

Watershed Master Plans: Assessing Critical Infrastructure Assets

August 2023



Introductions

The background features a repeating pattern of white, 3D-outlined cubes. The cubes are arranged in a staggered grid. The background color transitions from a light green on the left to a teal on the right.



Amanda Hollingsworth, PE, CFM

Stormwater Project Manager

Areas of Expertise

- **Watershed Master Planning**
- **Hydrologic and Hydraulic Modeling**
- **Floodplain Management**

- Skilled in a variety of software platforms including PCSWMM, HEC-RAS, and more
- Oversight of six different master plan efforts in 2023
- Leads a group of engineers from the Raleigh area



David Perry, PE, CFM

Stormwater Senior Project Manager

Areas of Expertise

- **Watershed Master Planning**
 - **Urban Stormwater Retrofit**
 - **Culvert Replacement**
- 25+ years of experience in stormwater management planning, design, permitting, and policy
 - Municipal client focus grew out of previous employment by the City of Charlotte Storm Water Services group
 - Leads WithersRavenel stormwater practice in Charlotte & western NC

What is a Watershed Master Plan?

“The objective of watershed master planning under Section 452.b (WMP) is to provide the community with a tool it can use to make decisions that will reduce the increased flooding from development on a watershed-wide basis and address existing flood problems.” – *National Flood Insurance Program (NFIP) Community Rating System (CRS) Coordinator’s Manual*



WHY do I need a Master Plan?

- **Identify Areas of Concern (AOCs)**
 - Water Quality & Flooding
 - Current and/or Future
- **Improves Asset Management**
 - Identify aging and/or undersized infrastructure or data gaps
- **Facilitate Regulatory Requirements**
 - NPDES MS4 Program - SWMP
 - Ordinance Review
- **Resiliency Based Planning and Design**
 - Capital Improvement Plan
- **Identify Funding Needs** → **Identify Funding Opportunities**
- **Proactive vs Reactive = Cost Savings**

TYPICAL OBJECTIVES

Water Quality

Water Quantity

Compliance

Funding

Capital Improvement Plan (CIP)

Resiliency

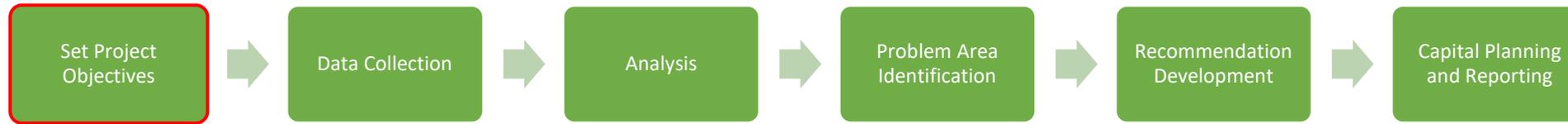
SW NEEDS OVER 5, 10, 15+ YEAR PERIOD

See July 2023 DEQ WOW Stormwater Presentation on Restoration Action Plans by Jonathan Hinkle, PE

Master Planning Process



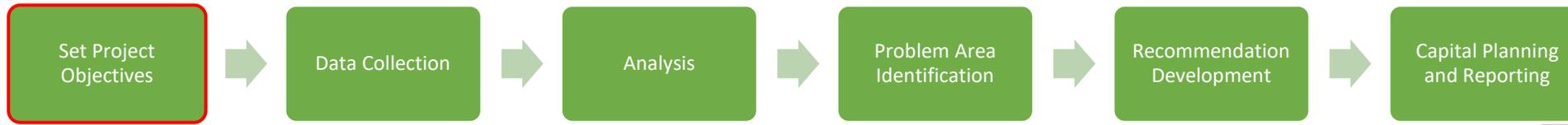
Set Project Objectives



• Define Project Area and Scope

- Areas and Infrastructure of Interest
 - Entire Municipality
 - Single Watershed
 - Priority Areas
- Storm Events/Level of Service
- Model Selection/Hydrology
- Data presentation and format in final deliverable
- End Goals

Set Project Objectives



Implementation Constraints

Budget

Time Constraints

Implementation Options

Service Area
(Sub-Catchment Size)

