Interstate 20. According to the 2020 census, the City has a population of 39,899 and covers an area of 23.49 square miles (U.S. Census Bureau, 2024).

Over the past decade, the City has experienced numerous hurricanes and high-intensity rainfall events that have caused repetitive flooding of streets, residences, and businesses. Notably, Hurricane Matthew in 2016 (Figure 1) brought torrential rain that caused severe flooding across the city, overwhelmed drainage systems, and led to extensive property damage. Similarly, Hurricane Florence in 2018 resulted in record rainfall, inundating neighborhoods and major roadways, and severely testing the stormwater infrastructure within City limits. Tropical Storm Michael followed shortly after, adding further stress to an already saturated landscape. More recently, in 2020, Hurricane Isaias caused localized flooding and underscored the ongoing vulnerabilities within the drainage network. In addition, heavy rainfall events that deliver large amounts of rain in a short period of time have caused flash flooding in various parts of the City, leading to road closures, disruptions to daily life, and threats to public safety. These events are becoming more frequent, as evidenced by Potential Tropical Cyclone (PTC) 8, which affected the City on September 16, 2024 (Figure 2, Figure 3, and Figure 4). It brought approximately 5.5 inches of rain within 24 hours, resulting in rapid road inundation as the stormwater infrastructure struggled to keep up.

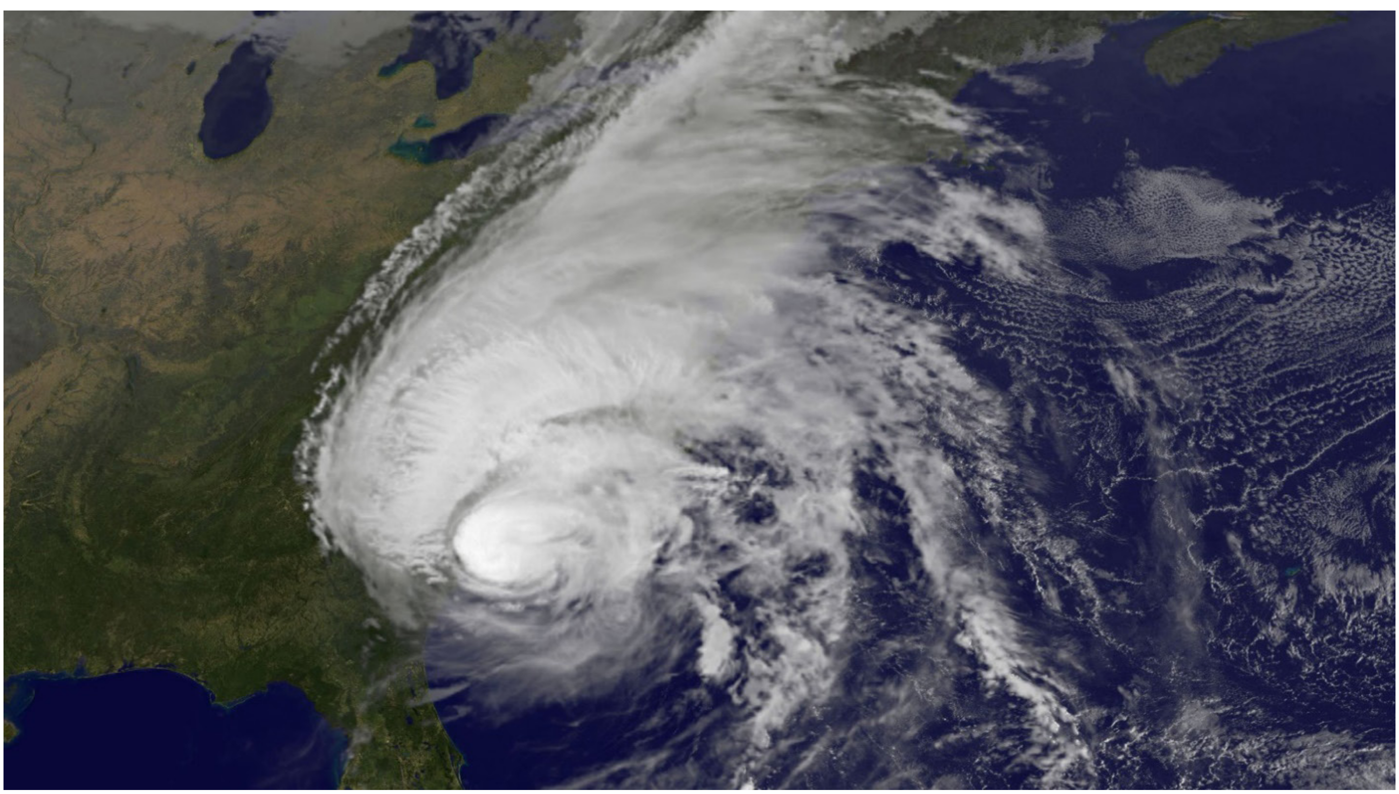


Figure 1: Hurricane Matthew satellite image (NASA, 2016)

These storms, along with many others, have consistently exposed weaknesses in the stormwater systems within the City, underscoring the critical need for ongoing improvements and proactive management strategies. Because of these events, the City has focused increasingly on stormwater infrastructure, with a goal of mitigating the substantial impacts of future storm events. To accomplish this goal, the City completed a stormwater system analysis and developed this Stormwater Master Plan (SWMP).

Figure 2: Flooding from PTC 8

Figure 3: Flooding from PTC 8

Figure 4: Cars affected by flooding from PTC 8

1.2 Project Objectives

On October 20, 2022, the City contracted AECOM Technical Services (AECOM) to develop a city-wide SWMP to identify flooding issues throughout the City, conduct an assessment of the existing infrastructure, develop goals and strategies to mitigate the identified areas of concern, and establish a prioritized project list. The SWMP development process spanned a period of 24 months and addressed the topic areas shown in Figure 5. The scope of work included six major tasks:

- **Assessment of Conditions:** Collect relevant base data, inventory stormwater facilities, and review maps, aerial imagery, plans, ordinances, and budgets. Verify existing conditions with field surveys and closed-circuit television inspections and assess the existing geographic information system (GIS) inventory.
- **Public Engagement:** Engage with a broad cross section of stakeholders in the community through surveys, meetings, and interviews with the intention to further develop goals and objectives, explore alternate viewpoints, and facilitate consensus for recommendations.
- **Facility Inventory and Mapping:** Develop an existing GIS stormwater conveyance inventory to include new, replaced, modified, and removed GIS features and provide the attributes necessary for hydrologic and hydraulic (H&H) modeling of surface flows, inlets, pipes, detention areas, watersheds, and sub-watersheds.
- **Hydrologic and Hydraulic Analysis:** Determine which areas are prone to flooding by creating an H&H model and identify potential flooding solutions using the H&H model.
- **Master Plan Development:** Prepare a detailed SWMP with recommendations based on the outcomes of community engagement, assessment of conditions, H&H modeling, and future land use trends.
- **Implementation Plan:** Conduct benefit-cost analyses on recommended projects and develop scoring criteria; work with City staff to prioritize stormwater improvement projects.

Figure 5: Stormwater Master Plan diagram

This SWMP is a tool to help the City of Florence achieve the following goals:

- Implement a sustainable method for managing and controlling stormwater.
- Balance environmental benefits, public safety, and protection of property.
- Upgrade aging stormwater infrastructure to mitigate the impacts of future storm events.
- Ensure that this document remains a living guide, evolving and adapting as the City grows and changes over time.

1.3 Study Area

The SWMP study area is shown in Figure 6 and includes the drainage area currently routed to the existing stormwater infrastructure. The study area consists of approximately 13.76 square miles, 74.6% of which is located within City limits; the remaining 25.4% falls under the jurisdiction of Florence County (Table 1). The remaining portion of the area within the city limits that drains directly to natural waterbodies or infrastructure not owned by the City was not included in the study area.

Table 1: Study Area Jurisdiction Summary

Description	Drainage Area (square miles)*	% of Study Area
City of Florence	10.3	74.6%
Outside of City of Florence	3.5	25.4%
Total Study Area	**13.8**	-

* Represents drainage area routed to the existing stormwater network

The City of Florence extends across 13 major watersheds. The major watersheds are identified based on the downstream receiving waterbody and are shown in Figure 6. The study area consists of 7 of the 13 major watersheds within the city limits. Table 2 shows a breakdown of the major watersheds located within the study area. The individual watershed maps are provided in Appendix A at the end of this report.

Table 2: Study Area Major Watershed Summary

Major Watershed	Drainage Area (square miles) *	% of Study Area
Beaverdam Creek	3.0	21.5%
Eastman Branch	0.1	0.7%
Gully Branch	1.6	11.3%
Jeffries Creek	3.4	25.0%
McCall Branch	1.3	9.2%
Middle Swamp	2.8	20.2%
Pye Branch	1.7	12.1%
Total Study Area	**13.8**	-

* Represents drainage area routed to the existing stormwater network.

Figure 6 also shows an overview of the existing stormwater network, including major pipes and open channels. Most of the infrastructure within the City is more than 50 years old and most likely was not designed for the increased frequency of high-intensity storm events experienced within the last decade. Commercial areas generally consist of curb-and-gutter drainage with connected underground stormwater pipes. Residential areas primarily consist of paved roads that use grass shoulder surface drainage and limited stormwater piping; however, there are some recently developed areas that have curb-and-gutter drainage with connected underground stormwater pipes. Throughout the project area, ponding and flooding are observed in many locations during regular and extreme storm events.

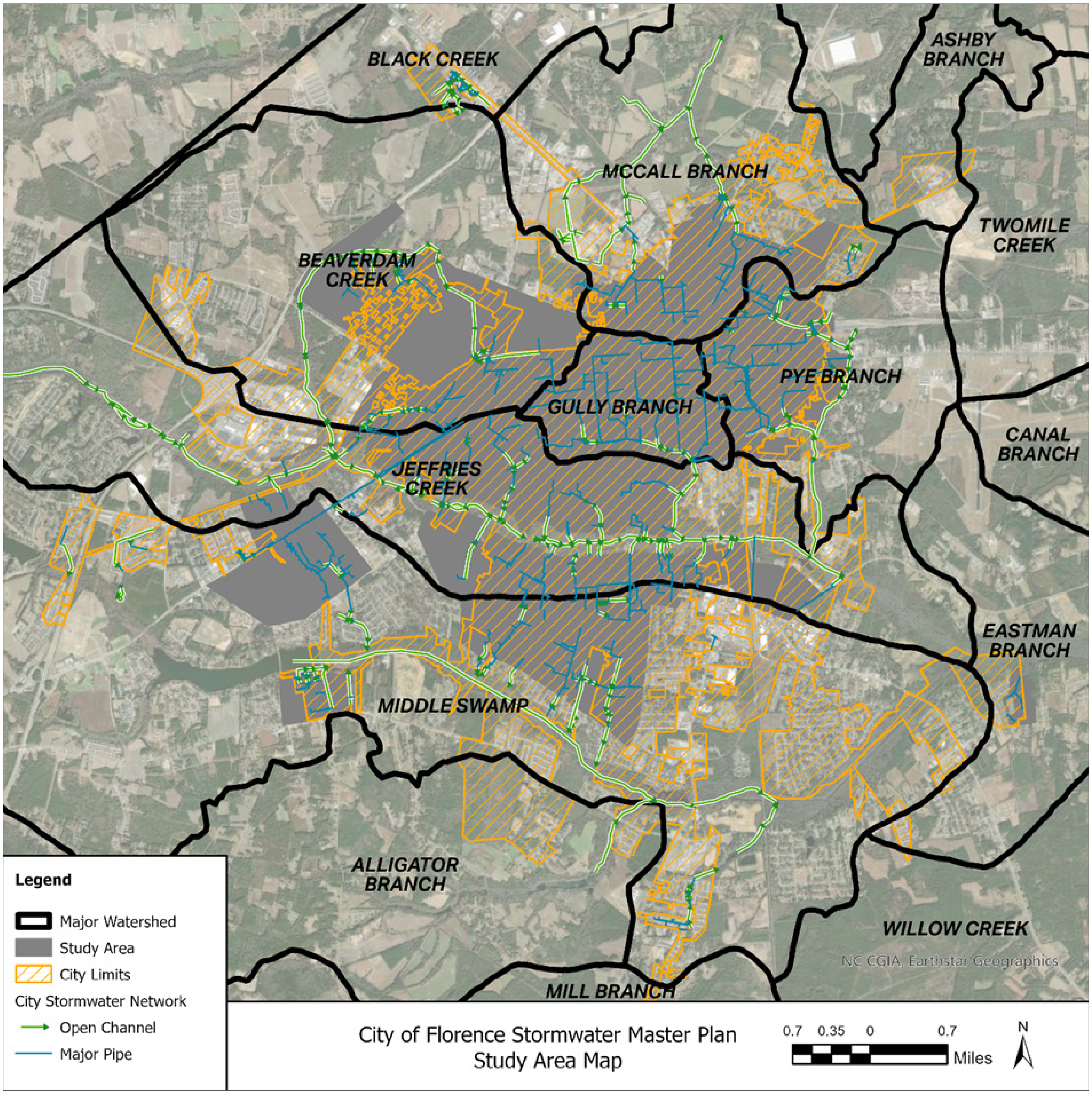


Figure 6: City of Florence study area and watershed map

1.3.1 Topography

AECOM referenced Light Detection and Ranging (LiDAR) and United States Geological Survey (USGS) topographic data to determine the local topography. The City of Florence lies between Middle Swamp to the south and southwest and Polk Swamp to the northeast. The City is divided by Jeffries Creek, which runs from the northwest to the southeast portion of the City. The northernmost portion of the City slopes north towards McCall Branch, while the north-central portion of the City drains to Jeffries Creek through several upstream waterbodies, including Pye Branch to the east, Beaverdam Creek to the west, Gully Branch to the north, with the remaining portion draining directly to Jeffries Creek. The southernmost portion of the City drains to Middle Swamp, which outlets to Jeffries Creek just outside of the city limits and ultimately drains into the Great Pee Dee River approximately 7 miles southeast of the City of Florence. The Great Pee Dee River discharges into the Waccamaw River on the east side of the City of Georgetown, South Carolina. The Waccamaw River discharges into the Atlantic Ocean approximately 15 miles southeast of the City of Georgetown, South Carolina.

Within the study area, the elevation ranges from a maximum of 147 feet North American Vertical Datum of 1988 (NAVD 88) near the north-central portion of the city to a minimum of 78 feet at the southeast portion of the city. In areas of the city located farther from natural waterbodies, particularly the north-central portion of the city (Gully Branch watershed) and the southern portion of the city (Middle Swamp watershed), surface slopes are shallower, in the range of 0.1% to 0.2%, which may be attributed to ponding during large rainfall events.

1.3.2 Land Use

Land use data for the study area was obtained from the National Land Cover Database (NLCD) and grouped into five major land use categories detailed in Table 3 and shown in Figure 7.

Most of the study area is considered developed, with 60.9% of the study area categorized as a high-intensity developed area and 26.8% of the study area categorized as a low-intensity developed area. The remaining portions of the study area consist of forest, open water, and agricultural land uses.

Table 3: Study Area Land Use Summary

Land Use Category	National Land Cover Dataset Type(s)	Area (square miles)	% of Area
Open Water	11 Open Water 90 Woody Wetlands 95 Emergent Wetlands	0.5	3.8%
Developed Area, Low to Medium Intensity	21 Developed, Open 22 Developed, Low 23 Developed, Medium	8.4	60.9%
Developed Area, High-Intensity	24 Developed, High	3.7	26.8%
Forest	41 Deciduous Forest 42 Evergreen 43 Mixed Forest	0.5	3.6%
Agricultural	31 Barrel Land 52 Shrub/scrub 71 Grassland 81 Pasture/hay 82 Cultivated Crops	0.7	4.9%
Total		**13.8**	-

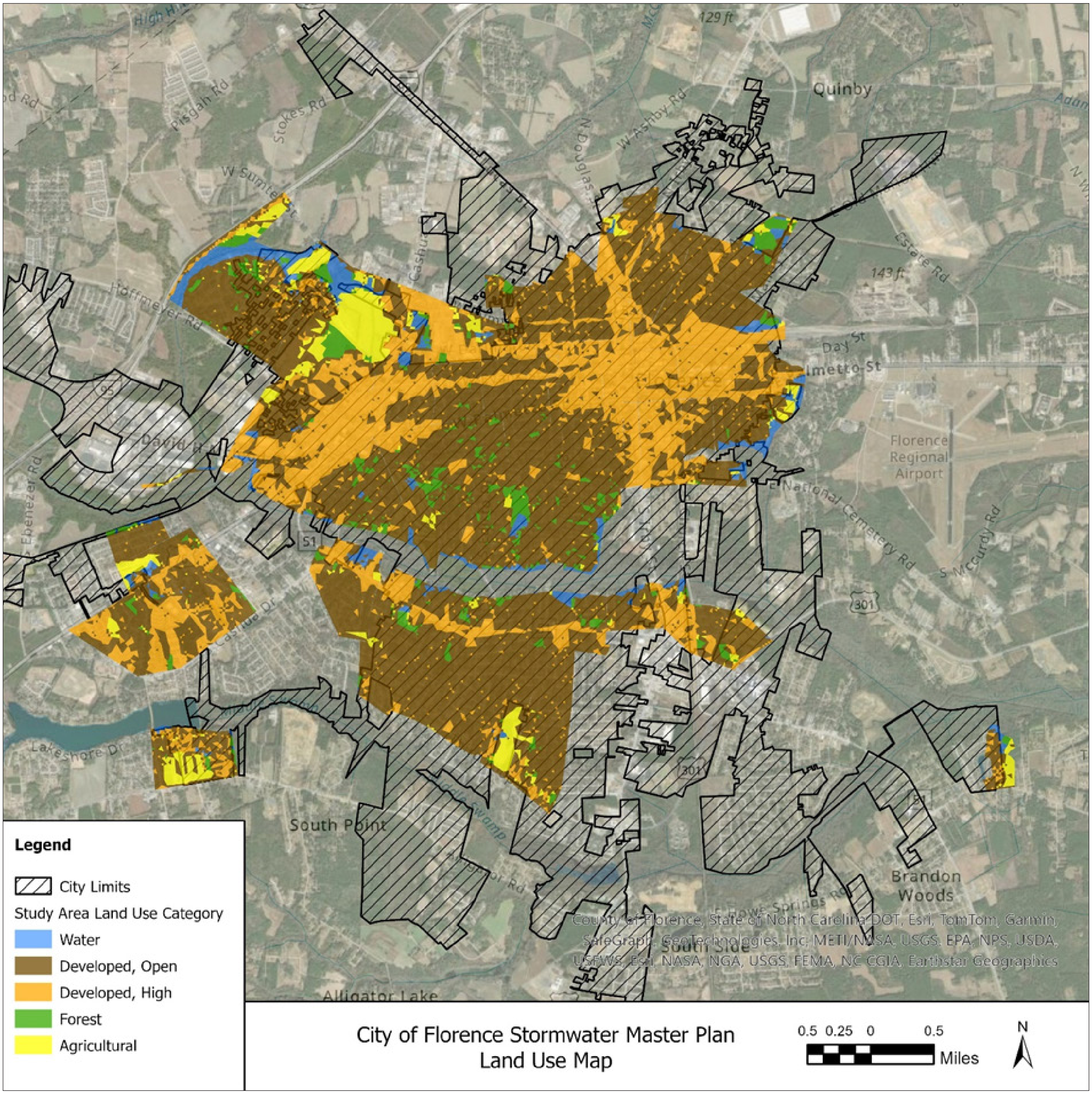


Figure 7: Study Area land use map

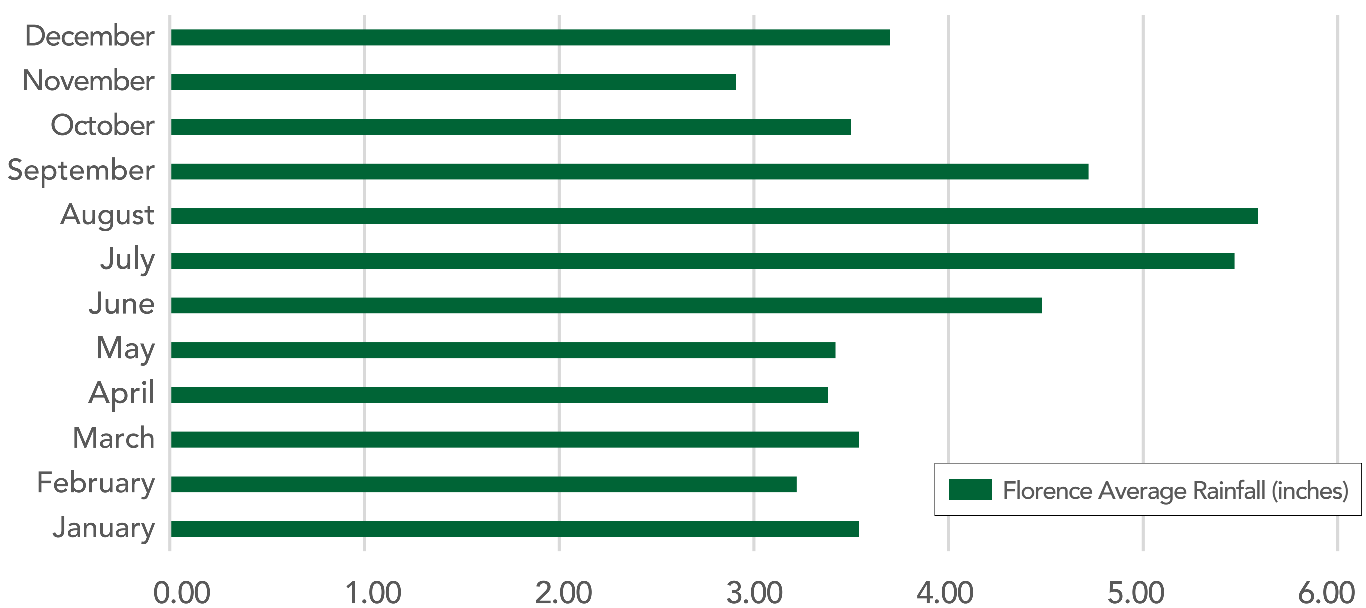
1.3.3 Rainfall

The stormwater system within the City should be adequately sized to handle frequent storm events and alleviate flooding from storms with larger intensities and extended durations. Monthly rainfall averages for Florence County are shown in the graph in Figure 8 Based on the rainfall data, the average annual rainfall for Florence County is 47.5 inches.

AECOM reviewed Appendix F of the South Carolina Department of Environmental Services[2] (SC DES) Storm Water Management BMP Handbook[3] (SC DES, 2005) to gather predicted rainfall data for 24-hour storm events, at various return periods, for Florence County North (see Table 4 below). The data were adapted from the Precipitation-Frequency Atlas of the United States, NOAA Atlas 14, Volume 2, Version 2 (2004), which was updated in 2006 (Version 3). The design storm events analyzed in this SWMP are discussed in more detail in **Section 3** (Stormwater Modeling).

Table 4: Florence County (North)

Return Period	Rainfall (Inches)
2-year	3.5
5-year	4.5
10-year	5.4
25-year	6.7
50-year	7.9
100-year	9.2



Data source: Florence County Climate Data (https://en.climate-data.org/north-america/united-states-of-america/south-carolina/florence-4208/)

Figure 8: Average rainfall in Florence County

2 On July 1, 2024, the South Carolina Department of Health and Environmental Control (SC DHEC) was dissolved into two agencies, the Department of Public Health (DPH) and the Department of Environmental Services (DES). SC DES oversees the protection and preservation of South Carolina's environment and natural resources.