Pipe Size

High Priority Areas



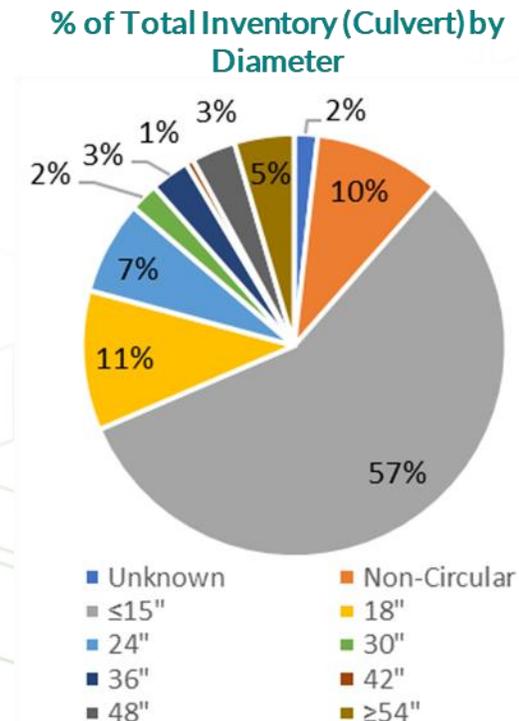
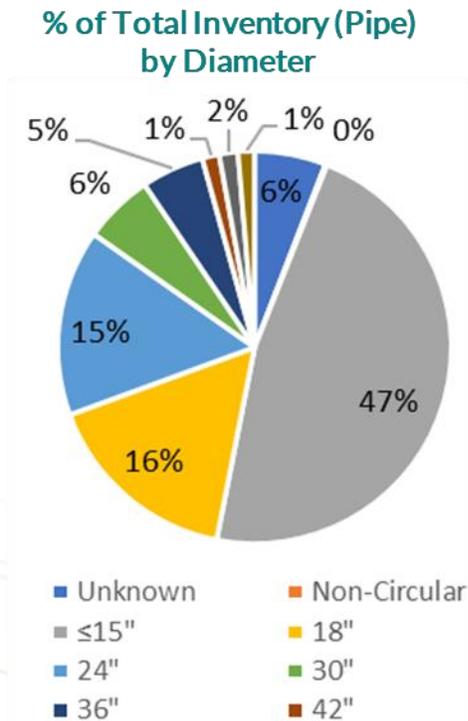
VS



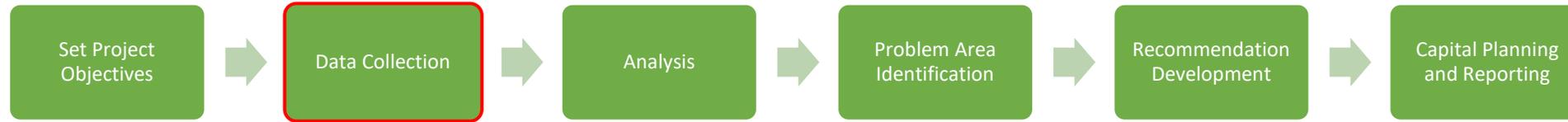
Data Collection



• Data Preparation and Gaps Analysis



Data Collection

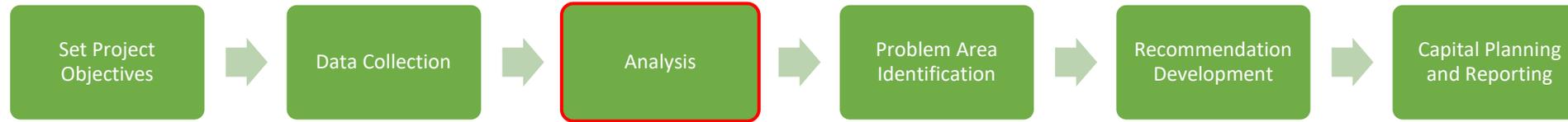


- **Field Work**



See May 2023 DEQ WOW Stormwater Presentation on Asset Management by David Perry, PE, CFM

Analysis



- **Model Selection**

- HEC-RAS/HEC-HMS
- SWMM
- InfoWorks ICM

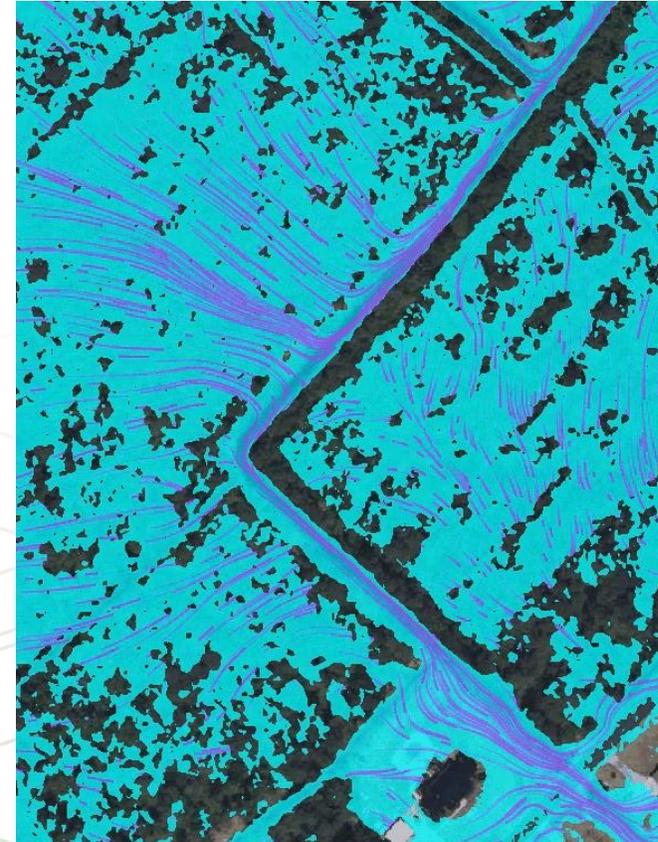
- **Hydrologic Characterization**

- **Network Limits**

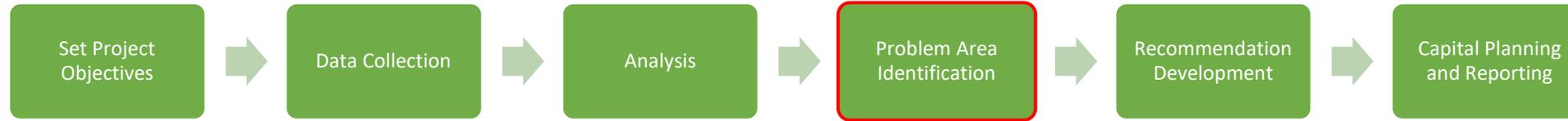
- **Boundary Conditions**

- **Validation/Calibration**

- **Multiple Teams**