3 All sections of the handbook are available at https://des.sc.gov/programs/bureau-water/stormwater/stormwater-management/stormwater-pollution-prevention-plans-swppps/best-management-practices-bmps/bmp-handbook.

2 Baseline Data and Community Input

Development of this SWMP began with a detailed assessment of existing conditions. This section discusses the general data collection and review, and the information gathering through public engagement activities, which were accomplished as part of this assessment.

2.1 Baseline Data Collection and Review

AECOM collected relevant baseline data, data from previous studies, drawings, information from City staff, public input, and field surveys to achieve an accurate picture of the development of stormwater infrastructure over the years. The sources for this baseline data collection and review included:

- Historical Drainage Studies: The status of stormwater infrastructure recommendations that were developed in previous storm drainage studies was determined
- Historical Plans: Historical projects were reviewed and their scope and importance to the storm drainage system today were summarized
- Field Data Collection: Existing stormwater facilities were inventoried through field investigations, aerial imagery and maps, and the City's current plans and ordinances were assessed.
- Input from City Staff and the Public: Meetings were conducted to gather further information.

2.1.1 Historical Document Review

The first step of the baseline data collection and review process involved a thorough review of historical stormwater documents. This review aimed to understand the evolution of stormwater management practices within the City, assess the effectiveness of previously implemented recommendations, and identify persistent or emerging problem areas. Over the years, the City conducted several comprehensive storm drainage studies, which were instrumental in shaping its stormwater infrastructure. By examining these past studies and other historical stormwater plans, AECOM gained valuable insights into past challenges, successes, and gaps that still need addressing.

This section provides an overview of key findings from previous studies, evaluates whether recommended improvements were executed, and highlights how stormwater issues have changed over time. The historical analysis not only informed the current SWMP but also served as a crucial foundation for understanding and improving Florence's stormwater management in the years ahead.

The City conducted three separate comprehensive Storm Drainage Studies in 1960, 1974, and 1989. As the last extensive study of the stormwater infrastructure within the City was more than 35 years ago, an important first step in creating this SWMP was to review the previous studies to determine what their findings and recommendations were and whether the recommendations were implemented. AECOM also reviewed how stormwater issues have evolved over the years and identified problem areas that persisted over time as well as new problems that occurred in the last 35 years.

The three previous studies are briefly described below, and the full study reports are provided in Appendix B, Appendix C, and Appendix D.

- **1960 Study (Appendix B):** An extensive stormwater study was completed by The Harwood Beebe, Co. in 1960. The city was divided into six drainage basins, and each basin was further delineated into subbasins. Each drainage area included open channels and closed conduit as proposed improvements. Land use studies were used to help plan for the future development of the city of Florence and to analyze how expansion would impact the existing stormwater system. The land use and population predictions aided in deciding where new ditches and storm sewers should be placed.

» **1974 Study (Appendix C):** The Hardwood Beebe, Co. completed another storm drainage study in 1974. This study achieved the following objectives:

- Developed stormwater management goals.
- Inventoried existing systems and problem areas.
- Analyzed design criteria for existing systems.
- Established design criteria for future facilities.
- Reviewed maintenance programs at the city, county, and state levels.
- Described in detail each of the six major drainage basins.
- Proposed stormwater facilities to accommodate the existing and future Urban Area.
- Discussed the associated costs to construct and maintain the proposed stormwater facilities
- Recommended steps to implement the stormwater management program.

» **1989 Study (Appendix D):** The Miley Company, Inc. updated the 1974 study in 1989 with an inventory of the improvements that were made during the 15 years between the two studies. The 1989 study also included an evaluation of problem areas that still exist, recommendations to correct the issues, cost estimates, and implementation methods.

- Improvements that were constructed during this period (1974-1989) included collection sewers in the Northeast and Northwest areas of Florence, the Timrod Park Area, the Southwest area of College Park, and other isolated problem areas such as the "Milk Ditch" and Country Club areas. The South Carolina Department of Highways and Public Transportation, now the South Carolina Department of Transportation (SCDOT) constructed major improvements for Darlington Street, Sumter Street, Church Street Extension, and Pamplico Highway.
- Improvements that were still needed were listed in three categories: maintenance, minor, and major improvements.

A. **Maintenance Improvements:** primarily included cleaning lines, ditches, and catch basins at the following locations: Palmetto Street, Homestead Avenue, Evans Street, Carolina Avenue, Pine Street, Graham Street, Pine acres, Brunwood, Kemp Street, W. Evans Street, and S. Dargan Street.

B. **Minor Improvements:** primarily included constructing new catch basins and/or replacing curb openings at the following locations: Palmetto Street, Seneca Avenue, Madison Avenue, Seneca Drive, W. Palmetto Street, Saluda Drive, Lafayette Circle, Pine Street, Warley Avenue, and Lawson Avenue.

C. **Major Improvements:** Twelve major improvements were proposed as a result of this study:

1. Construct a drainage ditch along Waterman Avenue north to the city limits and a major outfall for the northeast area, which needs to be cleaned and re-shaped.
2. Construct a drainage ditch from Oakland Street to Palmetto Street. The section from Oakland Street to the railyard should be piped. The section from the railyard to Palmetto Street needs to be cleaned and shaped.
3. Install a storm drain pipe along Malloy Street, Maxwell Street, and Hamlin Street.
4. Install drainage along abandoned railroad to serve the intersection of Coit Street and Darlington Street, the intersection of Irby Street and Darlington Street, and the 200 block of N. Dargan Street.

5. Replace the old brick arch with a new storm drain from Cheves Street and the railroad to Walnut Street. Pipe the existing ditch between Keshaw Street and Walnut Street, pipe the ditch from Church Street to Jarrott Street, and perform open channel improvements for the outfalls in this area.
6. Pipe existing ditch behind houses parallel to Winston Street. Provide storm drain from Edisto Drive and Cherokee Road along Cherokee Road to existing ditch and pipe the ditch.
7. Provide major channel improvements to Gully Branch for approximately 1,000 feet south of Cherokee Road.
8. Install storm drain along Bellevue Drive. Pipe existing ditch between St. Anthony Avenue and Woods Drive.
9. Pipe existing ditch from Waccamaw Drive to Poinsett Drive. Pipe existing ditch behind houses parallel to Partridge Drive.
10. Install a storm drain along S. Malden Drive to Jeffries Creek. Provide storm drainage on Maynard Avenue and Dexter Drive.
11. Pipe a major outfall ditch serving the Cloisters Subdivision and undeveloped area.
12. Provide storm drainage to serve the Woodmont Subdivision.

AECOM staff aimed to verify whether the 12 major improvements proposed in the 1989 study had been constructed. To accomplish this, the team reviewed the City's GIS data to determine whether the proposed improvements were reflected in the current stormwater infrastructure, which would indicate that they had been built. Following the GIS review, AECOM conducted field visits to capture photographs and physically verify the presence, current condition, and completion of these projects.

Out of the 12 major improvement projects proposed in the 1989 study, only 5 were determined to have been completed. It was also determined that one project was already included in the 2021 capital improvement projects. As mentioned in **Section 1.2**, one of the goals of the SWMP is to ensure that this plan remains a living guide. Therefore, the six remaining projects were added to the proposed capital improvement program (CIP) projects described in **Section 5.5**. The complete findings from these site visits, along with corresponding photographs and detailed evaluations are provided in Appendix E.

As part of the historical review process, AECOM also reviewed the City's previous stormwater plans with dates ranging from 1924 to 1998. This analysis included reviewing the scope of work, determining whether the design plans were constructed, and reviewing the City's GIS data to verify the plans. Data from the historical plans were used to verify existing conditions as well as to provide a better understanding of how the overall stormwater system operates. AECOM compiled the data into the Previous Stormwater Plans and Studies Summary Report, provided in Appendix F. The complete, individual historical plan sets are provided in Appendix G.

2.1.2 Desktop Review

After the concerns of stakeholders were documented, AECOM staff performed a "desktop review" of the stormwater issues in the city. This review, which was meant to be a prerequisite to the field data collection, was to better prepare our staff on the existing conditions before they stepped foot in the field. The desktop review involved evaluating specific problem areas, using aerial imagery, GIS data, and LiDAR. The main focus was to identify stormwater issues, potential causes, and recommended improvements based on visual and data-driven analysis.

» **Problem Areas:** Multiple sites with recurring flooding and stormwater issues, often exacerbated by factors such as flat topography, insufficient or blocked stormwater infrastructure, and undersized culverts, were identified across Florence.

» **Common Problems**

- Eroded stream banks and poor stream conditions

- Undersized or clogged pipes and culverts
- Inadequate or absent stormwater infrastructure, including inlets and ditches
- Blockages caused by debris, silt, and vegetation growth

» **Recommendations**

- Upsize existing culverts and pipes to increase capacity.
- Install new pipes and inlets to improve water conveyance and prevent flooding.
- Implement stream restoration and channel widening to enhance flow capacity.
- Clean and clear ditches, remove debris, and maintain existing stormwater facilities.

» **Methods Used**

- Problem areas were identified and prioritized through analysis of GIS data, Google Earth imagery, and proposed capital improvement projects.
- Recommendations were made based on visual assessments and available data prior to field verification.

Overall, this desktop review served as a crucial step in identifying areas needing further field investigation and helped guide the recommendations of the SWMP for potential stormwater projects. The complete desktop review is provided in Appendix H.

2.1.3 Field Data Collection

AECOM staff conducted comprehensive field investigations of the stormwater collection system within the City. The primary objective of these investigations was to update and enhance the City's stormwater data, addressing gaps in areas where information was incomplete or missing from the City's GIS data, previous projects, and desktop reviews. Using ArcGIS Field Maps in conjunction with GPS devices, AECOM staff systematically collected data, adding missing infrastructure, refining the locations of existing assets, and recording essential attributes such as pipe diameter and invert elevation. This meticulous data collection process not only provided the City with a clearer understanding of the full extent of its stormwater facilities but also played a pivotal role in the development of the H&H model. Figure 9 is a comprehensive map of the City's Stormwater GIS data, which was created following the field investigations. The map shows the enhanced accuracy and detail achieved through these efforts. For more detailed information, refer to the individual grid sheets in Appendix I.

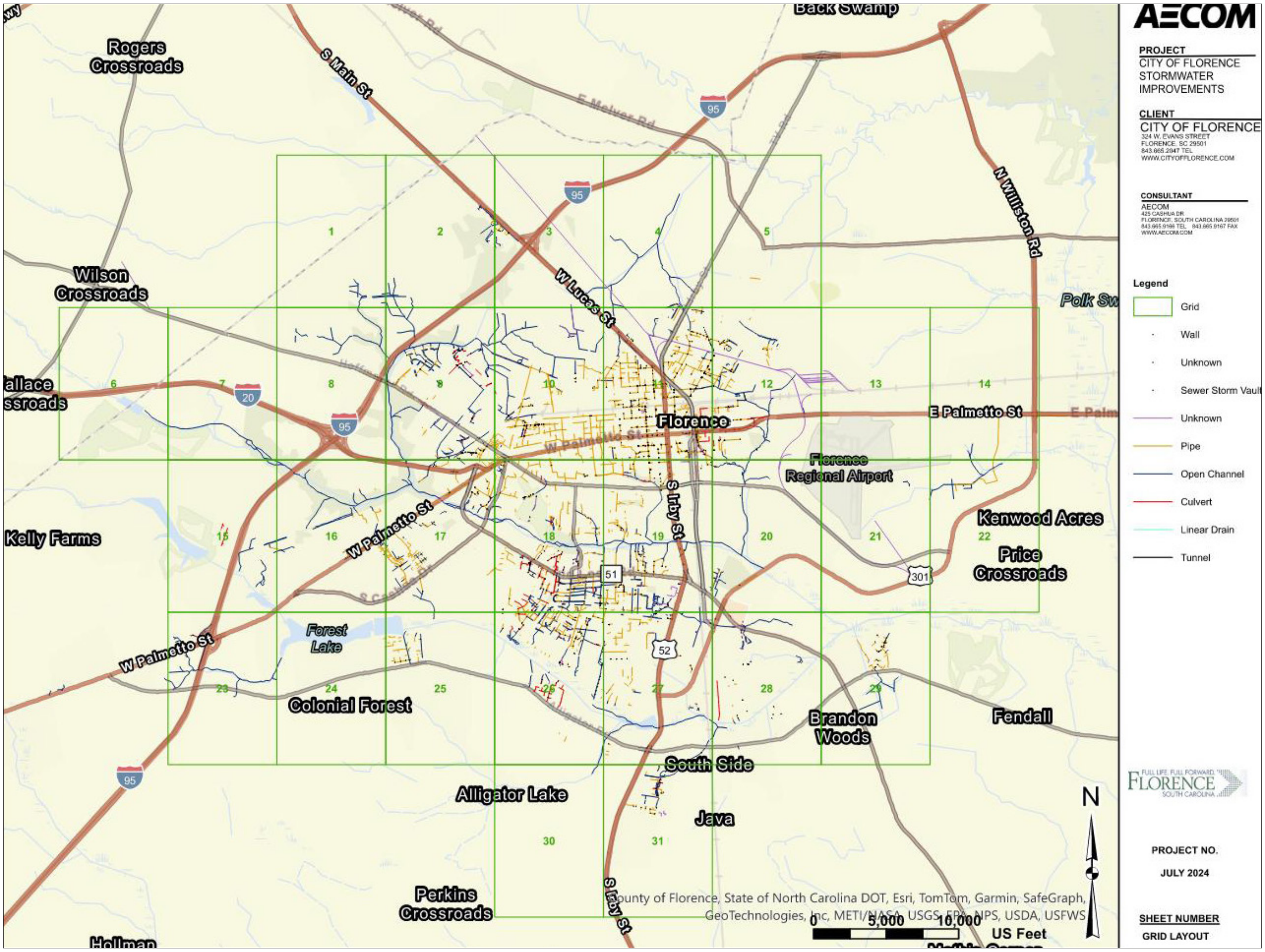


Figure 9: Comprehensive map of the City's stormwater GIS data

One example area where AECOM staff conducted an extensive field investigation with City Staff was the Gaillard Trunk Line. Detailed field notes documenting the surveyed drainage structures and lines in the Gaillard Trunk Line area are provided in Appendix J. For a comprehensive visual record of the site, the team used a pole camera to capture both video and photographic evidence. This survey was especially critical in updating the GIS data for this area, and the information gathered during this investigation not only clarified existing conditions but also significantly improved the accuracy of the City's stormwater management database. Figure 10, Figure 11, Figure 12, and Figure 13 show damaged infrastructure that was photographed during the Gaillard Trunk Line investigation. The structure numbers in the figure captions refer to the detailed field notes provided in Appendix J. The Gaillard Trunk Line area is just one of the many sites within the City that were investigated and surveyed to help update and enhance the City's stormwater data. This process of field verification was essential for resolving inconsistencies and filling in gaps across the City's entire stormwater geodatabase, ensuring the H&H model could be as accurate as possible.

Figure 10: Structure 3 DS line damage

Figure 11: Structure 9 DS line damage

Figure 12: Structure 17 line blockage

Figure 13: Structure 20 line conflict

2.2 Stormwater Master Plan Meetings

Meetings with both City staff and members of the public were held to solicit input from stakeholders on the development of this SWMP.

2.2.1 Meetings with City Staff

AECOM began holding monthly meetings with City of Florence staff in July 2022. These meetings served as both informative sessions on the status of stormwater hotspots, city input of additional stormwater hotspots within the city and progress meetings on the development of the SWMP and debriefings of the findings. The monthly meetings were also used to determine level of service implemented in the eventual prioritization of the capital improvements. During the monthly meetings, AECOM worked with City staff to ensure that all public engagement activities were being undertaken and that the SWMP would capture needs across the city as the City planned improvements to its stormwater infrastructure.

2.2.2 Public Engagement Meetings

AECOM realizes that the residents, business owners, City staff, and other stakeholders have first-hand experiences with flooding in Florence. Therefore, we wanted to hear from them to better understand the where, when, how, and why of each of these flood events so that we could more accurately develop mitigation solutions. Additionally, knowing more about each flooding event allowed us to calibrate the stormwater trunkline model to replicate the flooding reported by the community. Furthermore, we wanted the public to be part of the planning process and have a voice in how flood mitigation is accomplished. Finally, it was important that all stakeholders could come together for the common good and work collaboratively.

Four public meetings were held between April and May of 2023 to gather community input. Based on the engagement strategy, meetings were held in communities where flooding historically has been an issue. The exact locations and times of these meetings were as follows:

- Meeting #1: April 25, 2023, at Florence Family YMCA –1700 S. Rutherford Drive (Figure 14)
- Meeting #2: May 2, 2023, at NW Community Center – 801 Clement Street (Figure 15 and Figure 16)
- Meeting #3: May 4, 2023, at Levy Park Community Center – 356 S. Jeffords Street (Figure 17)
- Meeting #4: May 9, 2023, at Briggs Elementary School – 1012 Congaree Drive (Figure 18)

Members of the public who attended these meetings were encouraged to actively participate by voicing their concerns, filling out comment forms, which allowed them to provide detailed information about their stormwater concerns, including the specific locations, frequency, and nature of the issues they were experiencing.
To broaden stakeholder input, an online survey utilizing ArcGIS Survey123 was also launched during this period, enabling residents to share additional insights, and photos beyond what was captured at the meetings. The survey collected valuable data, such as the estimated depth and duration of flooding, as well as water quality observations, including the smell and color of runoff, which could indicate potential contamination. This community-driven data was instrumental in identifying problem areas and provided a more comprehensive understanding of the stormwater challenges faced by residents. The feedback from both the comment forms and the survey played a crucial role in shaping the SWMP, ensuring that the plan addressed real-world concerns and prioritized the needs of the community. The completed comment forms and survey results are available for review in Appendix K.

Figure 14: Public Engagement Meeting #1

Figure 15: Public Engagement Meeting #2

Figure 16: Public Engagement Meeting #2

Figure 17: Public Engagement Meeting #3

Figure 18: Public Engagement Meeting #4

During the public engagement process, stakeholders were given the opportunity to mark on large printout maps of the City the specific locations where they observed flooding issues. With the help from City staff and our AECOM engineers, the collective team was able to have one-on-one conversations with the residents to discuss their stormwater flooding experiences and concerns. AECOM staff then digitized these physical maps, along with feedback from comment forms and hotspot data from City staff, to create a comprehensive flooding summary map (Figure 19) that pinpointed where stakeholders identified flooding. The general trend from public engagement revealed that low-lying areas across the city, especially along the Jeffries Creek corridor, often have inadequate or no stormwater drainage, particularly on SCDOT roadways. Additionally, many developed areas affected by nuisance flooding have minimal topographic relief and lack proper storm drainage infrastructure.

The information gathered from the community played a significant role in the development of this report, especially during the modeling phase. By integrating the input from stakeholders, we ensured that the model accurately reflected real-world conditions and addressed the concerns of the people who live and work in the area. This process underscores our commitment to listening to the public and incorporating their insights into our planning and analysis.

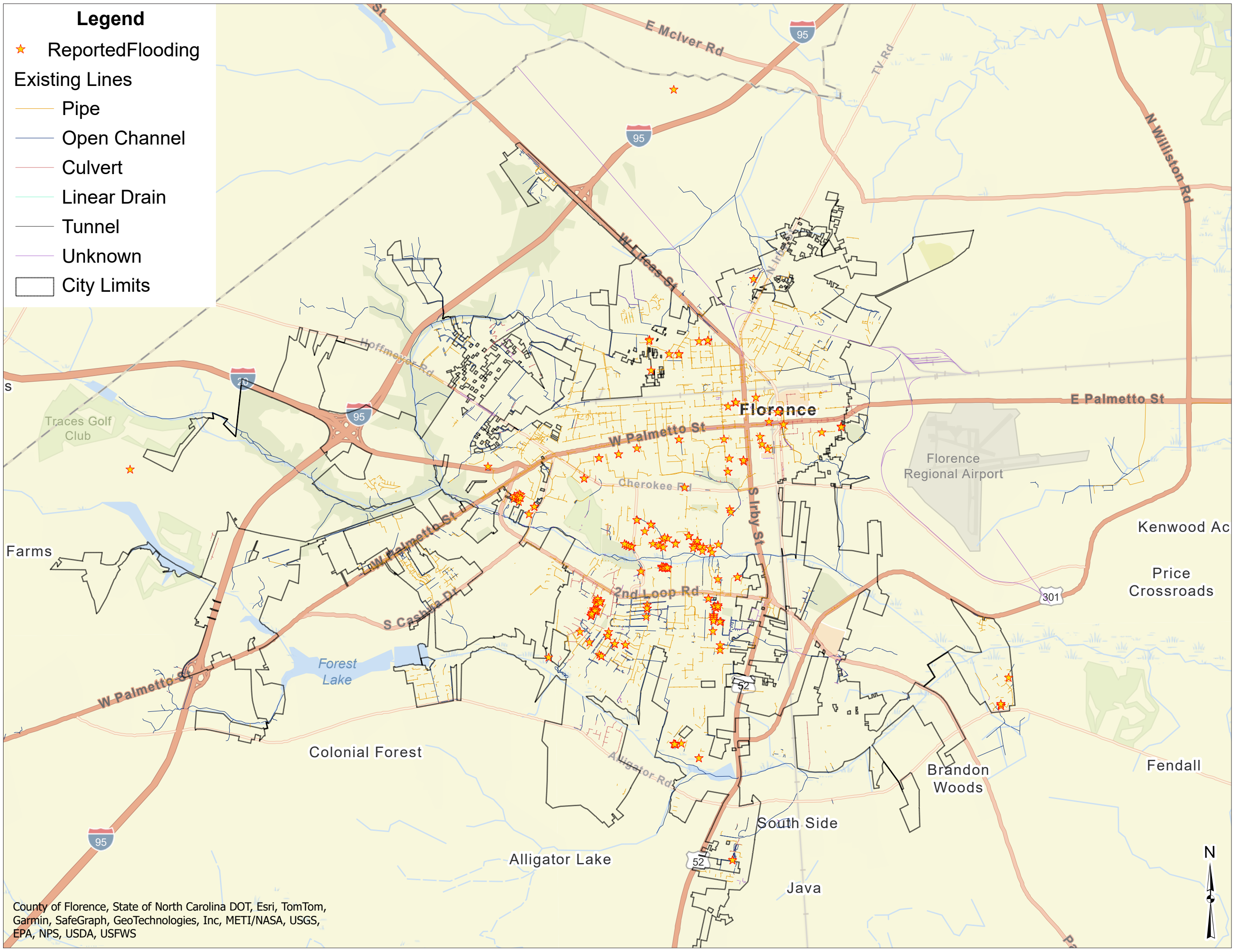


Figure 19: Flooding issues map

During this public engagement period, an array of different types of educational materials were available on the City's website and were posted on their social media pages. One was a document with "Frequently Asked Questions," which helped explain what a stormwater system and master plan are, why the plan is needed, and the main causes of flooding. An interactive portal was also posted on the City's website that allowed stakeholders to click through information at their own pace. The portal allowed anyone who was interested to learn more about the importance of stormwater management and water quality, provide feedback on flooding concerns, and learn more about the Stormwater Capital Improvements Program, which included the investigations and preliminary evaluations for 10 areas known to have repetitive flooding. The educational materials are provided in Appendix L at the end of this report.

2.2.2.1 Water Quality Statement

During the public engagement meetings, AECOM invited stakeholders to voice their concerns and share insights on water quality issues within the city. The following statement about water quality was provided to stakeholders who engaged in the public feedback period:

> *"While flooding is considered a critical component of a watershed plan, the quality of stormwater runoff is also very important to protect both the health of the citizens and natural environment within the City of Florence. Untreated stormwater runoff can*

contain pollutants that have the potential to make people sick and harm wildlife. The Jeffries Creek watershed, which covers almost the entire City of Florence, is considered impaired for bacteria. This means that many of the streams that drain to Jeffries Creek have a higher concentration of bacteria than the State standard, which may have the potential to cause illness. These bacteria can come from wildlife, pet waste, trash and litter, failing septic or sewer systems and urban runoff. When it rains, these pollutants are washed into our rivers and streams.

However, not to worry, the City of Florence is very proactive in addressing these pollutants. Over the last several years, they have made great strides to address water quality concerns that they can control, such as improving the sewer system, eliminating illegally connected pipes to the stormwater system, and promoting programs and efforts related to improved trash collection and public awareness – scoop the poop and proper disposal of household waste.

But there's more that can be done, and we need your help! As part of this master planning effort, the City is identifying areas within residential and commercial neighborhoods where more improvements to water quality can be made. If you know where there is smelly or discolored water, especially during or after rain events, please alert the City. The development of this master plan will identify best management practices (BMPs) that can be implemented to improve overall water health in the City. This master plan is being developed to not only reduce flooding, but to also preserve and enhance the water quality within the City for generations to come."

This statement not only educated stakeholders on water quality specifically related to stormwater, but also encouraged them to help improve their community by reporting where water quality is poor so that the corrective actions can be taken.

2.2.2.2 Conclusions from Public Engagement

The public engagement process proved to be an invaluable opportunity to better understand the flooding concerns of local stakeholders and to foster clearer communication between the City and its residents regarding stormwater infrastructure. One key insight from these meetings was the significant public misunderstanding about the roles of the various responsible parties.

Unlike potable water or sanitary sewer systems, stormwater infrastructure is multifaceted with four main entities responsible for its maintenance and management within the City: the City of Florence, Florence County, SCDOT, and private property owners. Many residents are unaware of this distinction, assuming that all stormwater infrastructure within City limits is solely the City's responsibility. As a result, the City realizes that additional public education is required to better inform stakeholders on how stormwater infrastructure is maintained and managed.

Another major takeaway was the need for better public awareness of historical stormwater designs and construction methods, which are contributing to present-day flooding issues. In the past, roads were designed and constructed to serve as temporary storage basins during storms, leading to frequent road flooding - an issue compounded by increasingly intense and frequent rain events.

Many of the complaints raised during the engagement sessions centered on flooded roads, but it is important to note that these roads were originally engineered and constructed to flood during large storm events. With more extreme weather patterns emerging, these roads are inundated more often, causing greater inconvenience and risk to residents. The SWMP aims to pinpoint these problem areas and develop modern solutions to improve stormwater management. Educating the public on historical engineering practices and their current impact is essential for building trust between the City and its residents. This education will also play a critical role in gaining public support for proposed improvements.

Finally, another important issue raised during public discussions was the effect of new development on the stormwater system within the City. As more areas are developed, it is crucial to inform stakeholders about how such changes can exacerbate flash flooding and strain existing infrastructure, if it is not properly designed and constructed in accordance with the City's Unified Development Ordinance. See **Section 4** for more information regarding this ordinance. By highlighting the importance of stormwater facilities, such as detention/retention ponds and curb-and-gutter systems, the City can implement measures so that future development does not increase the risk of flooding.

3 Stormwater Modeling

The City of Florence contracted with AECOM to assess the current stormwater network infrastructure and propose improvements to enhance stormwater management. AECOM conducted a comprehensive field survey to gather vital ground data for the stormwater network within a GIS framework. Subsequently, a hydraulic model was calibrated to simulate 10-year and 25-year design storms, using the existing conditions as a basis. Specific areas for improving conveyance capacity and implementing low-impact development strategies to attain the desired design storm objectives were identified.

The goal of watershed stormwater modeling was also to facilitate operation of the stormwater utility and the future planning for it. The stormwater modeling can be used to:

- » Assess the existing infrastructure within the City.
- » Develop tools to capture information generated in current as well as proposed stormwater design projects.
- » Help implement capital improvement projects to address flooding issues, which will highlight the value of the City's stormwater utility services.
- » Educate the public on stormwater changes.

3.1 Hydrologic and Hydraulic Model Development

AECOM developed a one-dimensional (1-D) H&H stormwater model of the existing stormwater collection system within the City, using Bentley SewerGEMS and ArcGIS Pro software. The outcomes generated from this model were employed to identify areas that require improvements, evaluate the capacity for conveying stormwater, develop potential stormwater capital improvement projects, plan for low-impact development strategies, and prioritize project implementation for the stormwater capital improvement projects identified.

3.1.1 Stormwater Network

The H&H model stormwater network was developed using available City GIS data obtained through the City's GIS portal. Modeled extents are shown in Figure 20 and consists of large-diameter trunklines, culverts, and drainage channels critical to stormwater conveyance throughout the city. Smaller diameter pipes serving residential areas were generally omitted, with the exception of areas with known flooding issues, which were modeled to assess potential improvements.

Development of the H&H model stormwater network involved the following tasks and assumptions:

- » **Drainage channels:** Cross sections for each open channel were developed in ArcGIS Pro using 1/3 arc-second (10 meter) Digital Elevation Model (DEM) data obtained from USGS. For the purposes of this study, a single representative cross section was cut at the approximate center of the channel run and applied to the length of the channel.
- » **Roughness coefficients:** A Manning's roughness value of 0.013 was assumed for all closed channel pipes, and a Manning's n value

of 0.045 was used for open channels. These values are considered conservative for capacity analysis purposes.

» **Invert elevations:** A large majority of the City's GIS database did not include invert elevation data. A limited field survey was conducted by AECOM's GIS and survey teams to obtain invert elevations where available. The following assumptions were followed for pipes with missing invert elevations, which were not included in the field survey:

  – If an upstream and a downstream invert elevation were known with missing invert elevations in-between, the missing invert elevation was estimated by interpolation.
  – If only one downstream invert elevation was known, the missing upstream invert elevation was calculated by assuming a constant slope based on the next upstream pipe.
  – If both upstream and downstream invert elevations were unknown, the pipe was assumed to be 3 feet below ground surface based on USGS DEM data. If this method resulted in a pipe slope less than or equal to 0 percent, the invert elevations were selected based on providing a minimum design velocity of 2.2 ft/s (assuming a Manning's roughness value of 0.013).

» **Rim elevations:** Due to the lack of known rim elevation data, manhole rim elevations were estimated for each modeled node, using 1-meter DEM data obtained from USGS.

3.1.2 Drainage Area Delineation

The following methodology was used to develop subbasins for incorporation into the H&H model:

1. ArcGIS Pro was used to perform digital terrain analysis of USGS 1/3 arc-second (10 meter) DEM data for delineation of major watersheds within the city.

2. The major watersheds delineated in Step 1 were then further delineated into subbasins for inclusion in the modeled stormwater network based on major storm pipes and natural waterways, including ridges and channels, and roadways. Subbasin IDs were assigned based on a subbasin's corresponding major watershed (i.e., subbasins within the Jeffries Creek watershed were labeled as Jeffries Creek-A, Jeffries Creek-B, and so forth). Subbasins located within more than one major watershed boundary were assigned IDs based on the watershed with the highest percentage of subbasin area. Runoff to natural major channels, such as Jeffries Creek and Middle Swamp, was omitted from the model analysis.

3. For areas that have historically resulted in road and/or residential yard flooding during large rainfall events, referred to as "hot spots," drainage areas delineated in Step 2 were further broken into smaller subbasins of less than 10 acres. This drainage area refinement was performed to ensure a proper level of detail to assess the performance of recommended improvements and to determine pipe sizing.

Figure 20 shows an overview map of the stormwater network within the City and subbasins incorporated into the H&H model.

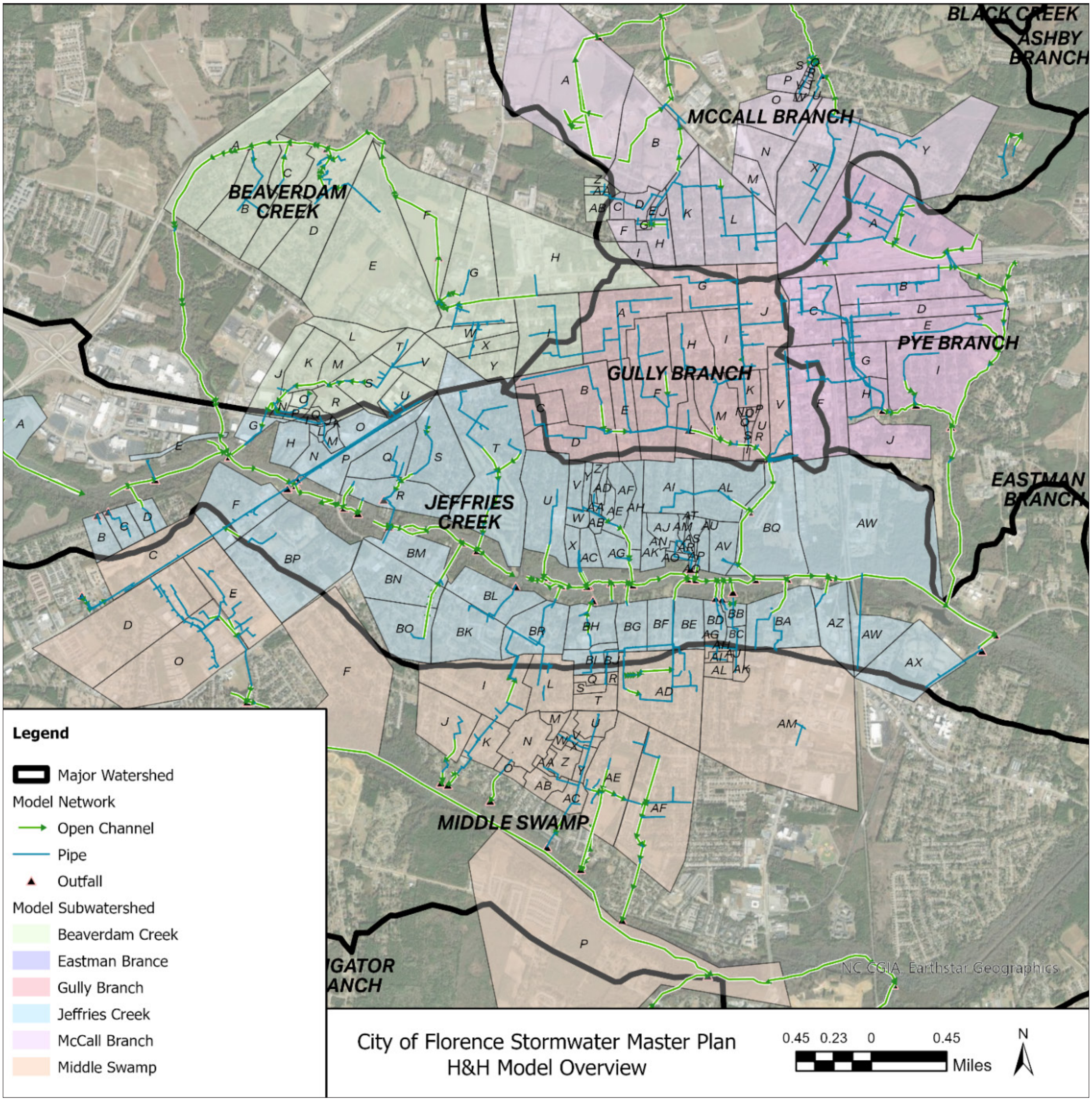


Figure 20: Modeled stormwater network and drainage areas

3.1.3 Hydrology

The Natural Resources Conservation Service (NRCS) hydrologic method was used to predict the peak rate of runoff from each delineated drainage area to the stormwater collection system within the City. This methodology's inputs into the H&H model included composite Curve Number (CN) and time of concentration (t_c) for each drainage area.

3.1.3.1 Composite Curve Number

Composite CN values were determined for each drainage area by calculating the corresponding land use and hydrologic soil group complex based on the runoff CN values for urban areas provided in the NRCS National Engineering Handbook, **Section 4** (Mockus, 1965). The composite CN values were determined for each catchment within the stormwater collection system, using the following sources:

» Hydrologic soil group data – Soil Survey Geographic Database (SSURGO) from the National Cooperative Soil Survey (NCSS)

» Land use data – National Land Cover Database (NLCD, 2011)

The overview maps showing hydrologic soil group data and composite CN values of each drainage area within the stormwater collection system are provided in Appendix M, which also contains all the H&H model results.

3.1.3.2 Time of Concentration

The minimum t_c used in this analysis was 6 minutes in accordance with the SCDOT stormwater design standards. For larger subbasins routed to trunklines greater than 30 inches in diameter or open channels, the t_c was determined using the NRCS lag method, which accounts for the increase in time for runoff from overland flow sources and side channels to reach the major watercourse. The following equations were used to determine t_c based on the NRCS lag method:

$$tc = \frac{L}{0.6}$$

$$L = \frac{I^{0.8}(S+1)^{0.7}}{1900Y^{0.5}}$$

Where:

I = longest hydraulic flow length of the drainage area (feet);

L = watershed lag time (hours);

S = (100/CN) – 10

Y = average watershed land slope (percent)

For smaller subbasins routed to smaller pipes less than 30 inches in diameter in generally urbanized areas, TR55 methodology was used to calculate t_c.

The longest hydraulic flow length and average surface slope was estimated using a combination of ArcGIS Pro Spatial Analyst and AutoCAD Civil 3D flow length tools using the 1-meter USGS DEM data. In relatively flat areas where the 1-meter USGS DEM granularity resulted in shallow surface slopes and increased t_c, Google Earth surface elevation data was used to estimate the average slope for the t_c calculations, which resulted in shorter t_c values and more conservative peak flows.

3.1.3.3 Impacts of Future Development

Future and ongoing land development was considered during development of the model hydrology to account for potential impacts on stormwater runoff. Estimated boundaries of planned residential and industrial construction projects were overlaid with delineated model subbasins to identify areas with potential increased impervious area in future conditions. For purposes of this study, it was assumed that drainage area boundaries tributary to the major stormwater network (larger diameter trunklines and open channels) will not change under future conditions.

Figure 21 shows the model subbasins that fell within future development boundaries. The CN values for these subbasins were increased to values representative of urban districts, as shown in Table 5.

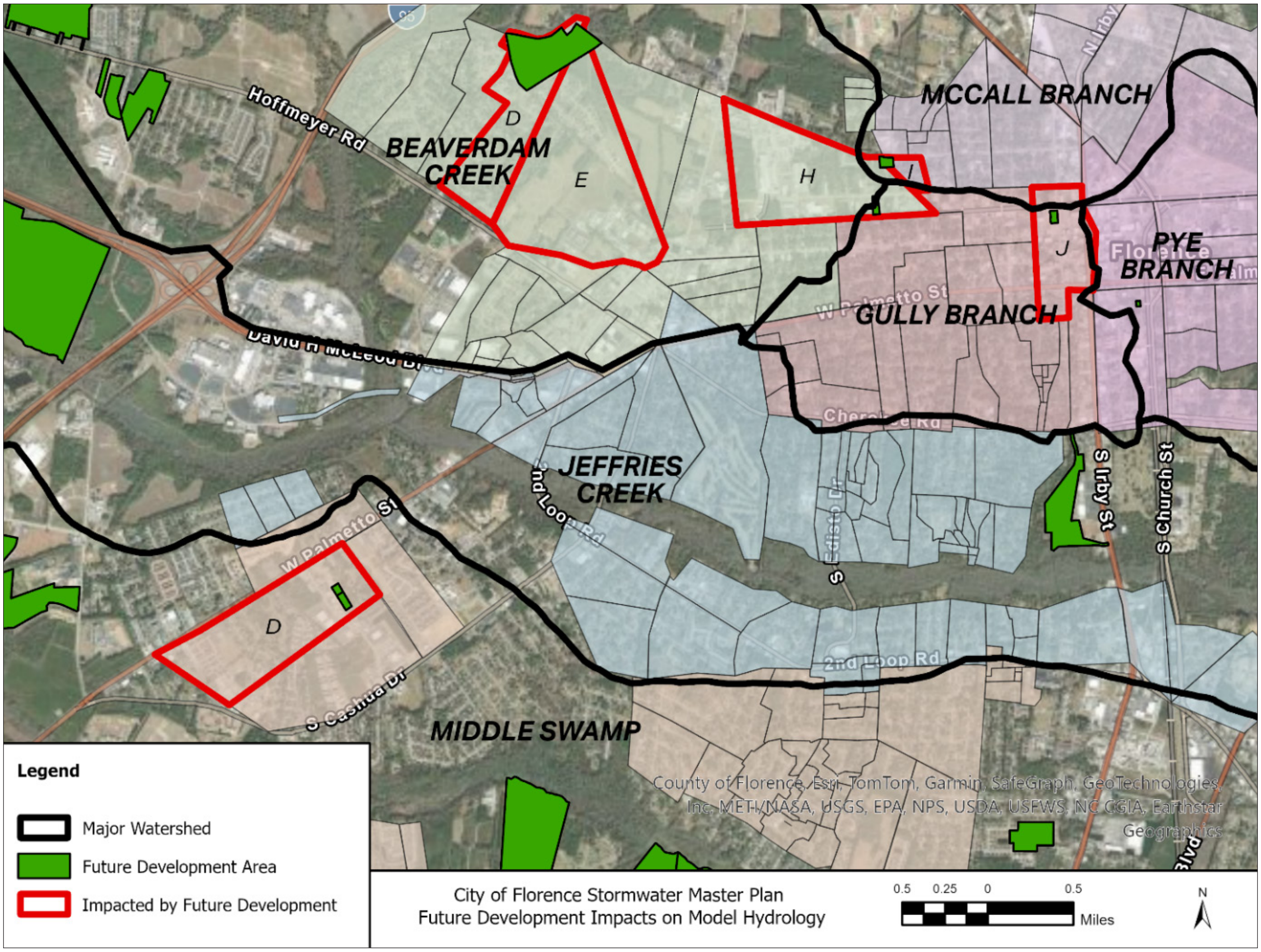


Figure 21: Future development impacts on model hydrology

Table 5: Impacts of Future Development on Curve Number (CN) Values

Major Watershed	Subbasin ID	Subbasin Area (acres)	Future Development Area (acres)	Future Development Area %	Existing CN Value	Future CN Value
Beaverdam Creek	D	157.4	40.8	25.9%	78.3	81.3
	E	320.1	5.1	1.6%	76.2	76.4
	F	134.4	2.2	1.7%	82.5	82.6
	H	222.6	2.6	1.2%	78.9	79.0
Gully Branch	J	99.8	1.3	1.3%	81.0	81.1
McCall Branch	D	216.9	3.9	1.4%	75.8	76.0
	I	13.9	1.0	7.2%	78.6	79.5

The CN value adjustments were incorporated into the baseline model and used for the existing system capacity evaluations discussed in **Section 3.2**.

3.1.4 Model Limitations

The following assumptions and limitations are noted for the H&H stormwater model developed as part of this study:

- The condition of pipes and manholes is assumed to be generally commensurate with the age of the system unless field observations or surveys provide additional detail. Pipes are assumed to be free of sediment.
- The model was simulated with "free discharge" conditions on stormwater outfalls into local waterbodies and open channels. As a result, the model is configured to assume that there are no backwater conditions from existing streams or channels into the stormwater network within the City.
- Stormwater inlets and smaller diameter pipes (less than 30 inches in diameter), which were not located in suspected flood-prone areas, were not included in the capacity evaluation.
- USGS-provided 1-meter DEM data was used to estimate manhole rim elevations and invert elevations in areas with missing elevation data. In areas with recent development, the land surface may vary from these values.
- Node flooding was predicted in areas with relatively large model subbasins due to minimal storage or ponding within the modeled system, which is typically provided by stormwater inlets and smaller diameter pipes. Hand calculations were performed to compare the predicted runoff versus trunkline capacity to verify whether node flooding was a result of the subbasin size or trunkline capacity restriction.

3.2 System Analysis

The developed H&H stormwater model was used to simulate the system's performance under various design conditions and identify potential improvements to increase stormwater conveyance capacity in areas with flooding or capacity limitations. This section describes the key criteria for evaluating system performance. The model-generated results showing profiles and quantifying flows are provided in Appendix M.

3.2.1 Design Storms

The 10- and 25-year design storms were used to evaluate capacity limitations and assess flooding for the stormwater network within the City. The design storms consisted of 24-hour rainfall depths obtained from the South Carolina DHEC Storm Water Management BMP Handbook (2005), which were applied to the SCS Type-II rainfall distribution. Table 6 shows the total rainfall and peak rainfall intensity for each of the design storms evaluated using the H&H model.

Table 6: Design Storm Summary for Florence County (North), SC

Recurrence Interval	Total Rainfall (inches)	Peak Rainfall Intensity (inches/hour)
10-year 24-hour	5.4	0.7
25-year 24-hour	6.7	0.9

3.2.2 Evaluation Criteria

The following performance criteria were used for the H&H stormwater model evaluation to identify potential flood-prone areas:

» Maximum hydraulic grade line (HGL) should not exceed the crown of pipe during the 10-year, 24-hour storm.

» Maximum HGL should not exceed the surface elevation during the 25-year, 24-hour design storm. This performance criterion was considered the "critical storm" and was used to predict potential surface flooding during large storm events. Due to the granularity of the model subbasins and minimal storage built into the model network and due to the minor system (inlets, smaller diameter pipes) that were not included, best engineering judgment was used to determine whether node flooding was a result of the subbasin size or trunkline capacity.

3.2.3 Model-Predicted Capacity Limitations

The H&H baseline model, which represented the existing stormwater system within the City with future land development impacts, was used to evaluate the capacity of the modeled stormwater network under the selected design storms. This involved locating pipes that were surcharged during the peak of the 10-year storm and areas with surface flooding (i.e., maximum HGL exceeds manhole rim elevation) during the peak of the 25-year storm.

The developed model showed node flooding in areas with relatively large model subbasins due to minimal storage within the modeled system, which is typically provided by surface ponding, stormwater inlets, and smaller diameter pipes. Hand calculations were performed to compare the predicted peak runoff versus trunkline capacity to verify whether node flooding was a result of trunkline capacity restrictions or limitations in the modeled network.

The capacity limitations identified by the H&H model results were sorted into two categories: those which were associated with known flooding locations, and those which were not associated with known flooding locations.

In some cases, the model did not predict flooding at a location that was identified as a flooding issue, which was likely a result of the following factors:

» Flooding related to maintenance or a malfunction of the local system (i.e., a blockage or sediment buildup in stormwater inlets or smaller diameter pipes).

» Flooding as a result of capacity restriction in an area of the minor system (inlets, smaller diameter pipes) not captured by the scope of the H&H model.

Figure 22 shows the modeled stormwater pipes that were predicted to be full or surcharged during the 10-year, 24-hour design storm and/or flooded during the 25-year, 24-hour design storm. The figure distinguishes between capacity limitations within known flooding locations versus capacity limitations in locations not associated with flood complaints received through public input or discussions with the City.

The model results showed approximately 11,100 linear feet of existing trunklines with capacity limitations under the selected design storms, 7,400 linear feet of which were associated with known flooding locations and 3,700 linear feet which were not associated with known flooding locations.

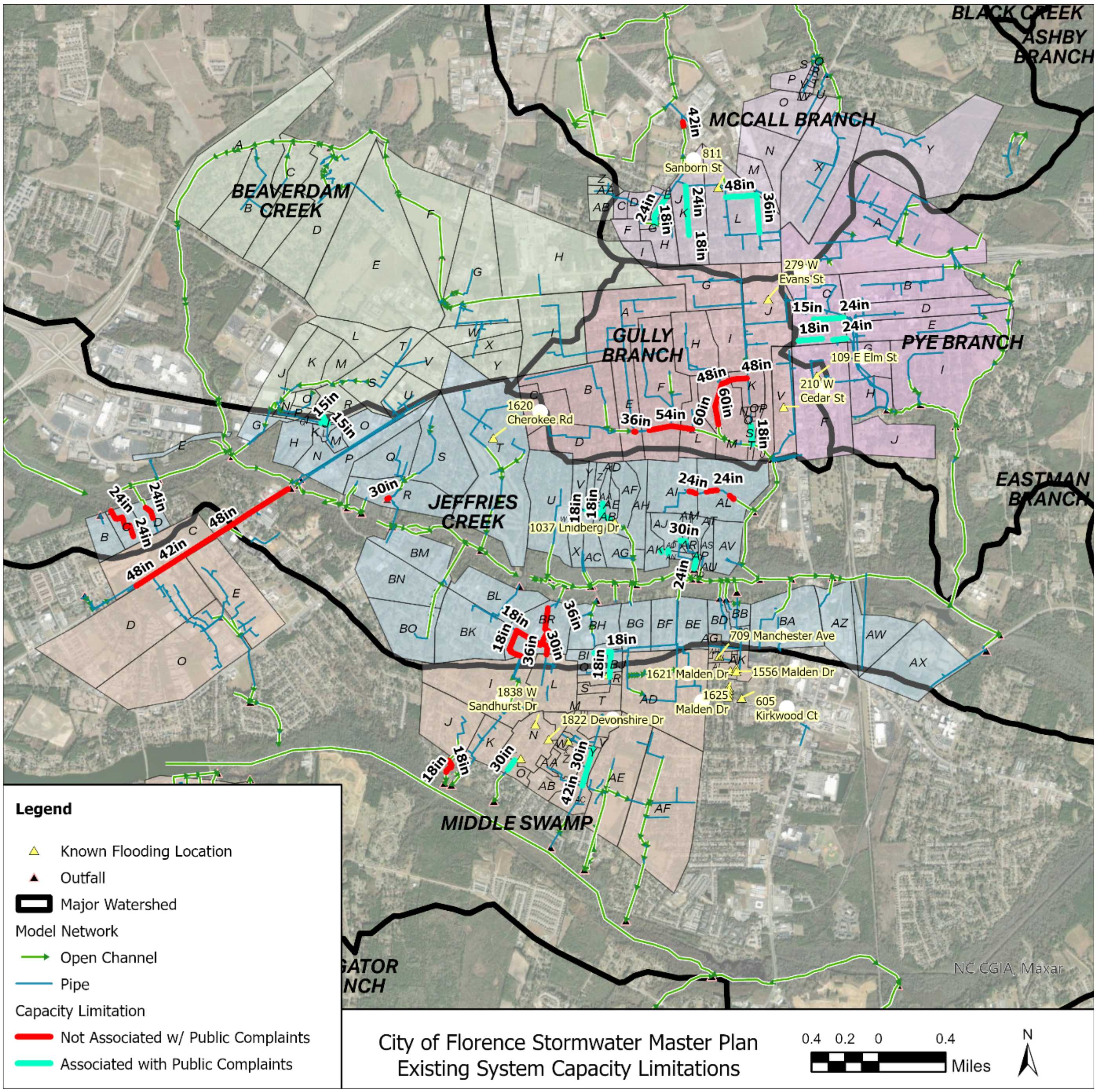


Figure 22: Model-predicted capacity restrictions

3.3 Watershed-Based Plan

As part of the broader SWMP, AECOM contracted Wildlands Engineering, Inc. to develop the city-wide Watershed-Based Plan (WBP). The WBP includes various tasks, such as subwatershed assessments, field data collection, water quality modeling, and the identification and evaluation of pollution control measures. The planning process involved conducting comprehensive field investigations, analyzing current and future conditions of subwatersheds, and identifying areas of concern, such as pollutant sources and suboptimal stormwater control measures. Feedback from stakeholder meetings was integrated into the WBP to ensure that the plan reflects the community's water quality priorities.

The WBP is designed to align with the requirements of the U.S. Environmental Protection Agency's Nine Element Plan, which is consistent with guidelines in Section 319 of the Clean Water Act, and to focus on water quality improvements across the City.

The Nine Minimum Elements for watershed plans include:

1. **Identification of Pollutant Sources:** The WBP identifies the primary causes and sources of pollution that need to be controlled to achieve the desired load reductions. This includes pinpointing critical areas within the watershed that contribute the most significant pollutant loads.

2. **Estimation of Load Reductions:** The WBP estimates the load reductions expected from proposed management measures, which are essential for demonstrating the effectiveness of planned interventions in improving water quality.

3. **Description of Management Measures:** The WBP details the non-point source management measures needed to achieve the estimated load reductions. It identifies critical areas where these measures will be implemented to maximize impact.

4. **Cost and Assistance Estimates:** The WBP outlines the estimated costs, necessary technical and financial assistance, and the authorities required to implement the plan. This helps in aligning resources and securing the necessary funding.

5. **Public Information and Education:** A key component of the WBP is engaging the public and enhancing their understanding of water quality issues. This involvement encourages public participation in selecting, designing, and implementing the proposed management measures.

6. **Implementation Schedule:** The WBP includes a detailed schedule for implementing the management measures, which is critical for maintaining momentum and accountability.

7. **Interim Milestones:** The WBP sets measurable milestones to track progress and ensure that management measures are being implemented effectively.

8. **Criteria for Measuring Success:** The WBP establishes criteria to determine whether load reductions are being achieved over time, ensuring that efforts are making substantial progress toward water quality standards.

9. **Monitoring Component:** The WBP includes a monitoring plan to evaluate the effectiveness of the implemented measures over time, providing feedback that is essential for ongoing adjustments and improvements.

Section 319 of the Clean Water Act provides financial support to state and local governments for implementing programs that control pollution from diffuse sources, such as urban runoff and stormwater discharges, which are not regulated under the National Pollutant Discharge Elimination System (NPDES). Upon completion, the WBP will be submitted to the SCDES for approval, positioning the City to apply for Section 319 grant funding. This funding can then be used to implement stormwater projects with water quality improvement components, ultimately helping the City of Florence address water quality issues comprehensively and sustainably. This approach ensures that the City of Florence will be well prepared to access crucial funding sources to support its stormwater management and water quality improvement initiatives, making the WBP a pivotal element of the overall SWMP.

The complete WBP is provided in Appendix N.

4 Design Standards and Ordinance Review

The Unified Development Ordinance (Ordinance) of the City of Florence, adopted January 15, 2018, serves as a critical legal framework that guides all aspects of the City's development and land use. It consolidates various regulations related to zoning, subdivision, stormwater management, and public infrastructure into a unified code, ensuring a cohesive approach to the City's planning efforts.

This section describes key elements of the Ordinance that are related to stormwater management and how the Ordinance aligns with the SWMP.

4.1 Key Elements Related to Stormwater Management

The following are the key elements of the Ordinance that are related to stormwater management:

1. **Zoning and Land Use:** The Ordinance outlines zoning districts with specific regulations on land use, ensuring that development aligns with the City's overall plan. These regulations influence where and how stormwater management systems can be implemented.
2. **Subdivision Regulations:** The Ordinance provides detailed guidelines for the subdivision of land, including requirements for stormwater infrastructure. Developers must adhere to these guidelines to ensure that new developments are equipped to manage stormwater effectively, reducing the risk of flooding and erosion.
3. **Stormwater Management and Erosion Control:** A significant portion of the Ordinance is dedicated to managing stormwater runoff and preventing erosion. It mandates the use of BMPs and requires developers to obtain permits for land-disturbing activities. This ensures that all new developments incorporate sustainable stormwater management systems that protect water quality and mitigate environmental impacts.
4. **Flood Prevention:** The Ordinance incorporates Federal Emergency Management Agency (FEMA) guidelines to regulate development in flood-prone areas, ensuring that all construction adheres to strict standards. This minimizes the risk of flood damage and protects public safety. Furthermore, the Ordinance outlines provisions to promote development and redevelopment in a manner that minimizes concentrated impervious surfaces. These provisions are intended to reduce the flood potential during smaller storm events, often referred to as nuisance flooding. The Ordinance and South Carolina Department of Health and Environmental Control (SCDHEC) regulations require post-construction peak runoff to be attenuated to predevelopment conditions. For redevelopment sites, the Ordinance requires post-construction stormwater peak discharge to attenuate to predevelopment, undisturbed conditions.
5. **Environmental Protection:** The U.S. Army Corps of Engineers (USACE) requires the conservation of natural resources, including the protection of wetlands and waterbodies. The Ordinance supports the City's efforts to balance development with environmental sustainability, ensuring that stormwater management practices align with broader environmental goals. The Ordinance also outlines provision for the implementation of water quality BMPs within impaired watersheds in the City to address pollutants of concern. This approach requires development to meet post-construction water quality standards to ensure no adverse impact occurs as part of development or redevelopment within the City.
6. **Public Infrastructure:** The Ordinance sets requirements for the provision and maintenance of public infrastructure, including stormwater systems. Developers are responsible for ensuring that their projects do not adversely impact the capacity of the City's infrastructure.

4.2 Integration with the Stormwater Master Plan

The Ordinance's comprehensive approach to zoning, land use, and environmental protection aligns closely with the goals of the SWMP. By adhering to the Ordinance, the City provides guidance so that all developments contribute to a sustainable and resilient stormwater management system. The Ordinance's regulations provide the necessary legal and structural framework to implement the strategies outlined in the SWMP, facilitating effective stormwater management and flood prevention across Florence.

For more information, consult the Department of Planning, Research, and Development at:

(843) 665-2047 or 324 West Evans Street, Florence, SC 29501.

Article 12 Storm Water Management, Drainage, and Flood Prevention is provided in Appendix O.

5 Stormwater Capital Improvement Projects

Section 5 outlines the key considerations, ongoing efforts, and potential projects related to stormwater capital improvements for the City. This section begins by addressing the constraints, limitations, and assumptions that guided the development of proposed stormwater improvements. The discussion then shifts to existing stormwater projects, including those identified in the 2021 Capital Improvements Program and two ongoing projects, followed by an analysis of identified areas of concern across the stormwater network within the City. Finally, potential stormwater projects are proposed to address remaining problem areas, categorized by type and watershed, with the aim of improving system capacity, addressing infrastructure deficiencies, and mitigating flood risks.

5.1 Constraints, Limitations, and Assumptions

The following constraints, limitations and assumptions were considered during the development of stormwater capital improvement projects:

- No adverse impacts, either upstream or downstream, should result from the proposed improvements within the watershed. Therefore, the maximum proposed HGL should be less than or equal to the existing HGL during the peak of the design storm.
- AECOM did not analyze the impacts of riverine flow (i.e., riverine flooding) to natural waterways as a result of proposed improvements to the stormwater network within the City.
- AECOM did not analyze existing stormwater outfall structure capacity.
- Proposed improvements are based upon using minimum pipe slopes ranging from 0.1% to 0.4% with the minimum pipe size necessary to convey full-pipe flow during the 10-year, 24-hour design storm and no flooding during the 25-year, 24-hour design storm. The proposed improvements do not account for adequate ground coverage, nor do they specify the pipe material or design strength necessary for any railroad or SCDOT road crossings. Such features will require more detailed design at the time of project implementation.

5.2 Existing Projects

Several existing stormwater improvement projects have been developed based on previous studies. These projects are in various stages of development, from preliminary assessment to construction phases. This section discusses the background of these stormwater improvements projects.

5.2.1 2021 Preliminary Assessment Capital Improvement Projects

Under the City's Capital Improvements Program for the fiscal year 2021, AECOM conducted preliminary assessments of 10 project areas within the City to evaluate causes of flooding and develop potential solutions. Table 7 summarizes the stormwater capital improvement projects evaluated during the 2021 study. Since 2021, the City has initiated detailed design on several of the projects, and the current completion status is shown in Table 7. The design has been completed for the Pennsylvania Street project, and it is currently in the bid solicitation phase. The bid plans for the Pennsylvania Street project can be found in Appendix P. The 10 stormwater capital improvement projects have been included in the proposed improvement projects as part of this SWMP (their corresponding SWMP project names from **Section 5.5** are in parentheses in Table 7). The goal is that all flooding concerns discussed in **Section 5.3** are addressed, either through the 2021 Capital Improvement Projects or the potential projects proposed as part of this SWMP in **Section 5.5**.

Table 7: 2021 Preliminary Assessment – Capital Improvement Projects

Project Name	Description	Completion Status
St. Anthony Avenue / College Park (MS – 4)	**Phase I** » Debris Removal **Phase II** » Open Channel Widening » Regrading Roadside Diches » Installing new drainage pipes and inlets	Not Completed
Sandhurst West (MS – 3)	**Phase I** » Debris Removal **Phase II** » Open Channel Widening » Installing new drainage pipes and inlets	Phase I Completed Phase II Not Completed
Waccamaw Drive / Tarleton Estates (JC – 14)	**Phase I** » Debris Removal **Phase II** » Installing new drainage pipes and inlets	Not Completed
Malden Drive (MS – 1)	**Phase I** » Debris Removal **Phase II** » Open Channel Widening » Installing new drainage pipes and inlets	Phase I Completed Phase II In progress
Cannon Street (MB – 2)	**Phase I** » Debris Removal **Phase II** » Open Channel Widening » Installing new drainage pipes and inlets	Not Completed
Woodland Drive / Thomas Road (JC – 10)	**Phase I** » Debris Removal **Phase II** » Installing new drainage pipes and inlets	Not Completed
Rebecca Street (MB – 5)	**Phase I** » Debris Removal **Phase II** » Installing new drainage pipes and inlets	Not Completed
Pennsylvania Street (MB – 1)	**Phase I** » Debris Removal **Phase II** » Open Channel Widening » Installing new drainage pipes and inlets	In Progress
Dargan and Elm Streets (PB – 3)	**Phase I** » Debris Removal **Phase II** » Installing new drainage pipes and inlets	Not Completed
Cheves Street (PB – 2)	**Phase I** » Debris Removal **Phase II** » Installing new drainage pipes and inlets	Not Completed

5.2.2 Ongoing, Grant-Funded Projects

In addition to the stormwater improvement projects evaluated in the 2021 study, the City is in the process of executing the North Church and Oakland Avenue Stormwater Improvements project and the Cedar and McQueen Stormwater Improvements project. See Table 8 for a description and status of the ongoing, grant-funded stormwater improvement projects in the City. The permit plans for North Church and Oakland Avenue, and the bid plans for Cedar and McQueen can be found in Appendix P.

Table 8: Ongoing Stormwater Improvement Projects

Project Name	Description	Status
North Church and Oakland Avenue Stormwater Improvements	4,200 LF of 18-inch to 48-inch RCP 300 LF of 72x36-inch Box Culvert	Permitting Phase
Cedar and McQueen Stormwater Improvements	3,750 LF of 15-inch to 60-inch RCP 665 LF of Curb and Gutter 70 Catch Basins 11,760 LF of 10-inch to 60-inch Storm Drain Heavy Cleaning 4+ acres of water quality improvements	Construction Phase (Contract Price of $4,700,052.50)
Stormwater System Improvements on Pennsylvania Street*	3,575 LF of 18-inch to 54" RCP 630 LF of Curb and Gutter 73 Catch Basins 21,500 LF of 12-inch to 60-inch Storm Drain Heavy Cleaning 43 New Trees	Bid Solicitation

LF = linear feet
RCP = reinforced concrete pipe
* The Pennsylvania Street project is one of the 2021 Capital Improvement Projects

5.3 Areas of Concern

Through staff interviews, review of City complaint logs, previous stormwater studies, H&H modelling, and input from the public engagement process, 51 areas with stormwater concerns were identified across the City. In some cases, one area of concern is associated with multiple properties, and they were grouped based on location within the existing stormwater network. AECOM analyzed these areas of concern using the City's GIS database and the H&H model of the stormwater network within the City and found the following related issues:

- Undersized trunklines or channels
- Lack of stormwater infrastructure (i.e., pipes or drainage inlets)
- Maintenance issues, such as vegetation and/or debris

Table 9 is a summary of the areas of concern based on problem category. Table 10 provides an area description, associated address(es) if applicable, problem category, and the project name from the potential stormwater improvement projects detailed in **Section 5.5**. Of the 51 total areas of concern, 10 were associated with an existing stormwater capital improvement project discussed in **Section 5.2**, suggesting that additional stormwater improvements projects are required to address the remaining 41 areas of concern.

Table 9: Stormwater Areas of Concern Overview

Problem Category	Areas of Concern
Model-Predicted Capacity Restriction	9
Observed Flooding Area Not Impacted by Existing Project	26
Observed Flooding Impacted by Existing CIP Project	10
1989 Storm Drainage Study Recommended Project	6
Total:	**51**

Table 10: Stormwater Areas of Concern Detailed Summary

Project Name	Area Description	Reported Address(es)	Problem Description
Beaverdam Creek - 01	Dozier Boulevard	106 Dozier Boulevard	Observed Flooding
Eastman Branch - 01	Richmond Hills Subdivision	2213 Richmond Hills Drive, 2013 Glenmore Way	Observed Flooding
Gully Branch - 01	South McQueen Street	706 S. McQueen Street	Observed Flooding
Gully Branch - 02	Mcintosh Woods Boulevard	-	Model-Predicted Capacity Restriction
Gully Branch - 03	1400 Block of Madison Avenue	1406 Madison Avenue	Observed Flooding
Gully Branch - 04	Cherokee x Lawson	723 Cherokee Road	Observed Flooding
Gully Branch - 05	Cherokee Road and Winston Street Area	-	1989 Proposed Project
Jeffries Creek - 01	Backyards of Madison Avenue	1514 Madison Avenue	Observed Flooding
Jeffries Creek - 02	Lucas Park	-	Model-Predicted Capacity Restriction
Jeffries Creek - 03	Claremont Avenue	1032 Edisto Drive	Observed Flooding

Table 10: Stormwater Areas of Concern Detailed Summary (continued)

Project Name	Area Description	Reported Address(es)	Problem Description
Jeffries Creek - 04	Wisteria x Brunwood	Intersection of Wisteria Avenue and Brunwood Avenue	Observed Flooding
Jeffries Creek - 05	Wisteria x Wentworth	1101, 1105, 1100 Wentworth Drive	Observed Flooding
Jeffries Creek - 06	Wisteria x Park	1021 South Park Avenue, 540 Wisteria Drive, 546 Wisteria Drive, 537 Wisteria Drive	Observed Flooding
Jeffries Creek - 07	Wisteria x Congaree	900 Wisteria Drive	Observed Flooding
Jeffries Creek - 08	Woodland Drive / Burris Road	525 Woodland Drive	Model-Predicted Capacity Restriction and Observed Flooding
Jeffries Creek - 09	Fernleaf Lane / South Thomas Road	422, 426, 430 South Thomas Road, 2128, 2124 Fernleaf Lane	Observed Flooding
Jeffries Creek – 10 (2021 CIP)	Woodland Drive / South Thomas Road	-	Observed Flooding
Jeffries Creek - 11	Boxwood Ave	-	Model-Predicted Capacity Restriction
Jeffries Creek - 12	Larkspur Road	-	Model-Predicted Capacity Restriction
Jeffries Creek - 13	Manchester to Second Loop	1554, 1555, 1556, 1557 Malden Drive, 640 Second Loop Road, 709 Manchester Avenue	Observed Flooding
Jeffries Creek – 14 (2021 CIP)	Waccamaw-Tarleton Estates	1201 Berkley Avenue	Observed Flooding
Jeffries Creek - 15	Bellevue Drive	1601, 1604, 1605, 1608, 1609, 1613 St Anthony Avenue	Model-Predicted Capacity Restriction
Jeffries Creek - 16	Jeffries Lane	450 Jeffries Lane	Observed Flooding
Jeffries Creek - 17	Wisteria x Santee	504 Wisteria Drive, 1034 and 1050 Santee Drive	Observed Flooding
McCall Branch – 01 (2021 CIP)	Pennsylvania Street	811 Sanburn Street, West Sumter Street	Observed Flooding
McCall Branch – 02 (2021 CIP)	Cannon Street	-	Observed Flooding
McCall Branch - 03	Dunbar Street	-	Observed Flooding
McCall Branch - 04	CSX Railroad Culvert	-	Model-Predicted Capacity Restriction

Table 10: Stormwater Areas of Concern Detailed Summary (continued)

Project Name	Area Description	Reported Address(es)	Problem Description
McCall Branch – 05 (2021 CIP)	Rebecca Street	-	Observed Flooding
McCall Branch - 06	Cumberland Drive	724 Cumberland Drive	Observed Flooding
McCall Branch - 07	Roosevelt Street	804 Roosevelt Street	Observed Flooding
McCall Branch - 08	Waterman Avenue North	-	1989 Proposed Project
Middle Swamp – 01 (2021 CIP)	Malden Drive Area	1617, 1621, 1625, 1701 Malden Drive	Observed Flooding
Middle Swamp - 02	Nottingham Drive	1815 Nottingham Drive	Observed Flooding
Middle Swamp – 03 (2021 CIP)	Sandhurst West	1838 West Sandhurst Drive	Observed Flooding
Middle Swamp – 04 (2021 CIP)	St. Anthony Avenue / College Park	1709, 1710, 1712, 1713, 1751, 1755 St. Anthony Avenue	Observed Flooding
Middle Swamp - 05	South Enchanted Lane	-	Model-Predicted Capacity Restriction
Middle Swamp - 06	West Palmetto Street	-	Model-Predicted Capacity Restriction
Middle Swamp - 07	Red Tip Circle Outfall	645, 657, 643 Red Tip Circle	Observed Flooding
Middle Swamp - 08	Devonshire Drive	1822 Devonshire Drive	Observed Flooding
Middle Swamp - 09	Kirkwood Court	605 Kirkwood Court	Observed Flooding
Middle Swamp - 10	Poinsett Drive	-	Observed Flooding
Middle Swamp - 11	Billy Branch/Irby Crossing	1738 South Irby Street	Observed Flooding
Middle Swamp - 12	Partridge Drive	-	1989 Proposed Project
Middle Swamp - 13	Malden Drive and YMCA Area	-	1989 Proposed Project
Middle Swamp - 14	Cloisters Subdivision	-	1989 Proposed Project
Middle Swamp - 15	Southbrook Circle Subdivision	3480 Southbrook Circle	Observed Flooding
Pye Branch - 01	Charlotte Street	316 South Charlotte Street	Observed Flooding
Pye Branch – 02 (2021 CIP)	Cheves Street	W Palmetto Street	Observed Flooding
Pye Branch – 03 (2021 CIP)	Dargan and Elm Street	109 East Elm Street	Observed Flooding
Pye Branch - 04	Cheves Street, Jarrott Street, Kershaw Street, and Walnut Street Area	-	1989 Proposed Project

5.4 Project Types

Table 11 lists the potential stormwater improvement projects considered to address stormwater concerns. Of the potential control measures listed in Table 11, storage projects (i.e., flow detention and deep storage tunnels) were not considered a cost-effective option for the City due to the associated disturbance to private properties as well as the lack of available land for flow detention.

Table 11: Stormwater Improvement Project Types

Project Type	Description
Conveyance Improvements	Upsizing of existing trunklines or widening of existing open channels to increase existing system capacity and reduce hydraulic bottlenecks. Installation of new pipes, channels or outfalls to provide stormwater conveyance to areas with minimal or lack of stormwater infrastructure.
Regrading	Regrading of existing roadside ditches to redirect stormwater runoff from low-lying areas to the stormwater network.
Maintenance	Cleaning or dredging of existing stormwater infrastructure, including debris and root removal, to increase conveyance capacity. Repairing/replacing damaged pipes or other stormwater infrastructure.
Increased Inlet Capacity	Installation of new inlets or replacement of existing inlets to increase inlet capacity.
Storage	Construction of detention areas to store stormwater runoff to reduce the peak flow into the collection system during large rainfall events. Installation of deep storage tunnels to provide storage of stormwater runoff with relatively minimal disturbance to the ground surface, which can be beneficial in congested urban areas. Flows are introduced into tunnels through drop shafts, and pumping facilities are often required at the downstream end.

5.5 Potential Projects

Proposed stormwater improvements were developed for the identified areas of concern not associated with an existing or ongoing stormwater improvements project. The existing stormwater improvements projects, which have yet to be completed, were deemed necessary to improve existing stormwater concerns and were therefore included in the list of potential projects.

Potential projects are presented and identified based on the associated major watershed area and are discussed in the following subsections. Individual maps of each potential project can be found in Appendix Q. Preliminary, conceptual cost estimates were also created for each project and can be found in Appendix R.

5.5.1 Beaverdam Creek Watershed

The scope of Project BC-1, located in the Beaverdam Creek watershed, is detailed below and shown in Figure 23.

Project BC-1: Dozier Boulevard Stormwater Improvements

Project BC-1 was developed in response to historical roadway and commercial building flooding at the intersection of Dozier Boulevard and David H Mcleod Boulevard, particularly the commercial property at 101 Dozier Boulevard. H&H model analysis showed that the existing 15-inch to 18-inch piping serving the commercial properties at the intersection of Dozier Boulevard and David H McLeod Boulevard is undersized, resulting in surface flooding during the 25-year design storm. Additionally, the outfall from the apartment and commercial complex located on the southeast side of the intersection is unknown. This project includes the following proposed improvements to meet the targeted design criteria:

- Replace 200 LF of 15-inch pipe with 24-inch pipe, 150 LF of 15-inch pipe with 30-inch pipe, and 820 LF of 18-inch pipe with 30-inch pipe serving businesses on Dozier Boulevard.
- Clean and clear 150 LF of the existing ditch along the north side of David H McLeod Boulevard; extend the ditch 200 LF to the outlet at the existing pond adjacent to Beaverdam Creek.
- Regrade 5 existing inlet structures at intersection of David H Mcleod Boulevard and Dozier Boulevard.

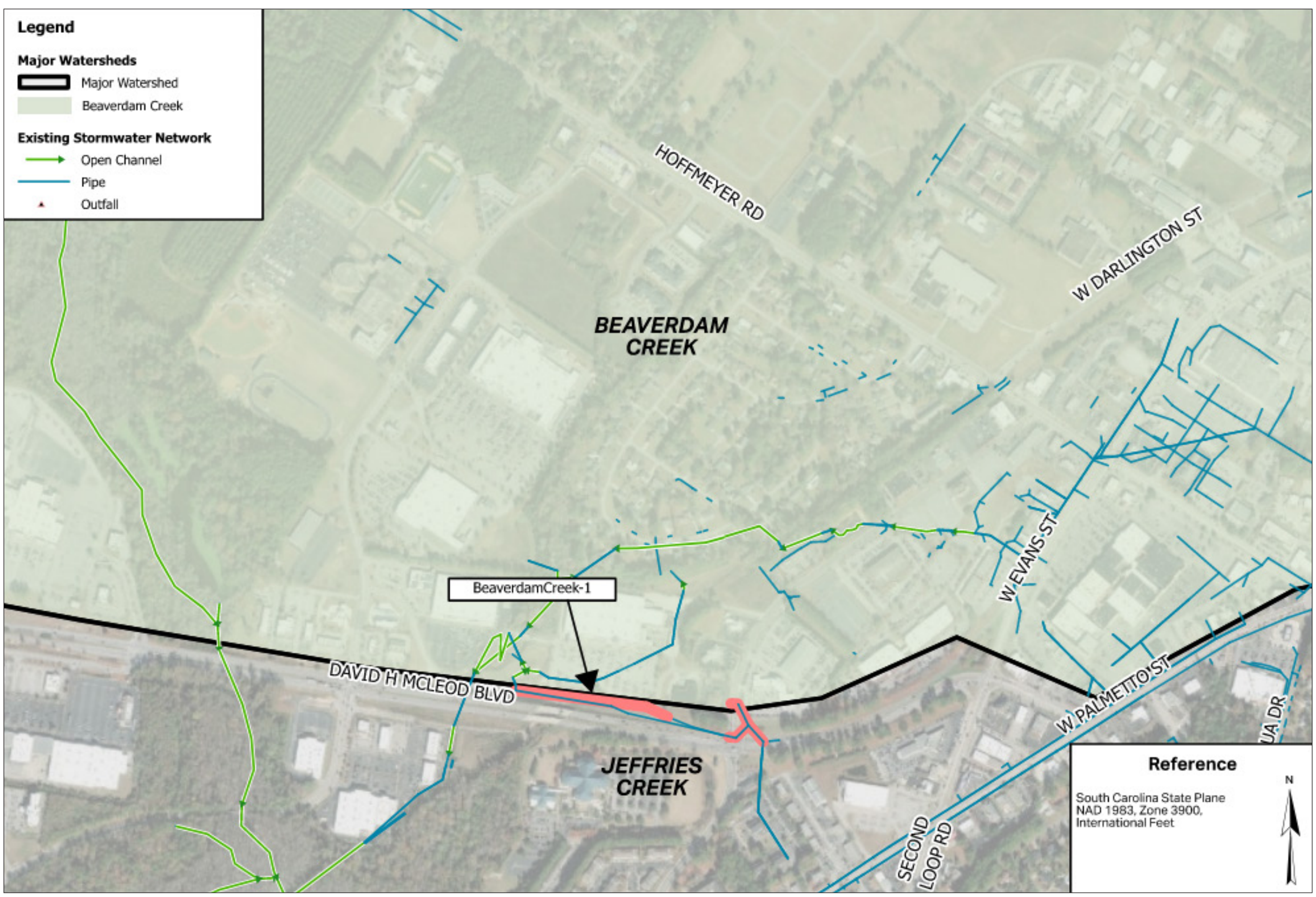


Figure 23: Beaverdam Creek Watershed potential stormwater improvement project

5.5.2 Eastman Branch Watershed

The scope of Project EB-1, located in the Eastman Branch watershed, is detailed below and shown in Figure 24.

Project EB-1: Richmond Hills Subdivision Stormwater Improvements

Project EB-1 was developed to improve residential flooding at the Richmond Hills subdivision, particularly in the low-lying property (2213 Richmond Hills) located adjacent to the residential detention pond and to repair the area located at the northeast portion of the subdivision (Glenmore Way) due to apparent sink holes. H&H modeling results also showed that existing stormwater pipes serving the subdivision are adequately sized to meet the design criteria. The following improvements are recommended for Project EB-1.

- Perform localized grading at 2213 Richmond Hills Drive to protect against detention pond surcharging into yards.
- Repair 290 LF of existing 48-inch pipe located east of Glenmore Way; repair is recommended due to apparent sink holes.

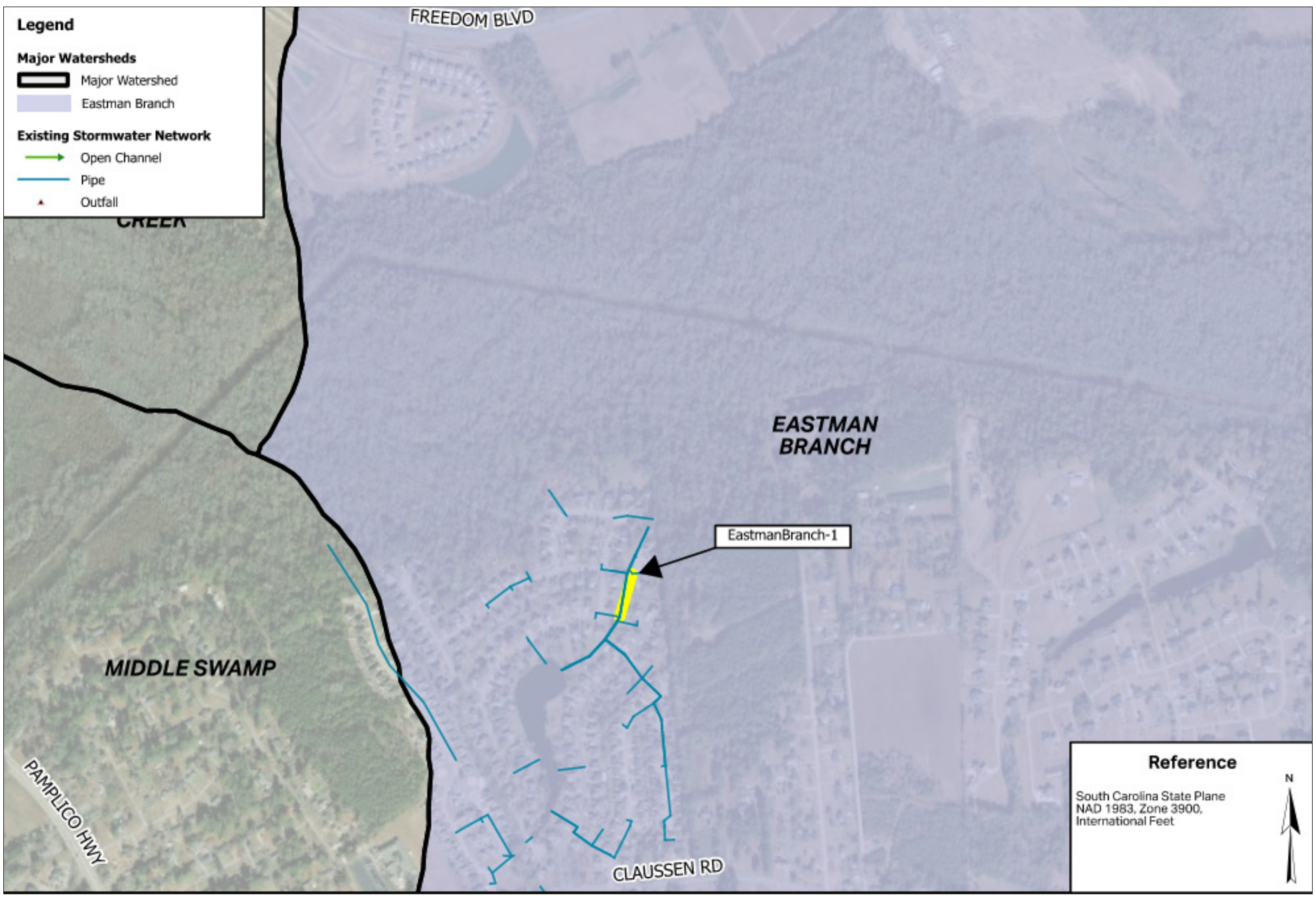


Figure 24: Eastman Branch Watershed potential stormwater improvement project

5.5.3 Gully Branch Watershed

The proposed scope for each potential project in the Gully Branch watershed is detailed below, and an overview map of the proposed stormwater improvements in the Gully Branch is shown in Figure 25.

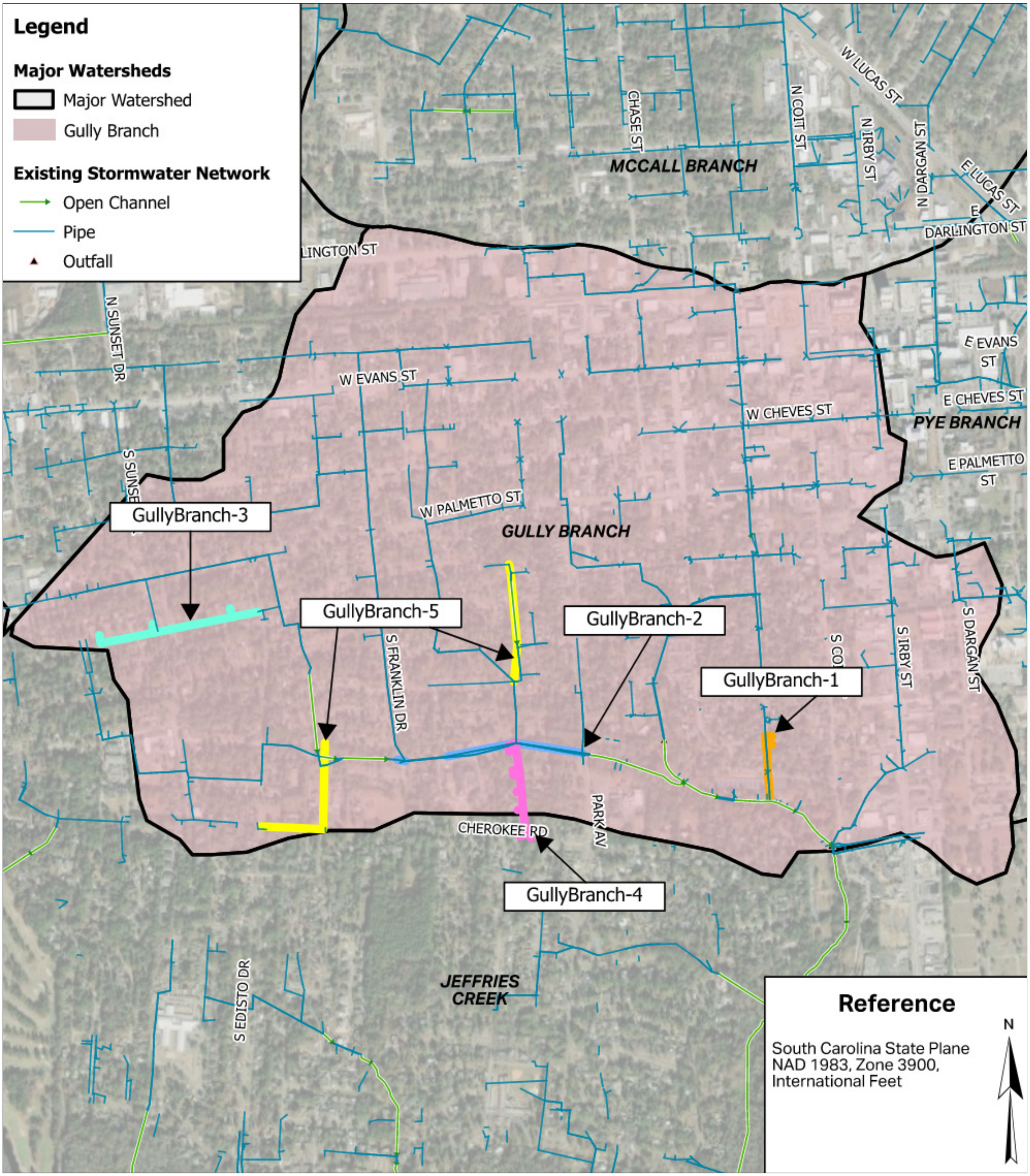


Figure 25: Gully Branch Watershed potential stormwater improvement projects

Project GB-1: South McQueen Street Stormwater Improvements

Project GB-1 was developed to address historical yard and roadway flooding at the intersection of South McQueen Street and Poplar Street (706 South McQueen Street). H&H model analysis showed that the existing inlet pipes serving the intersection, and the downstream 18-inch trunkline do not meet the targeted design criteria. The analysis also showed that the area could benefit from additional inlets and replacement of existing undersized inlets at the intersection of South McQueen Street and Poplar Street. As a result, the following improvements are recommended:

- Install 2 new inlets at the intersection of South McQueen Street and Poplar Street and connect to the existing trunkline via 85 LF of new 18-inch pipe.
- Replace the 2 existing curb inlets located at the intersection of South McQueen Street and Poplar Street to increase inlet capacity.
- Upsize 600 LF of existing 18-inch pipe with 24-inch pipe from the intersection of McQueen Street and Poplar Street to the existing outfall at Timrod Park.

Project GB-2: Wannamaker Road / South Franklin Drive Stormwater Improvements

Project GB-2 was developed in response to the findings of the H&H model capacity analysis, which showed that the stormwater infrastructure (two parallel 54-inch pipes) running along Wannamaker Road (State Route S-21-211) from South Franklin Drive to South Park Avenue and the upstream 36-inch culvert underneath South Franklin Drive do not meet the desired level of service. Observed flooding has not been reported in the immediate area of this project. However, the two parallel 54-inch pipes serve more than half of the Gully Branch watershed and are a potential bottleneck for the upstream area. The following improvements are recommended for this project:

- Upsize 1,380 LF of existing 54-inch pipe located on the north side of Wannamaker Road to 72-inch-diameter pipe.
- Upsize 80 LF of existing 36-inch culvert located at South Franklin Drive and Wannamaker Avenue to 54-inch-diameter culvert.

Project GB-3: Madison Avenue / Seneca Drive Stormwater Improvements

Project GB-3 was developed to address apparent ponding issues along Madison Avenue from Seneca Drive to south Edisto Drive, which are due to minimal stormwater infrastructure and inadequate grading to existing stormwater inlets. The following proposed improvements are included in Project GB-3:

- Replace 2 existing inlets on Madison Avenue and install 4 new inlets.
- Install 850 LF of 15-inch pipe and connect new stormwater inlets to existing 30-inch pipe east of South Edisto Drive.
- Mill and resurface 33,500 square feet of roadway along the southern side of Madison Avenue from Seneca Drive to South Edisto Drive to allow for additional roadway drainage.

Project GB-4: West Cherokee Road / Lawton Avenue Stormwater Improvements

The proposed improvements under Project GB-4 are intended to address the lack of stormwater infrastructure along South Lawton Avenue, which likely resulted in the reported flooding at the private property located at the intersection of West Cherokee Road and Lawton Avenue (723 Cherokee Road). The proposed improvements include the following:

- Install 1,125 LF of new pipe along South Lawton Road and connect to the existing 54-inch pipe.
- Install 2 catch basins and 11 yard inlets.

Project GB-5: Cherokee Road / Winston Street Area Stormwater Improvements

This project was one of the 12 projects recommended by the 1989 Storm Drainage Study and is one of the six projects from the study that were never completed. The proposed improvements include the following:

- Install 1,020 LF of new 18-inch RCP.
- Install 1,800 LF of new 24-inch RCP.
- Install 8 catch basins.

5.5.4 Jeffries Creek Watershed

The proposed scope for each potential project in the Jeffries Creek watershed is detailed below. Figure 26 shows an overview of the potential stormwater improvements projects in the Jeffries Creek watershed.

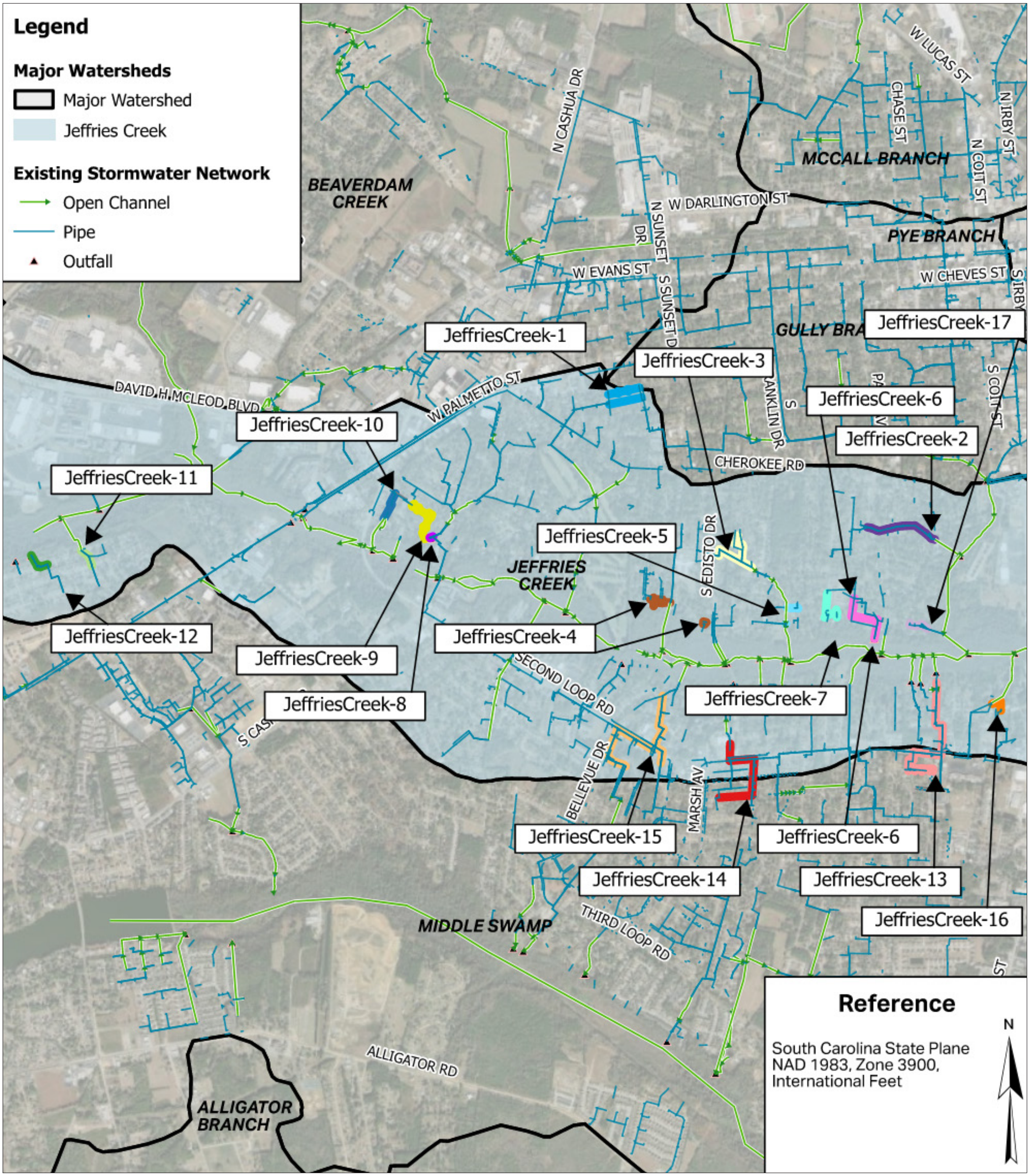


Figure 26: Jeffries Creek Watershed potential stormwater improvement projects

Project JC-1: Backyards of Madison Avenue Stormwater Improvements

Project JC-1 was developed to address the historical flooding issues reported at 1514 Madison Avenue. The homes in the area between Seneca Drive and Greenway Drive are served by an existing ditch that runs in back of the property lines of the homes on Madison Avenue and Jackson Avenue. The topography is relatively flat and could be improved by replacing the ditch with pipes to provide stormwater runoff conveyance from these homes. The following improvements are recommended under Project JC-1:

- Install 775 LF of new 15-inch pipe and 4 inlets along Madison Avenue and connect to the existing 15-inch pipe on Seneca Drive.
- Replace 725 LF of existing ditch with new 15-inch pipe and 3 inlets along the property line between Madison Avenue and Seneca Drive and connect to the existing 15-inch pipe on Seneca Avenue.

Project JC-2: Lucas Park Stormwater Improvements

Project JC-2 was developed based on the findings of the H&H model capacity analysis, which showed that the existing pipe located within the extents of Lucas Park, north of State Road S-21-840, was undersized for the desired level of service. The following improvements are recommended for Project JC-2:

- Upsize 93 LF of existing 24-inch pipe to 42-inch pipe, 704 LF of existing 30-inch pipe to 48-inch pipe, and 801 LF of existing 36-inch to 42-inch pipe to 54-inch pipe.

Project JC-3: Claremont Avenue Stream Restoration and Stormwater Improvements

Project JC-3 was developed in response to historical flooding issues reported in the backyards of residences along Claremont Avenue, particularly the residences at 1032 Edisto Drive and 1037 Lindberg Drive. The H&H modeling analysis indicated several bottlenecks within the stormwater network serving the area, including the existing 15-inch to 18-inch piping serving Alton Circle and the existing 18-inch culvert located at the intersection of Claremont Avenue and Edisto Drive. Field investigations of the existing streambed also indicated erosion and ponding in low-lying areas. The following improvements are recommended under Project JC-3:

- Restore and widen 950 LF of the existing streambed located behind residences along Claremont Avenue.
- Replace the existing 18-inch culvert crossing at the intersection of Edisto Drive and Claremont Avenue with a 30-inch culvert.
- Install 560 LF of new 24-inch pipe and 5 new inlets along Alton Circle and connect to the new 30-inch pipe west of Beverly Drive.
- Upsize 400 LF of existing 18-inch pipe west of Beverly Drive with 30-inch pipe.
- Remove 5 existing inlets located behind residences on Alton Circle and abandon the connected 15-inch to 18-inch piping.

Project JC-4: Wisteria Drive / Brunwood Drive Stormwater Improvements

Project JC-4 was developed to improve recurring flooding issues at the intersection of Wisteria Drive and Brunwood Drive and at the intersection of Wisteria Drive and Edisto Drive (related to flooding occurrences at 1300, 1304, 1308, and 1316 Wisteria Drive). Conveyance issues are likely attributed to minimal stormwater infrastructure in low-lying areas. The following improvements are included in Project JC-4:

- Install 250 LF new 24-inch pipe and 475 LF new 36-inch pipe near the intersection of Wisteria Drive and Brunwood Drive.
- Replace 5 existing inlets and install 6 new inlets and connect into new 24-inch to 36-inch pipe along Wisteria Drive.
- Replace 1 existing inlet located at the intersection of Ridgeland Drive and Wisteria Drive with a new inlet.

- Replace 4 existing inlets located just west of the intersection of Wisteria Drive and Edisto Drive and install 200 LF of new 12-inch pipe to connect new inlets to the existing outfall located on the east property line of 1305 Wisteria Drive.

Project JC-5: Wisteria Drive / Wentworth Drive Stormwater Improvements

Project JC-5 is intended to improve historical flooding issues at the properties located near the intersection of Wentworth Drive (State Road S-21-949) and Lorraine Avenue, particularly the residences at 1101, 1105, and 1110 Wentworth Drive. The area of concern is currently served by 15-inch to 18-inch piping, which outlets to a ditch following the north property line of 1105 Wentworth Drive before discharging into the stream located in the backyards of the properties on the west side of Wentworth Drive. The following proposed improvements are included under Project JC-5:

- Install 350 LF of new 30-inch pipe in place of the existing open channel ditch following the north property line of 1105 Wentworth Drive and connect to the existing network.
- Replace 5 existing inlets located near the intersection of Wentworth Drive and Lorraine Avenue with new models.
- Upsize the existing 36-inch culvert (approximately 175 LF) located east of the intersection of Wisteria Drive and Wentworth Drive with 48-inch pipe.

Project JC-6: Wisteria Drive / South Park Avenue Stormwater Improvements

Project JC-6 was developed to improve historical flooding issues at the properties located near the intersection of Wisteria Drive and Park Avenue, particularly the residences at 1021 South Park Avenue and 528, 537, 540, and 546 Wisteria Drive. Existing infrastructure serving this area appears to be in poor condition and is undersized to meet the desired level of service. The following improvements are recommended under Project JC-6:

- Replace 11 existing inlets with new models.
- Upsize 400 LF of existing 24-inch pipe running along the east property line of 540 Wisteria Drive with 42-inch pipe.
- Install 1,025 LF of new 30-inch to 36-inch pipe and 4 new inlets behind residences at the intersection of Wisteria Drive and South Park Avenue.

Project JC-7: Wisteria Drive / Congaree Drive Stormwater Improvements

Project JC-7 was developed to improve historical flooding issues at the intersection of Wisteria Drive and Congaree Drive, specifically at 900 Wisteria Drive. The area is currently served by minimal stormwater infrastructure with no known stormwater outfall. The following improvements are recommended under Project JC-7:

- Install 500 LF of new 18-inch pipe along Congaree Drive extending from Lorraine Avenue to Wisteria Drive.
- Install an additional 300 LF of new 24-inch pipe along Wisteria Drive from Congaree Drive to the existing outfall at the existing ditch located along the eastern property line of 722 Wisteria Drive.
- Replace 3 existing inlets at the intersection of Congaree Drive and Lorraine Avenue.
- Install 2 new inlets and replace 3 existing inlets near the intersection of Wisteria Drive and Congaree Drive.

Project JC-8: Woodland Drive / Burris Road Stormwater Improvements

Project JC-8 was developed based on the findings of the H&H model capacity analysis, which showed the existing parallel 30-inch pipe crossings located just east of the intersection of Burris Road and Woodland Drive to be a hydraulic bottleneck. Additionally, historical flooding has been observed at 525 Woodland Drive, which drains to the parallel 30-inch pipe crossings and would likely be improved by the proposed capacity improvements. The following capacity improvements are recommended under Project JC-8:

- Upsize the west pipe crossing (approximately 70 LF) located at the intersection of Woodland Drive and Burris Road from 30-inch-diameter to 48-inch-diameter pipe.
- Upsize the east pipe crossing (approximately 53 LF) located at the intersection of Woodland Drive and Burris Road from 30-inch-diameter to 54-inch-diameter pipe.

Project JC-9: Fernleaf Lane / South Thomas Road Stormwater Improvements

Project JC-9 was developed to improve the historical flooding issues at the properties located along South Thomas Road (422, 426, and 430 South Thomas Road) and Fernleaf Lane (2128 and 2124 Fernleaf Lane), which are impacted by minimal stormwater infrastructure in the area. These properties are located in a low-lying area and currently served by existing 2-inch to 8-inch piping located within the back property line, which outlets to the existing 18-inch pipe on Fernleaf Lane. The following stormwater improvements are recommended under Project JC-9:

- Install 1,150 LF of 18-inch pipe and 12 inlets along South Thomas Road and Burris Road to convey stormwater from the area of concern to a new outfall located along the stream near the intersection of Woodland Drive.
- Install 12 new inlets along South Thomas Road and Burris Road and remove the two existing inlets at the intersection of Woodland Drive and Burris Road.

Project JC-10: Woodland Drive / Thomas Road Stormwater Improvements (2021 CIP Project)

Project JC-10 was part of the 2021 Capital Improvements Program's preliminary assessment. The goal of this project is to improve the historical flooding issues on South Thomas Road, specifically the western portion of South Thomas Road and Senate Street (Legacy Lane). The following stormwater improvements are recommended under Project JC-10:

- Regrade 1,380 LF of existing roadside ditches along Senate Street and widen approximately 300 LF of the existing channel near the outfall to stream.
- Install 310 LF of 18-inch RCP, 660 LF of 24-inch RCP, and 8 inlets along South Thomas Road and Senate Street to the existing outfall near Woodland Drive.

Project JC-11: Boxwood Avenue Stormwater Improvements

Project JC-11 was developed based on the findings of the H&H model capacity analysis, which showed that the existing 18-inch to 24-inch piping serving the eastern portion of the residential neighborhood north of West Palmetto Street was undersized to meet the desired level of service. No flooding observations have been reported in the immediate area of this project. The following improvements are recommended under Project JC-11:

- Upsize 205 LF of existing 18-inch pipe located on the eastern property line of 2909 Larkspur Road to 30-inch pipe.
- Upsize 200 LF of existing 24-inch pipe located on the eastern property line of 2815 Boxwood Avenue to 30-inch pipe.

Project JC-12: Larkspur Road Stormwater Improvements

Project JC-12 was developed based on the findings of the H&H model capacity analysis which showed that the existing 24-inch piping serving the western portion of the residential neighborhood north of West Palmetto Street to be undersized to meet the desired level of service. No flooding observations have been reported in the immediate area of this project. The following improvements are recommended under Project JC-12:

- Upsize 500 LF of existing 24-inch pipe located along Larkspur Drive to the existing outfall at Jeffries Creek to 30-inch pipe.

Project JC-13: Second Loop and Damon Drive Stormwater Improvements

Project JC-13 was developed to improve the flooding issues reported at 709 Manchester Avenue and at the apartments located near the intersection of Second Loop and Damon Drive. The following improvements are recommended under Project JC-13:

- Replace the existing inlet in the apartment parking lot located near Second Loop and Damon Drive.
- Upsize 700 LF of existing 18-inch pipe on 2nd Loop Rd to 24-inch pipe and abandon the existing ditch.
- Install 900 LF of new 18-inch pipe and 12 inlets on Manchester Avenue and extend to existing piping on 2nd Loop Avenue.
- Upsize 1,700 LF of 24-inch to 30-inch pipe with 30-inch to 42-inch pipe running on the eastern property line of the residences on Malden Drive to the existing outfall to Jeffries Creek.

Project JC-14: Waccamaw-Tarleton Estates Stormwater Improvements (2021 CIP Project)

Project JC-14 was part of the 2021 Capital Improvements Program preliminary assessment. The goal of this project is to improve the flooding issues near the intersection of Berkley Avenue and Waccamaw Drive (associated with the apparent flooding location of 1201 Berkley Avenue) and includes the following improvements:

- 2,880 LF of Debris Removal
- 2,380 LF of 48” RCP, 80 LF of 54” RCP Bore and Jack
- 15 Drainage Inlets

Project JC-15: Bellevue Drive Stormwater Improvements

Project JC-15 was developed based on the findings of the H&H model capacity analysis which showed the existing 18”-36” piping serving the area near Second Loop Road and Bellevue Drive to be undersized to meet the desired level of service. Additionally, this area is associated with several flooding complaints including 1601, 1604, 16 05, 1608, 1609 and 1613 Anthony Avenue. The following improvements are recommended under Project JC-15:

- Upsize 2120 of existing 18" pipe on Wayne Street, Bellevue Drive and Second Loop Avenue to 24-inch- 36" pipe.
- Upsize 435 LF of existing 30" pipe located on Second Loop Road and Woods Drive to 36”- 42" pipe.
- Upsize 1225 LF of existing 36" pipe to 42" pipe located north of the intersection of Woods Drive and Second Loop Road.

Project JC-16: Jefferies Lane Stormwater Improvements

Project JC-15 was developed to improve historical flooding issues at 450 Jefferies Lane, which is located adjacent to an existing 24-inch stormwater outlet connected to the existing open channel which runs northwest to Jeffries Creek. The following improvements are recommended under Project JC-16:

- Replace 5 existing inlets located along Jefferies Lane with new models and regrade to existing ditches.
- Clean/clear 1,000 LF of existing ditches located northeast of Jefferies Lane.

Project JC-17: Wisteria Drive / Santee Drive Stormwater Improvements

Project JC-17 was developed to improve historical flooding issues at the properties located near the intersection of Santee Drive and Wisteria Drive (504 Wisteria Drive, 1034 Santee Drive, Santee Drive). The following improvements are recommended under Project JC-17:

- Replace 6 existing inlets near the intersection of Wisteria Drive and Santee Drive, install 2 new inlets and install 850 LF of new 12”-18” pipe to connect new inlets to existing 24-inch pipe discharging to creek.
- Regrade roadway median near the intersection of Santee Drive and Wisteria Drive to new inlets to collect additional roadway runoff.

5.5.5 McCall Branch Watershed

The proposed scope for the potential stormwater improvement projects located in the McCall Branch watershed is detailed below. Figure 27 shows an overview of the potential stormwater improvements projects in the McCall Branch watershed.

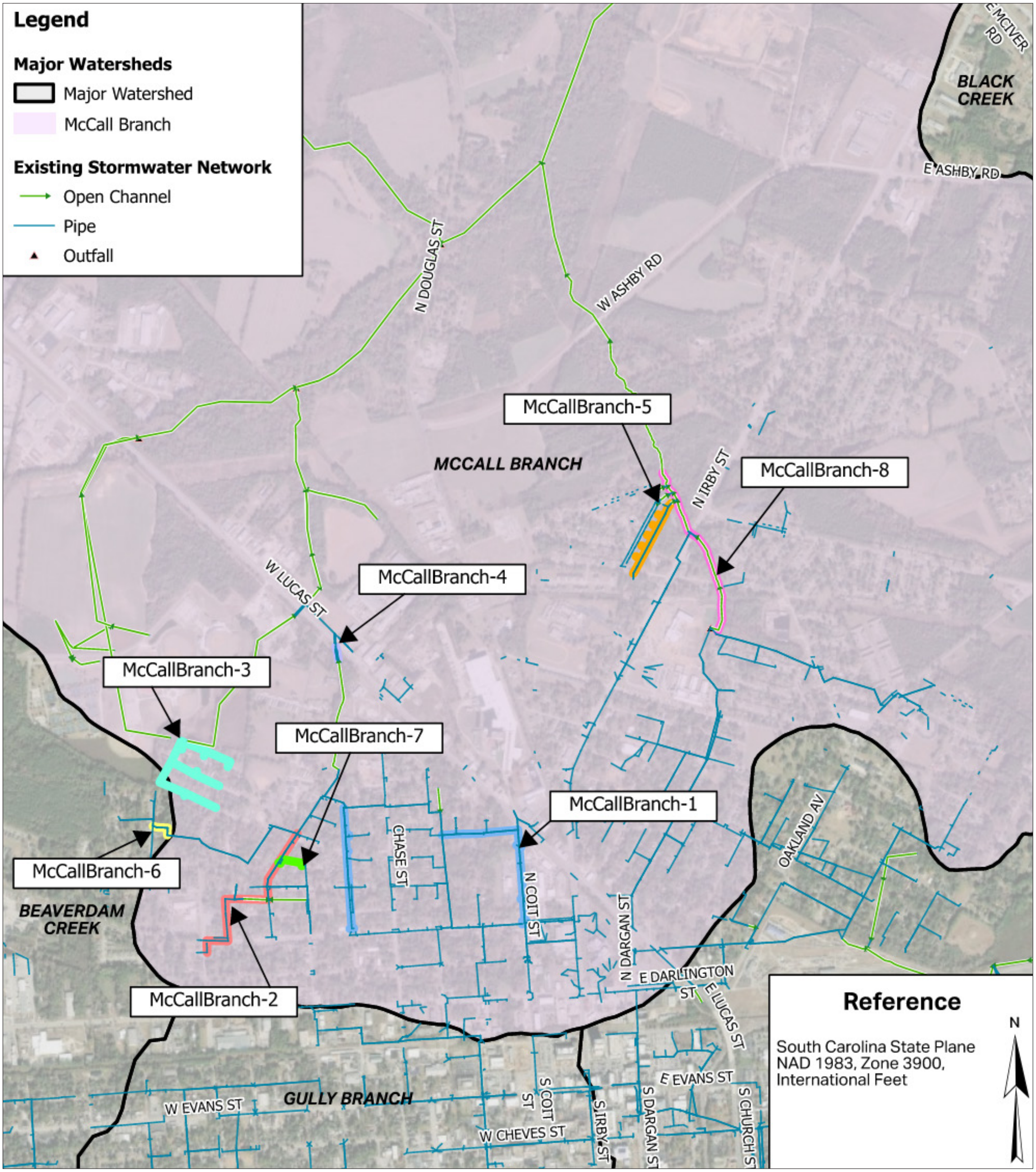


Figure 27: McCall Branch Watershed potential stormwater improvement projects

Project MB-1: Pennsylvania Street Stormwater Improvements (2021 CIP Project)

Project MB-1 was part of the 2021 Capital Improvements Program preliminary assessment and is currently under design/construction. The following proposed improvements are included in Project MB-1:

- 18,970 LF of Debris Removal
- 200 LF of 18”, 1,600 LF of 30-inch, 1,160 LF of 36”, 990 LF of 48” RCP
- 18 Drainage Inlets
- 490 LF of Open Channel Widening

Project MB-2: Cannon Street Stormwater Improvements (2021 CIP Project)

Project MB-2 was part of the 2021 Capital Improvements Program preliminary assessment and includes the following proposed improvements:

- 6340 LF of heavy cleaning, debris and root removal.
- Install 1400 LF 30-inch RCP & 920 LF 42” RCP.
- Install 17 inlets.

Project MB-3: Dunbar Street Neighborhood Stormwater Improvements

Project MB-3 was developed to provide stormwater conveyance in the Dunbar Street neighborhood which is currently lacking stormwater collection infrastructure within local roadways.

- Install 2950 LF of new 12”-18” pipe, 16 inlets and 500 LF of roadside ditches along Pennsylvania Street, Carver Street, Ingram Street and Dunbar Street.

Project MB-4: CSX Railroad Culvert Upsizing

Project MB-4 was developed based on the findings of the H&H analysis which showed that the existing 72” pipe which runs parallel to the CSX railroad on West Lucas Street a potential hydraulic bottleneck for the upstream stormwater collection system. The following capacity improvements are recommended under Project MB-4:

- Upsize 550 LF of 72” pipe located along West Lucas Street to 84” pipe.

Project MB-5: Rebecca Street Stormwater Improvements (2021 CIP Project)

Project MB-5 was part of the 2021 Capital Improvements Program preliminary assessment and includes the following proposed improvements:

- Install 1020 LF new 18"-30"" RCP and 9 inlets.
- Install 400 LF of lateral 12" PVC pipe from back yards and 14 new 14 yard inlets.
- 980 LF of heavy cleaning of debris and tree roots.

Project MB-6: Cumberland Drive Stormwater Improvements

Project MB-6 was developed to improve historical roadway and residential lot flooding along Cumberland Drive. The area appears to be relatively flat and existing inlets were clogged with debris and vegetation during field inspections. The existing 18” piping serving the area also showed to be undersized for the desired level of service based on H&H analysis. The following improvements are included in Proposed MB-6:

- Replace 9 inlets along Cumberland Dr. with concrete flumes.
- Upsize 400 LF of existing 18" pipe which runs on the northern edge of 714 Cumberland Drive with 30" pipe and replace 3 inlets along extents.

Project MB-7: Roosevelt Drive Stormwater Improvements

Project MB-7 was developed to address historical residential flooding at 804 Roosevelt Drive. This project ties into the Cannon Street stormwater improvements project (MB-2) and could be combined with Project MB-2 during design/construction. Field investigations showed that the area of concern is relatively flat with minimal stormwater inlets, and the existing roadway slopes towards the property at 804 Roosevelt Drive. The following improvements are included in Project MB-7:

- Install 2 new catch basins in front of 804 Roosevelt Drive.
- Install 340 LF of new 18" pipe and connect into existing 24-inch pipe on Cannon Street.

Project MB-8: Waterman Avenue North Stormwater Improvements

This project was 1 of the 12 projects recommended by the 1989 Storm Drainage Study and is 1 of the 6 projects from the study that were never completed. The proposed improvements include the following:

- 2600 LF of Channel Widening and Vegetation Clearing

5.5.6 Middle Swamp Watershed

The proposed scope for the potential stormwater improvement projects located in the Middle Swamp watershed is detailed below. Figure 28 shows an overview of the potential stormwater improvements projects in the Middle Swamp watershed.

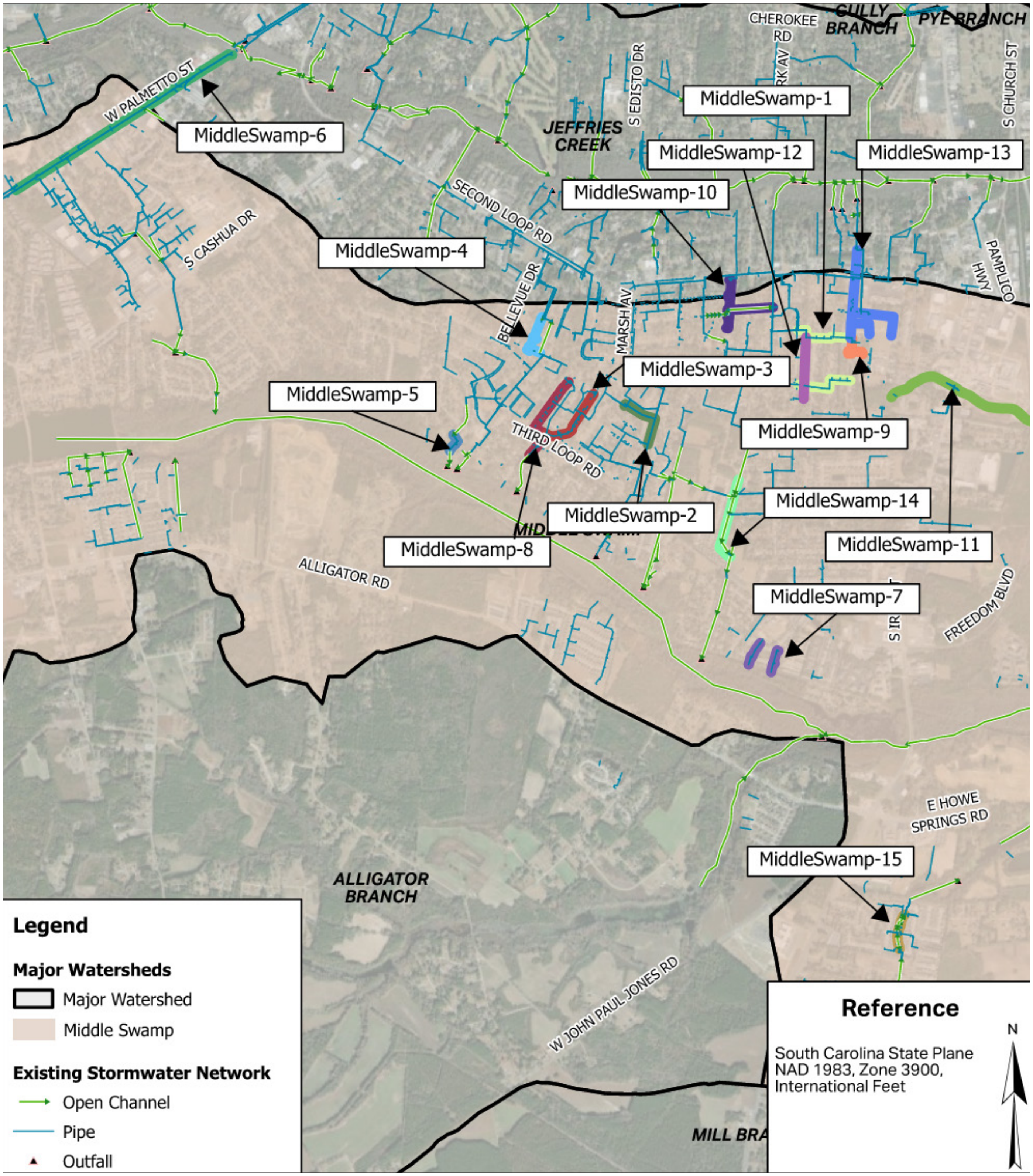


Figure 28: Middle Swamp Watershed potential stormwater improvement projects

Project MS-1: Malden Drive Stormwater Improvements (2021 CIP Project)

Project MS-1 was included as part of the 2021 Capital Improvements Program preliminary assessment. Phase I is complete and involved approximately 6095 LF of heavy cleaning, debris and root removal. Phase II has yet to be completed and includes the following proposed improvements to increase conveyance capacity of the existing stormwater network:

- Install 325 LF 18” RCP, 230 LF 24-inch RCP, 1120 LF 30-inch RCP, 220 LF 42” RCP, and 970 LF 48” RCP.
- Install 20 inlets
- 3770 LF of open channel widening.

Project MS-2: Nottingham Drive Stormwater Improvements

Project MS-2 was developed to improve historical flooding issues near the intersection of Nottingham Road and Windsor Road, specifically at the property located at 1815 Nottingham Drive. The topography in this area appears to be relatively flat with an apparent low spot at the corner of the property at 1815 Nottingham Drive. Additionally, the existing 18” piping serving the intersection appears to be undersized for the desired level of service, as well as the downstream portion of existing 30-inch piping located behind the residences along East Sandhurst Drive. The following improvements are recommended under Project MS-2:

- Replace 4 existing inlets at the intersection of Windsor Road and Nottingham Road and regrade to new 24-inch pipe.
- Upsize 640 LF of existing 18” pipe on Windsor Road with 24-inch pipe.
- Upsize 600 LF of existing 30-inch pipe which runs behind properties along East Sandhurst Drive with 36” pipe.

Project MS-3: Sandhurst West Stormwater Improvements (2021 CIP Project)

Project MS-3 was included as part of the 2021 Capital Improvements Program preliminary assessment. Phase I of this project was completed, which included 1,560 of debris removal. Phase II has not been completed and includes the following improvements:

- Install 2,160 LF of 54” RCP, 60 LF of 54” RCP Bore and Jack
- Install 10 Drainage Inlets
- 175 LF of Open Channel Widening

Project MS-4: St Anthony’s / College Park Stormwater Improvements (2021 CIP Project)

Project MS-4 was included as part of the 2021 Capital Improvements Program preliminary assessment and is intended to improve residential and roadway flooding along Saint Anthony Avenue. This project has yet to be completed and includes the following proposed improvements:

- 350 LF of 18” RCP, 1,210 LF of 24-inch RCP
- 11 Drainage Inlets
- 780 LF of Open Channel Widening, 1,420 LF of Regrading Roadside Ditches

Project MS-5: South Enchanted Lane Stormwater Improvements

Project MS-5 was developed based on the findings of the H&H model capacity analysis which showed that the existing 18” piping serving the residential neighborhood along South Enchanted Lane to be undersized for the desired level of service. Observed flooding has not been reported in the immediate area of this project, however, the existing piping is responsible for conveying stormwater runoff from approximately 70 acres and was identified as potential hydraulic bottleneck. The following improvements are recommended under Project MS-5:

- Upsize 460 LF of 18" pipe on South Enchanted Lane to 30" pipe.

Project MS-6: West Palmetto Street Stormwater Improvements

Project MS-6 was developed based on the findings of the H&H model capacity analysis which showed that the existing 42" - 48" trunkline along West Palmetto Street does not meet the desired level of service. Observed flooding has not been reported in the immediate area of this project. The following improvements are recommended under Project MS-6:

– Upsize 4530 LF of 48" pipe along West Palmetto Street to 60" pipe.

Project MS-7: Red Tip Circle Stormwater Improvements

Project MS-7 was developed to improve historical residential flooding issues reported along Red Tip Circle (643, 645, and 647 Red Tip Circle) near the existing 24-inch pipe outfall into Middle Swamp. The following improvements are recommended under Project MS-7:

– Upsizing 900 LF of 18" pipe with 24-inch-30" pipe along Garden Hills Drive and Red Tip Circle.
– Install 900 LF of new french drains or curb-and-gutter along edge of roadway along Red Tip Circle to convey flow towards new 24-inch-30-inch piping.

Project MS-8: Devonshire Drive Stormwater Improvements

Project MS-8 was developed to improve historical residential flooding issues reported along Devonshire Drive (1882 Devonshire Drive). Existing stormwater infrastructure in the area primarily consists of roadside ditches and culverts. The topography is also relatively flat with little opportunity open channels to effectively convey stormwater flow away from residential lots. The following improvements are recommended under Project MS-8:

– Install 1500 LF new 18"- 24-inch pipe to replace existing roadside ditches on Devonshire Drive and connect to trunkline located at the corner of Devonshire Drive and West Sandhurst Drive.
– Remove/replace 17 inlets along Devonshire Drive.

Project MS-9: Kirkwood Court Stormwater Improvements

The goal of Project MS-9 is to improve historical flooding in residential lots along Kirkwood Court. There is currently no known stormwater infrastructure on Kirkwood Court, resulting in ponding at the low spot in front of 605 Kirkwood Court. The following improvements are included under Project MS-9:

– Install 6 new inlets (6 CBs) and 630 LF new 12"-18" pipe from Cul-de-Sac on Kirkwood Court to new piping installed under Malden Stormwater Improvements Project

Project MS-10: Poinsett Drive Stormwater Improvements

Project MS-10 was developed to improve historical flooding along Poinsett Drive. This area is served by an existing drainage ditch which runs along the northern property line of 1564 Pointsett Drive. There is currently minimal stormwater infrastructure serving the area, particular at the intersections with Rutledge Avenue and Berkely Avenue. The following improvements are recommended as part of Project MS-10 to provide additional stormwater conveyance to the area:

– Install 1470 LF of new 12"-18" pipe along Poinsett Drive and 14 new catch basins and tie into new 30-inch pipe along north edge of 1564 Pointsett Drive.
– Install 1000 LF new 30-inch pipe to replace existing ditch running along the north property line of 1564 Pointsett Drive. Install 3 new yard inlets and route to new 30-inch pipe.

Project MS-11: Billy Branch/ Irby Crossing Stormwater Improvements

The goal of Project MS-11 is to improve historical flooding issues at properties located along
South Irby Street at the Billy Branch culvert crossing and along the Billy Branch stream. The following improvements are recommended under Project MS-11:

- 1350 LF of existing channel widening, vegetation clearing/removal west of South Irby Street.
- 1900 LF of existing channel widening east of South Irby Street.
- Upsize 70 LF of existing 8" pipe outfall located west of West Claudie Avenue to 18" outfall into Billy Branch.
- Upsize 330 LF of existing culvert crossing on South Irby Street.

Project MS-12: Patridge Drive Stormwater Improvements

This project was 1 of the 12 projects recommended by the 1989 Storm Drainage Study and is 1 of the 6 projects from the study that were never completed. The proposed improvements include the following:

- 20 LF of new 18" pipe
- 1250 LF of new 24-inch pipe
- 4 new catch basins

Project MS-13: Malden Drive and YMCA Area Stormwater Improvements

This project was 1 of the 12 projects recommended by the 1989 Storm Drainage Study and is 1 of the 6 projects from the study that were never completed. The proposed improvements include the following:

- 1520 LF of new 18" pipe
- 1000 LF of new 24-inch pipe
- 3000 LF of new 36" pipe
- 16 new catch basins

Project MS-14: Cloisters Subdivision Stormwater Improvements

This project was 1 of the 12 projects recommended by the 1989 Storm Drainage Study and is 1 of the 6 projects from the study that were never completed. The proposed improvements include the following:

- 1200 LF of new 24-inch pipe
- 2600 LF of new 48" pipe
- 8 new catch basins

Project MS-15: Southbrook Subdivision Stormwater Improvements

Project MS-15 was developed to improve the historical roadway and residential lot flooding near the existing ditch and ponds behind residences on Southbrook Circle and East Brandford Road. Field investigations showed the existing ditch to be clogged with apparent capacity limitations. The following improvements are recommended under Project MS-15:

- Clean/clear 1700 LF of stream behind houses on Southbrook Circle.
- Clean/clear 7200 SF of ponds between Southbrook Circle and Branford Road.
- Clean/clear 37000 SF of pond between Branford Road and East Thorncliff Road.
- Clean/clear 745 of stream between stormwater ponds.

5.5.7 Pye Branch Watershed

The proposed scope for the potential stormwater improvement projects located in the Pye Branch watershed is detailed below. Figure 29 shows an overview of the potential stormwater improvements projects in the Pye Branch watershed.

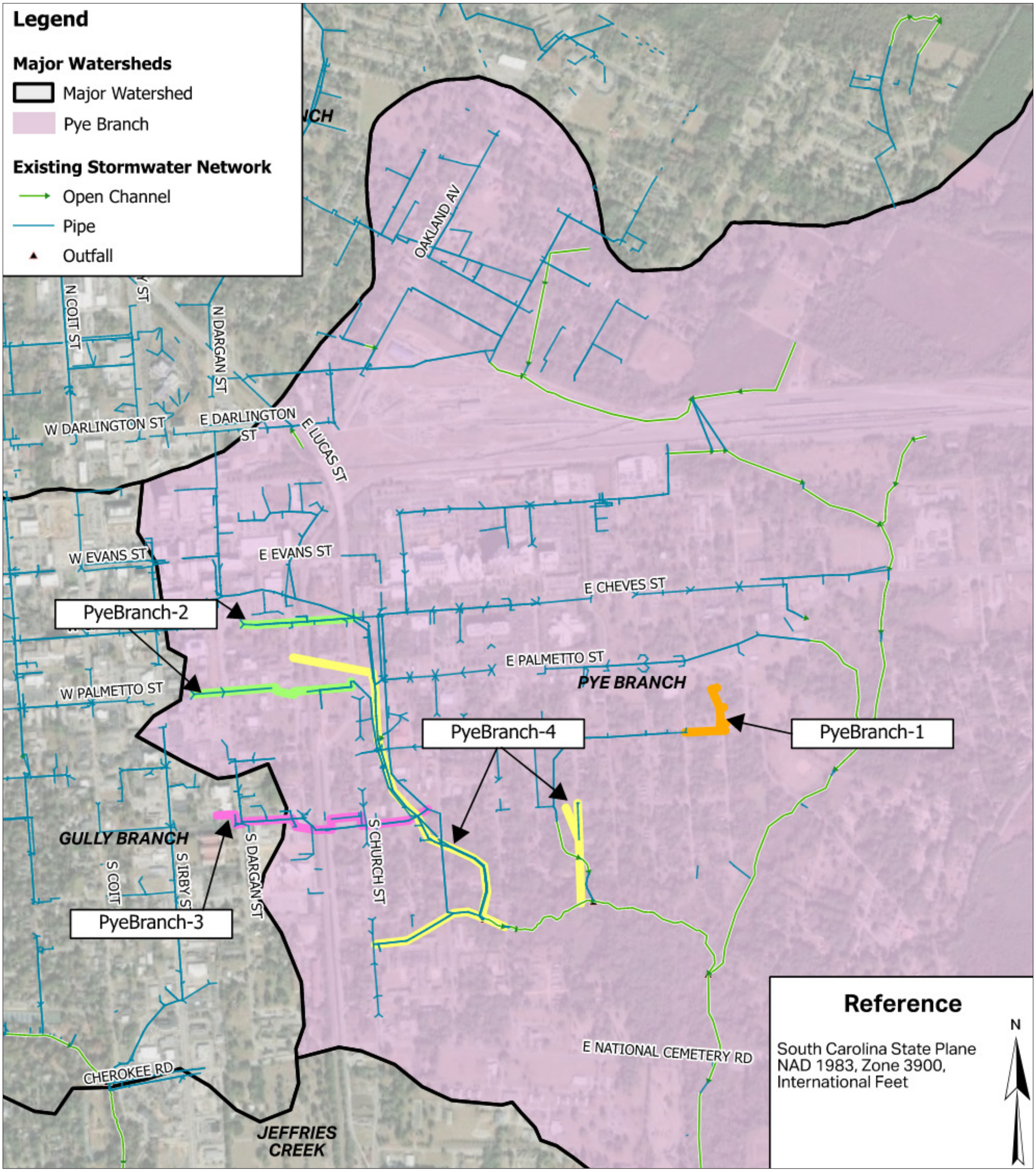


Figure 29: Pye Branch Watershed potential stormwater improvement projects

Project PB-1: Charlotte Street Stormwater Improvements

The goal of Project PB-1 is to improve historical flooding issues at properties located along Charlotte Street (316 Charlotte Street) which are likely attributed to a lack of stormwater infrastructure, specifically at the intersection of Charlotte Street and East Pine Street. The following improvements are recommended under Project PB-1:

- Install 925 LF of new 12"-18" pipe and 9 new inlets along Charlotte Street and East Pine Street and connect to existing 18" pipe at Ballard Street.

Project PB-2: East Cheves Street Stormwater Improvements (2021 CIP Project)

Project PB-2 was included as part of the 2021 Capital Improvements Program preliminary assessment. The goal of this project is to improve historical ponding issues near the intersection of South Church Street and East Cheves Street and included the following proposed improvements:

- 2705 LF of heavy cleaning, debris, and root removal.
- Install 435 LF 24-inch RCP, 465 LF 30-inch RCP & 405 LF 36" RCP
- Install 21 inlets.

This project faces the unique challenge of flooding at the railroad underpasses on East Cheves Street and East Palmetto Street. Both roads, along with their stormwater runoff, fall under the jurisdiction of the SCDOT. Additionally, the land and infrastructure along the railroad is not owned by the City, which would complicate project implementation.

One possible solution the City could recommend to SCDOT is the installation of crossbars at the underpasses, similar to railroad barriers. These crossbars would automatically block the underpasses during flood events, preventing vehicles from entering flooded areas and reducing the risk of accidents. While this solution would not resolve the flooding itself, it would enhance public safety by deterring entry into dangerous areas. However, the City cannot implement this solution independently, as SCDOT owns and maintains these roads.

Project PB-3: Dargan and Elm Street Stormwater Improvements (2021 CIP Project)

Project PB-3 was also included as part of the 2021 Capital Improvements Program preliminary assessment and includes the following improvements:

- 2320 LF of heavy cleaning, debris, and root removal. Install 340 LF 30-inch RCP, 1360 LF 48" RCP, & 560 LF 54" RCP.
- Install 23 inlets.

Project PB-4: Southeastern Florence Stormwater Improvements

This project was 1 of the 12 projects recommended by the 1989 Storm Drainage Study and is 1 of the 6 projects from the study that were never completed. The proposed improvements include the following:

- 800 LF of channel widening and vegetation clearing
- 510 LF of new 18" pipe
- 2000 LF of new 36" pipe
- 4500 LF of new 60" pipe
- 19 new catch basins

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6 Prioritization of Stormwater Improvement Projects

For the stormwater infrastructure improvements identified in **Section 5** (Stormwater Capital Improvements Projects), AECOM developed a prioritization and weighting matrix to inform project implementation. Prioritization criteria were developed and used to sort the projects into priority tiers, and then weighting factors were established to inform the development of a project implementation schedule. The development and application of the prioritization criteria, weighting factors, and resultant project priority tiers, as well as scheduling, are described in this section.

6.1 Metrics and Scoring

AECOM performed a Benefit-Cost Analysis (BCA) on the recommended projects, developed scoring criteria, and worked with City staff to prioritize the recommended projects.

AECOM developed a methodology to prioritize and schedule the proposed infrastructure improvements recommended in **Section 5** with an aim to minimize bias. A scoring and ranking system needs to consider many factors to direct capital investments toward the highest priorities. A quantitative prioritization matrix system was created in which project ideas could be chosen for funding by merit, based upon evaluation in nine categories. The six categories and the prioritization system were developed with input from the City and were based on AECOM's experience with similar projects. Figure 30 illustrates the weighting of each criterion.

The three major criteria in the prioritization matrix were percentage of Low-to-Moderate Income (LMI) areas, flood risk reduction, and BCA. The remaining three criteria were: mobility improvement, phasing considerations, and impact on city resources.

The proposed improvements identified in **Section 5**, as a result of the H&H modeling, are located throughout the entire city, but vary in size and impact to the community between locations.

6.1.1 Low-to-Moderate Income

The first major criterion of this study was to determine the benefit to the LMI population. The LMI score is important to establish because a maximum of 50% of mitigation funds is allowed to go to non-LMI communities; however, there is no limit to the maximum of funds that can go to LMI communities. The final split of funding between LMI and non-LMI projects is up to the City's discretion. In summary, LMI projects are more favorable. For this reason, the LMI score category can be regarded as the most important one to be evaluated.

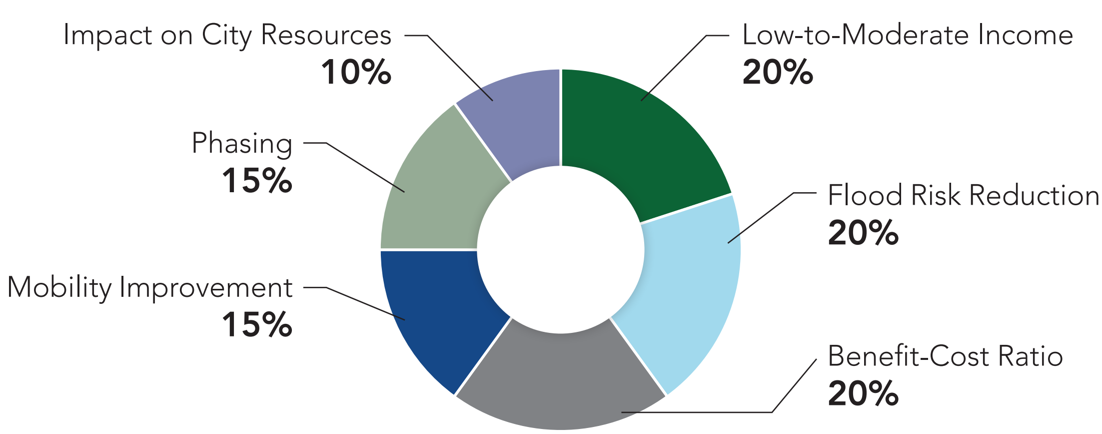

Figure 30: Project prioritization weighting

The LMI data used in this study were developed by HUD and covered the period from 2011 to 2015. This time period was chosen as it was the period with the most recently published data.

An area was drawn for each project to represent both the service area as well as the extent of the mitigation impact. This service area was overlaid with the LMI data to calculate a weighted average LMI percentage. This calculated percentage is multiplied by 20 points to produce the final LMI points awarded. An example calculation is shown below:

Service Area LMI = 65% X 20 points = 13 LMI Points

Defining Service Areas

While the LMI formula is straightforward, the more difficult task is defining the service area. The process to draw the service area varied by project classification—infrastructure, housing, or service projects—and is discussed below.

Service projects, such as a hospital, have a boundary drawn around the urbanized communities immediately surrounding the project. However, with a service project such as a hospital it can be argued that the hospital serves a larger area and population, such as people from rural areas or even people from neighboring cities or states. The line was drawn at rural areas because LMI should be based on people and income and not land. Rural areas have an unfair weight that skews LMI percentage due to land size. Other cities or any extent further was also unreasonable because the LMI percentage would be skewed, as few people from cities farther away attend the hospital.

Housing is the easiest project type when defining the service area. It is assumed that a house would have a service area equal to its land (property) boundary. To simplify this assumption, no weight was given for land size, as LMI should be based on people and income. This is appropriate as LMI census tracts are drawn mostly along roads and rarely if ever divide a home's property.

Infrastructure, such as a stormwater network in a neighborhood, was drawn primarily based on the infrastructure's watershed boundary. A watershed is defined by topology, or in other words by how the ground slopes to drain water. Any area where rain runoff discharges into the stormwater network is included as part of the watershed area. At times, the watershed boundary was shortened, as many watersheds can elongate hundreds of miles downstream or upstream. In other cases, a watershed boundary was extended, as storm drain networks often connect multiple watersheds conveying runoff through pipes underground, which cannot be obtained from the topology. The appropriate service areas were defined based on the data provided and the modeling data, by engineers with experience in hydrologic and hydraulic studies.

It should be noted that using a service area is not only required by grant funding requirements but the use is also an industry standard. As stated by HUD, the LMI data does contain a margin of error (HUD, NOTICE: CPD-19-02) and is not a perfect representation of LMI due to privacy rights and several other factors. Consideration should be shown toward communities that can otherwise demonstrate a more representative LMI.

It should also be noted that the LMI data used for this analysis is based on census data from 2011 through 2015. LMI data is not static and can change significantly over just a few years, often in ways that do not align with community expectations or assumptions. It is important to recognize that LMI data for the City will continue to evolve, and the 2011-2015 LMI data used for this analysis represent only a snapshot in time.

It should also be noted that service areas were updated when better data were received, especially for projects lacking a specific address. The service area was also updated during mitigation modeling, as the area of mitigation impact could be better defined as result of the model. It is assumed that the service area and the area of mitigation impact are the same area for this study. For the LMI criterion, the LMI boundaries with percentages were overlayed on the project area and watershed map to determine which projects were located within the LMI boundaries (see Figure 31). For more detailed information, refer to the individual grid sheets in Appendix S.

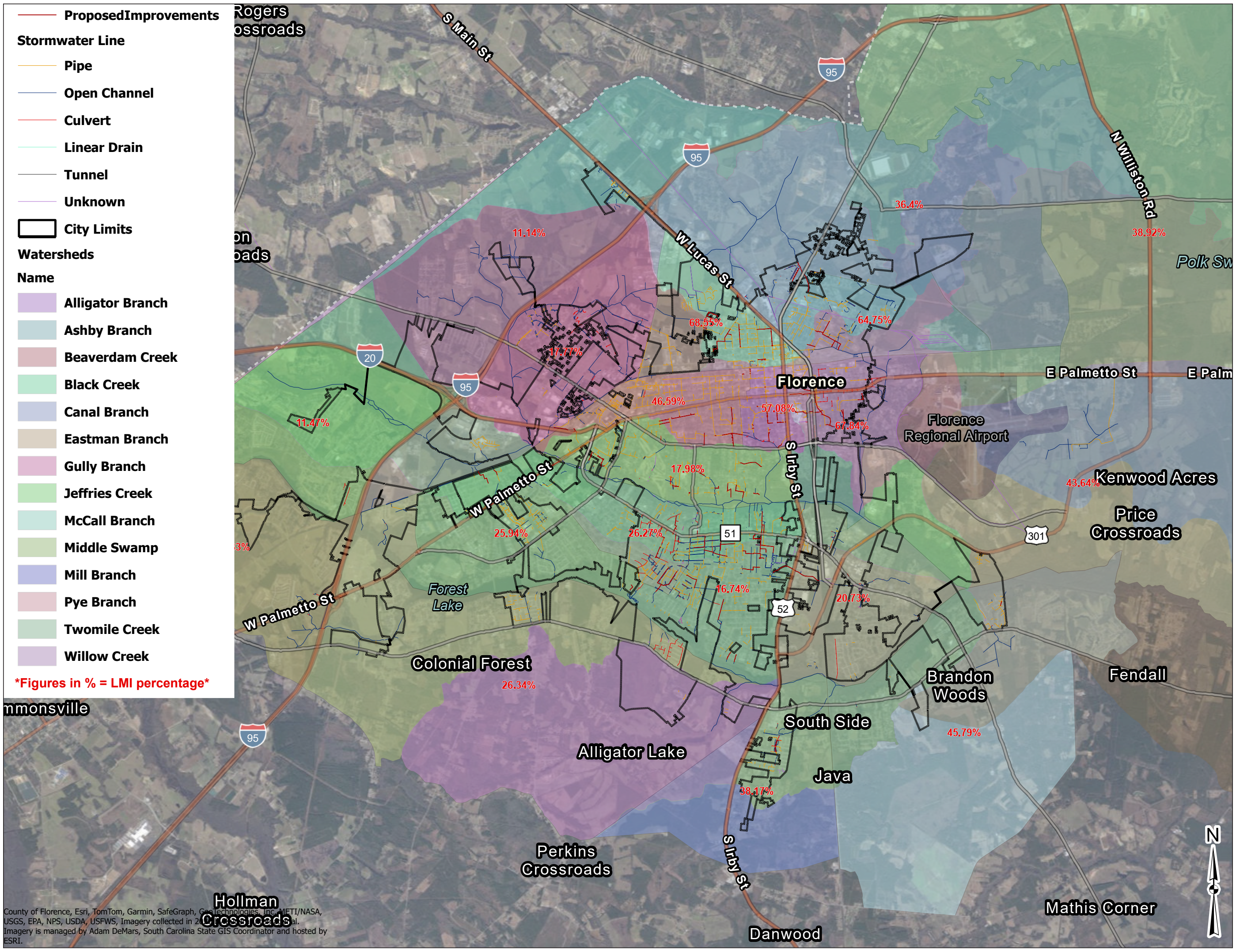

Figure 31: Low-to-Moderate Income (LMI) project overview

6.1.2 Flood Risk Reduction

Another major criterion was the issue of flood risk reduction. Given the locations of the projects in relation to discharge waterbodies, local rainfall is the most common cause of flooding, as rain can fall anywhere. Riverine flooding can only occur in stream water features defined by the USGS.

The 25-year, 24-hour storm event is the industry design standard for stormwater infrastructure projects. However, the 5-, 10-, 25-, 50-, and 100-year, 24-hour storm events were used in determining the flood risk reduction. Project ideas' protection performance can vary, as the storms occur with different durations, intensities, and prior conditions.

As the model is a 1-D model, the true extents of flooding are unknown for this study. The key to ensuring flood reduction in areas served by the proposed stormwater improvements was comparing the existing and proposed stormwater network HGLs. The HGL indicates whether the water level is above or below the existing surface elevation at stage/storage nodes. During the existing stormwater network modeling, nearly all nodes indicated that the HGL was significantly higher, resulting in flooding of structures. In theory, a foot of depth above the surface elevation at nodes was chosen to represent areas with potential structural damage. This assumes that no damage would occur before 6 inches to account for the slab foundation of structures and that an additional 6 inches would cause significant damage to these structures.

With this knowledge, the flood risk reduction structures were quantified by counting the structures within areas defined by the drainage patterns of the existing terrain and served by the proposed stormwater improvements. Based on the number of structures served by each of the proposed projects, the flood risk reduction points are shown in Table 12.

The BCA phase considers some of the variations for larger storm events; however, accounting for all variations is not always possible.

Table 12: Structural Flood Risk Reduction Values

Quantity of Protection Category	Points
0 - 5 Structures	5
6 - 10 Structures	10
11 - 15 Structures	15
15+ Structures	20

Structures were counted individually regardless of size and function. For example, a school and a single-family home would each be counted as one structure. This approach was streamlined for this study.

6.1.3 Benefit-Cost Analysis

For each of the proposed improvement projects, a benefit cost and a construction cost estimate were calculated to perform a BCA. A BCA is a major criterion because it indicates whether a project is worth being constructed based on the amount of benefits that the project will receive solely based on costs.

Benefit

The benefit is based on the number of structures served by each project as discussed in **Section 6.1.2**.

Benefit = $10,000 X # of residential structures benefitting from improvements

and/or

Benefit = $25,000 X # of non-residential structures benefitting from improvements

Cost

The construction costs are based on applying a standard unit cost of items to each project equally. Quantities of improvement materials varied per project.

Benefit-Cost Analysis Ratio

The BCA ratio is calculated by dividing the total benefit by the construction cost. A project with a BCA Ratio>1 indicates that the benefits of constructing the project will outweigh the construction costs. If a project's BCA Ratio <1, the project is less likely to be considered for construction or outside funding. The total number of projects were divided into four quartiles and assigned points, as shown in Table 13.

Table 13: Quartile of BCA Ratio Points

Quartile of BCA Ratio	Points
0-25% (Lower Quartile)	0
25-50% (Lower Middle Quartile)	7
50-75% (Upper Middle Quartile)	13
75-100% (Upper Quartile)	20

6.1.4 Mobility Improvement

During everyday weather conditions or disasters (such as storm event flooding), it is important to have safe and efficient mobility and transportation corridors and stations for first responders, other emergency personnel, and the general public. Projects with an attribute related to improving this mobility will factor in positively. How points are awarded is summarized in Table 14 below.

Table 14: Mobility Improvement Points

Mobility Improvement Category	Points
Minor road improvements	1
Secondary roadway improvements	3
Primary road improvements	5
Critical infrastructure improvements	5
Water/wastewater infrastructure improvements	5

As shown in Table 14 above, 1, 3, or 5 points were assigned based on how a project improved mobility for the public and first responders. A definitive line could be drawn by categorizing roads as major or minor per SCDOT. Generally, a major road is an airport, evacuation route, highway, or railroad, and even a main route used by multiple neighborhoods. Projects impacting major roads are assumed to be used by first responders and a significant portion of the public and were given 5 points. Minor roads were awarded 3 points, as it was assumed that a limited portion of the public and first responders would use them (neighborhood road, rural road, or low-use road). If the flooding did not occur or improve on a road, 0 points were awarded.

6.1.5 Phasing Considerations

A phased approach in implementing a project idea can help overcome resistance to change, allows lessons learned in early phases to be incorporated into systems installed in later phases, and ensures that a solid foundation of project idea-level data is available prior to rolling up enterprise-level information.

Projects that support a phased approach to implementation of larger projects are viewed as increasing the effectiveness of future regional project ideas beyond their current funding. How the phasing considerations categories and points were awarded is summarized in Table 15 below.

Table 15: Phasing Consideration Points

Phasing Consideration Category	Points
No connection to larger scale project	0
Limited contribution	7
Significant contribution	15

A significant contribution (15 points) was defined as a project idea with identified phases and scope within multiple areas of the City. As nearly all of the stormwater infrastructure within the City is undersized, the Downstream projects such as trunkline and outfall channel projects received "significant contribution" status. Constructing upstream improvements first would be unbeneficial, since the downstream locations cannot accommodate the increase in flow. Projects with a phased implementation schedule or projects that could be phased with other projects within the same area of the City qualified for 7 points, or a limited contribution status. Projects that had no connection to a larger scale project received 0 points.

6.1.6 Impact on City Resources

The final criterion in the prioritization score was the project's impact on City resources. This allowed the City to evaluate each proposed stormwater improvement and assign prioritization scores based on how it would benefit other City resources. This category accounted for 10% of the overall prioritization score, with a maximum of 10 points available. Points were determined by answering two straightforward questions:

1. Does the project impact other utilities?
2. Are there frequent complaints/work orders?

Each question was worth 5 points. If the project was expected to have a positive impact on other utilities, such as protecting water, sewer, gas, or electric systems from damage during heavy rain events, 5 points were awarded. The complaints/work orders question assessed the strain on City personnel. If City staff regularly must address issues that could be resolved by the proposed project, another 5 points were awarded. If the answer to either question was no, 0 points were given for that question.

6.2 Stormwater Improvement Projects Prioritization Scores

Each of the potential stormwater improvement projects discussed in **Section 5.5** were assigned a priority score using the metrics presented in **Section 6.1**. Table 16 shows the final prioritization scores sorted from highest priority to lowest priority score as well as the responsible party assigned to the project based on location and jurisdictional boundaries. The benefit cost ratios for each project, which are one factor in determining the prioritization score, are also shown in Table 16. Refer to Appendix T for a detailed breakdown of the prioritization scores for each potential stormwater improvement project. Projects with a higher prioritization score should be scheduled for completion first, as they represent the highest priority for implementation.

Table 16: Prioritization Scores

CIP Name	Prioritization Score	Cost (2024 Dollars)	Benefit Cost Ratio (%)	Responsible Party
MiddleSwamp-07	56.06	$739,150	29.76	City / Property Owner
MiddleSwamp-12	54.03	$411,625	82.6	City / SCDOT / Property Owner
GullyBranch-02	48.32	$2,350,073	9.36	SCDOT / Property Owner
PyeBranch-04	44.71	$5,983,894	3.34	City / SCDOT / Property Owner
JeffriesCreek-06	44.06	$1,092,456	14.65	SCDOT
GullyBranch-05	43.75	$1,282,000	28.08	SCDOT / Property Owner
PyeBranch-02	43.7	$2,215,419	20.31	SCDOT
MiddleSwamp-06	42.74	$7,291,286	6.86	SCDOT
MiddleSwamp-14	41.33	$2,036,325	11.29	City
MiddleSwamp-09	40.03	$503,063	27.83	City
JeffriesCreek-13	36.79	$3,179,638	10.06	Property Owner
MiddleSwamp-04	36.79	$883,838	22.63	County
MiddleSwamp-13	36.68	$2,388,050	11.73	City / SCDOT
MiddleSwamp-15	36.56	$605,660	44.58	HOA / Property Owner / County
McCallBranch-03	36.47	$2,155,245	25.06	City / SCDOT
MiddleSwamp-08	36.42	$1,251,200	49.55	SCDOT / Property Owner
GullyBranch-03	36.18	$899,819	43.34	SCDOT
MiddleSwamp-01	35.03	$3,274,388	11.3	SCDOT
JeffriesCreek-15	34.79	$3,053,853	7.86	SCDOT / Property Owner
McCallBranch-02	34.69	$1,984,768	20.15	SCDOT
MiddleSwamp-02	34.33	$826,119	25.42	City
GullyBranch-04	34.28	$971,731	18.52	SCDOT
JeffriesCreek-05	34.06	$271,031	22.14	SCDOT / Property Owner
JeffriesCreek-03	33.72	$889,947	22.47	Property Owner
PyeBranch-03	33.7	$2,278,944	6.58	SCDOT
JeffriesCreek-12	32.64	$705,641	11.34	City / Property Owner
JeffriesCreek-07	32.06	$623,581	11.23	SCDOT / Property Owner
JeffriesCreek-14	31.88	$2,511,319	11.55	SCDOT
JeffriesCreek-01	31.18	$833,475	26.4	SCDOT
PyeBranch-01	29.51	$697,350	24.38	City / SCDOT
MiddleSwamp-03	29.42	$2,564,274	12.48	SCDOT
JeffriesCreek-02	28.06	$1,681,369	1.49	City
MiddleSwamp-10	27.33	$1,791,850	17.86	City / Property Owner
EastmanBranch-01	25.61	$372,109	26.87	HOA / Property Owner
McCallBranch-01	25.39	$3,123,739	3.2	SCDOT
BeaverdamCreek-01	24.4	$519,341	9.63	SCDOT
JeffriesCreek-09	23.74	$829,006	15.68	SCDOT
JeffriesCreek-10	23.74	$614,537	14.65	SCDOT

Table 16: Prioritization Scores (continued)

CIP Name	Prioritization Score	Cost (2024 Dollars)	Benefit Cost Ratio (%)	Responsible Party
McCallBranch-07	23.69	$148,340	33.71	SCDOT
MiddleSwamp-11	23.06	$1,130,256	8.85	County
McCallBranch-05	22.77	$948,838	12.65	City / Property Owner
McCallBranch-08	20.2	$642,839	15.59	City / County
MiddleSwamp-05	20.16	$311,676	32.08	City / Property Owner
JeffriesCreek-04	19.06	$819,381	12.2	SCDOT / Property Owner
GullyBranch-01	15.84	$499,075	18.03	SCDOT
McCallBranch-06	14.47	$313,450	12.76	City
JeffriesCreek-17	14.06	$378,006	23.81	SCDOT / Property Owner
JeffriesCreek-08	8.74	$202,430	4.94	SCDOT
McCallBranch-04	8.47	$148,698	16.81	CSX Corporation
JeffriesCreek-11	7.64	$193,454	20.68	County / Property Owner
JeffriesCreek-16	7.33	$313,552	9.57	SCDOT
Total Cost (2024 Dollars):		**$71,737,108**		

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7 Project Funding Sources

This section presents the various funding sources that could be considered by the City in its effort to improve its stormwater infrastructure and mitigate the impacts of future flooding. Funding sources include federally funded grants, two types of FEMA funding, Florence County capital improvement programs (CIPs), and local funding. Each type of source is discussed below.

7.1 CDBG Mitigation Funding

Community Development Block Grant – Mitigation (CDBG-MIT) is an infrastructure program within HUD. The program, which is managed by the South Carolina Office of Resilience (SCOR), provides an opportunity for areas impacted by recent disasters to carry out strategic and high-impact activities to mitigate disaster risks and reduce future losses. HUD defines mitigation as activities that increase resilience to disasters and reduce or eliminate the long-term risk of loss of life, injury, damage to and loss of property, and suffering and hardship by lessening the impact of future disasters.

7.1.1 Qualifications

The CDBG–MIT infrastructure program focuses on reducing potential riverine and stormwater flooding impacts. To be eligible for this grant funding, an applicant must be a town, city, or county in one of the 17 counties in the designated mitigation area (see the map in Figure 32).

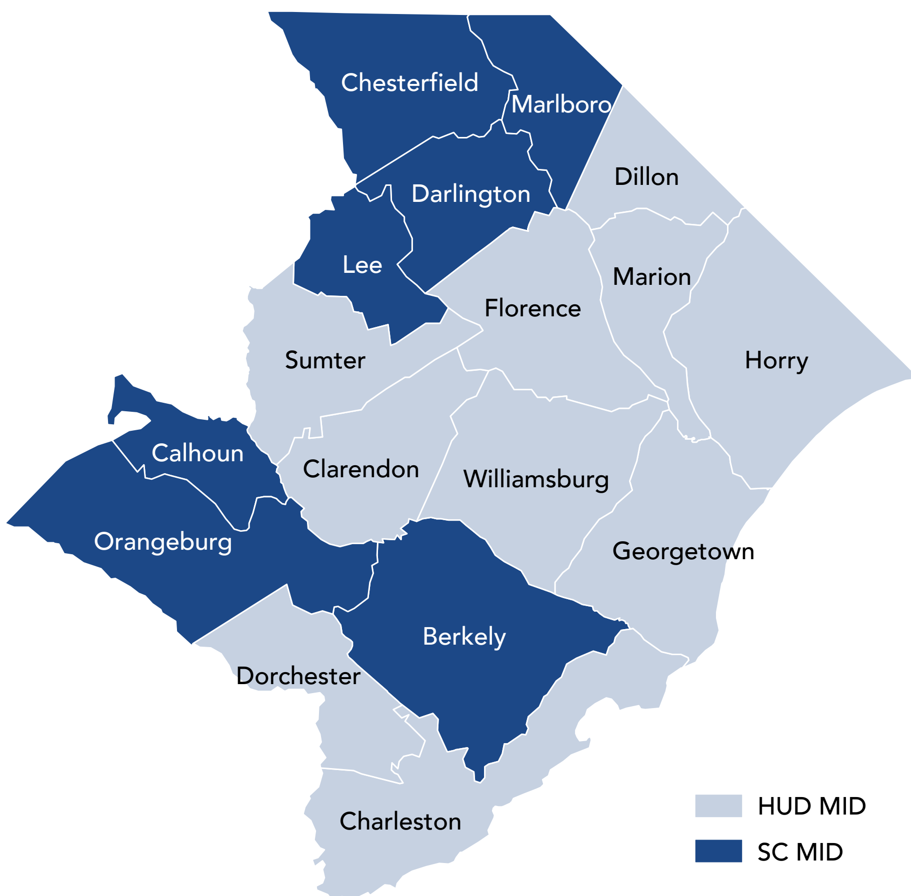

Figure 32: Mitigation area map

Applicants should also meet the following minimum requirements:

» Must experience riverine and/or surface flooding.

» Must be located within the Pee Dee and Santee Watersheds.

» Must have no less than 50% of funds benefitting LMI citizens.

» Must be able to show a BCA) ≥ 1.0.

The CDBG–MIT program offers funding for a wide range of projects that will ultimately mitigate disaster risks and reduce future losses due to flooding issues. The eligible and ineligible activities are defined in the following subsection.

7.1.2 Eligible and Ineligible Activities

The CDBG-MIT clearly defines activities that are eligible for project funding, and they include:

» Installing new storm sewer systems

» Upsizing and/or replacing existing storm sewer lines

» Restoring natural or historical waterways

» Establishing detention ponds

» Developing floodplain protection

» Restoring wetlands

The CDBG also clearly defines activities that are ineligible for project funding, and they include:

» Funding of buildings used for the general conducting of government

» Emergency response services

» Forced mortgage payoff

» Enlargement of a dam or its water level beyond the original design specifications

» Assistance to private utilities

7.1.3 Applications for Funding

Applications for the CDBG-MIT infrastructure program are typically due at the beginning of October of each year. The applications undergo a series of reviews, and final selected project applicants are typically notified in February of the following year. It is important to note that CDBG-MIT grants are not guaranteed, and each year the grant program is updated or changed.

More information on the application process can be found at https://scor.sc.gov/CDBGmitigation.

7.2 FEMA BRIC Funding

The Building Resilient Infrastructure and Communities (BRIC) program is a FEMA pre-disaster mitigation program that is managed by the South Carolina Emergency Management Division (SCEMD). The goal of the BRIC program is to take actions now to reduce vulnerability to future disasters. This funding source is based on a 75% / 25% non-federal cost-share basis. The 25% cost share can be provided by local government revenues or non-government funds, or may be provided in conjunction with a CDBG-MIT grant.

7.2.1 Qualifications

BRIC provides federal funds to incentivize natural hazard risk reduction activities that mitigate risk to people and public infrastructure. To be eligible for this grant funding, applicants should meet the following minimum requirements:

» Must be a state agency, local government (counties, municipalities, school districts), or a federally recognized Tribal organization.

» Must demonstrate need for flood control/ infrastructure.

» Must be able to show a BCA ≥ 1.0.

» Must have the ability to pay or obtain 25% of the cost from non-federal sources.

BRIC offers funding for a wide range of projects that will ultimately mitigate disaster risks and reduce future losses due to flooding issues. The eligible and ineligible activities are defined in the following subsection.

7.2.2 Eligible and Ineligible Activities

FEMA clearly defines activities that are eligible for BRIC project funding, and these activities include:

» Acquisition/Demolition

» Flood Control/Infrastructure

» Retrofits

» Mitigation Planning

» Advance Assistance/Project Scoping

FEMA also clearly defines activities that are ineligible for BRIC project funding, including:

» Projects already federally funded

» Projects already in progress

» Studies not directly related to a mitigation project

» Vehicles

» Emergency support equipment

» Response communications systems

7.2.3 Applications for Funding

Applications for the BRIC infrastructure program are typically due in mid-November. The applications undergo a series of reviews that prioritize the projects. Final selected project applicants are typically notified in the summer of the following year. The BRIC program is competitive on a national project level or a state project level. The submitted project is classified as a state-level or national-level project based on the estimated construction costs. If a project exceeds $1,000,000.00, the project will be bumped into the national-level project review.

It is important to note that BRIC grants are not guaranteed, and each year the grant program is updated or changed.

More information on the application process and the BRIC program's specific requirements can be found by visiting https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities.

7.3 FEMA HMGP Funding

The HMGP is a FEMA post-disaster mitigation program that is represented by the SCEMD. The HMGP provides funding for projects that reduce or eliminate the risk to people and property from hazards, specifically after disasters. This funding source is based on a 75% / 25% non-federal cost share basis. The 25% cost share can be provided by local government revenues or non-government funds, or may be provided in conjunction with a Community Development Block Grant.

7.3.1 Qualifications

HMGP provides federal funds to applicants only after a federal major disaster declaration or Fire Management Assistance Grant declaration. To be eligible for this grant funding, applicants should meet the following minimum requirements:

» Must be a government entity or approved nonprofit.

» Must be located in an area where a major disaster recently occurred or be an area that was declared a federal disaster.

» Must be able to show a BCA ≥ 1.0.

» Must have the ability to pay or obtain 25% of cost from non-federal sources.

HMGP offers funding for a wide range of projects that will ultimately mitigate disaster risks and reduce future losses due to flooding issues. The eligible and ineligible activities are defined in the following subsection.

7.3.2 Eligible and Ineligible Activities

FEMA clearly defines activities that are eligible for HMGP project funding, and these activities include:

» Acquisition/Demolition

» Flood Control/Infrastructure

» Retrofits

» Mitigation Planning

» Advance Assistance/Project Scoping

FEMA also clearly defines activities that are deemed ineligible for receiving HMGP project funding, including:

» Projects already federally funded

» Projects already in progress

» Studies not directly related to a mitigation project

» Vehicles

» Emergency support equipment

» Response communications systems

7.3.3 Applications for Funding

Applications for the HMGP infrastructure program are typically due in two parts. The first is the pre-application, which is due in early November following the declaration of a disaster. The final application is due at the beginning of February of the following year. The applications undergo a series of reviews that prioritize the projects. The final selected project applicants are notified in the calendar year in which the final application is due. The HMGP infrastructure program is competitive on a state project level. The amount of money available for funding is based on a percentage of the estimated disaster costs.

It is important to note that the HMGP grant is not guaranteed even if a disaster happens, and each year the grant program is updated or changed.

More information on the application process and specific requirements can be found by visiting https://www.scemd.org/recover/mitigation/.

7.4 County Capital Improvement Programs

Counties have established CIPs, such as the "Pennies for Progress" tax program, to fund infrastructure projects. These projects typically range from road-widening projects to road safety improvements, water and wastewater improvements, stormwater improvements, and new parks and recreational facilities. While CIPs are very successful at generating a large amount of funding, they have a relatively small impact on County residents.

The City will need to have discussions with Florence County to develop a CIP that would include projects beneficial to all residents in the County, including those who reside within the city.

7.5 Local Funding

The Ordinance of the City of Florences states that fees related to stormwater management, including permit fees and maintenance fees, are determined according to a fee schedule set by the City Council. The Ordinance outlines specific fees associated with stormwater management, particularly in the context of land disturbance activities and compliance with NPDES permitting requirements.

Stormwater Fees Summary:

» Application Fees:
  - There are specific fees associated with submitting applications for stormwater permits, including fees for the review of Stormwater Pollution Prevention Plans and other related documents.
  - The amount varies depending on the scope of the project and is detailed in the fee schedule approved by the City Council.

» Maintenance Fees:
  - For ongoing projects, fees may apply for maintaining stormwater infrastructure and BMPs.

- These fees ensure that the infrastructure is properly maintained in accordance with the approved plans and city requirements.

» Late Notification Fees:

- Fees are applied for late submission of Notices of Intent or other required documentation. These fees are intended to enforce compliance with the Ordinance's deadlines and ensure timely processing of permits.

» Stormwater Utility Fee:

- Post-construction fees are charged per parcel monthly and are reflected as a stormwater utility fee on the owner's water bill. The fee is determined based on the amount of impervious cover on the parcel as calculated in an Equivalent Residential Unit.
- These fees are used to maintain the City's MS4 compliance program and to implement stormwater improvement projects.
- The utility rate is set by the City's utility department and approved by the City Council. This fee is reevaluated on a regular basis to ensure that adequate funding is available to meet the City's stormwater needs.
- The Ordinance provides provisions in Article 15 to allow for Stormwater Utility Fee reductions through the implementation of BMPs that the required treatment standards set forth by the Ordinance and SCDHEC regulations. This promotes the implementation of water quality BMPs to reduce long-term financial costs to the owner.

The fee structure is designed to cover the costs associated with the City's review, permitting, and enforcement processes related to stormwater management. This fee schedule is updated periodically, and the specific amounts can be obtained directly from the City of Florence website. According to the current fee schedule (July 1, 2024 through June 30, 2025), the monthly stormwater fee is $3.84 for a customer with 1,501 - 5,000 square feet of impervious surface. The stormwater fee schedule consists of four categories based on square footage of impervious surface area.

It is recommended that the City establish a 10-year rate study and implement incremental rate adjustments to account for inflation and the rising costs of construction. This approach will ensure that the stormwater utility fee remains adequate to cover future infrastructure maintenance and improvement projects, while also maintaining compliance with regulatory requirements. A structured, long-term financial plan will provide stability in funding and allow for proactive management of the City's stormwater system in alignment with its growing needs.

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