Problem Area Identification



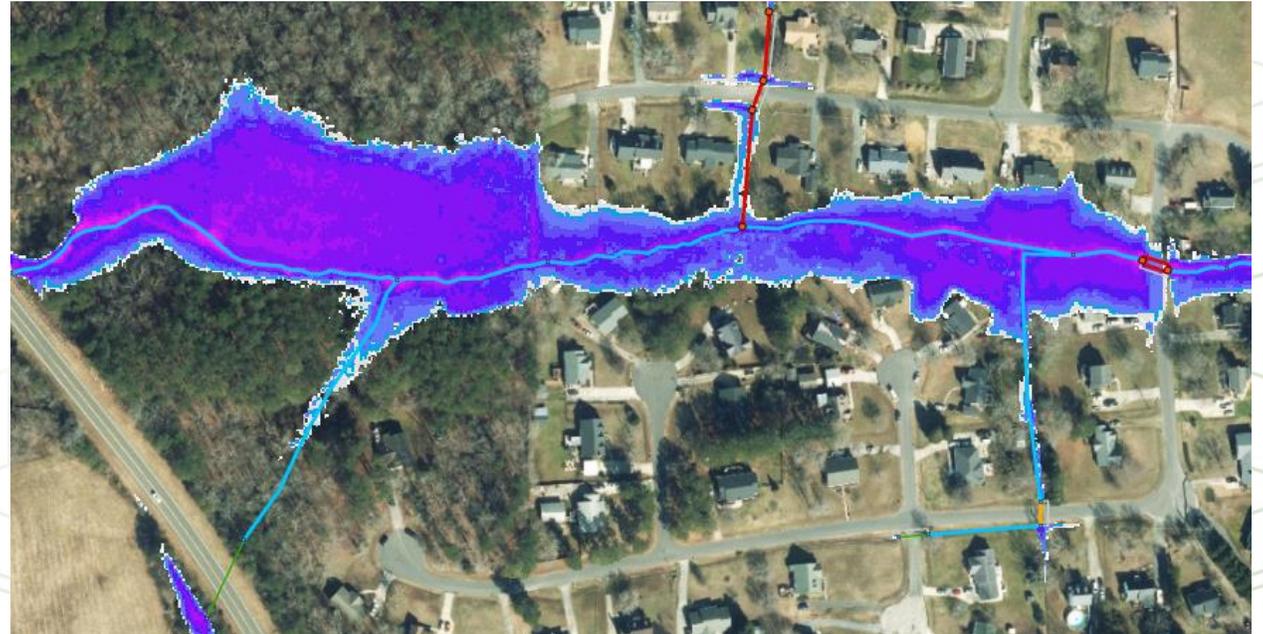
- **Level of Service**

- Design Events

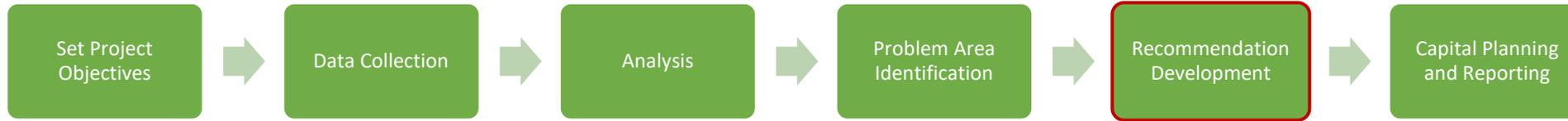
- Pipe Systems versus Stream Crossings

- **Other Factors**

- Structures Impacted
 - Emergency Vehicle Access

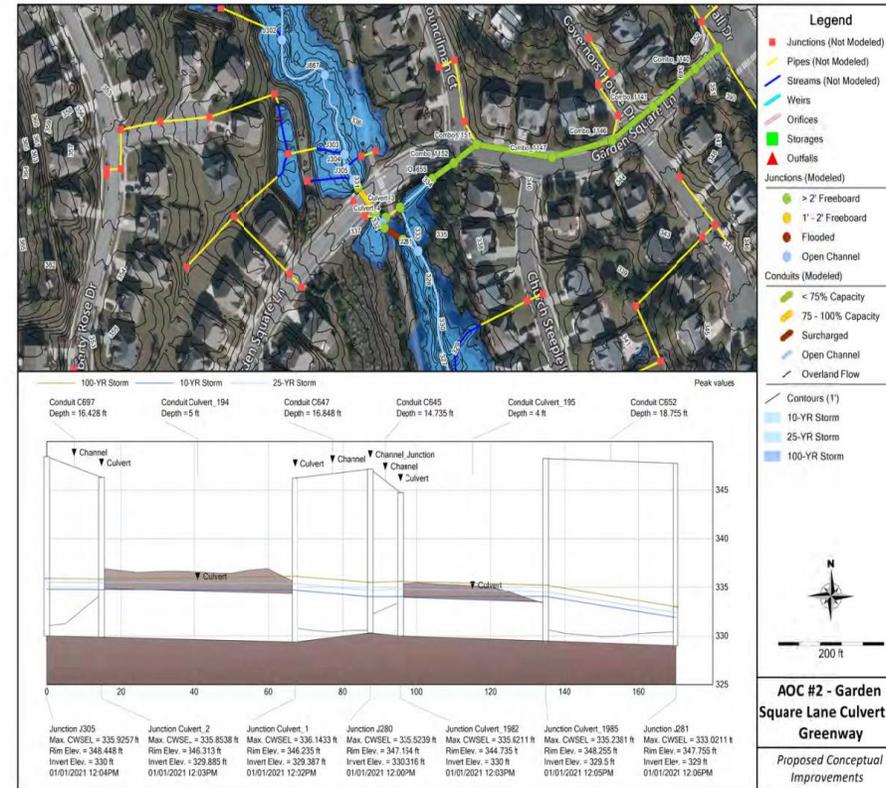
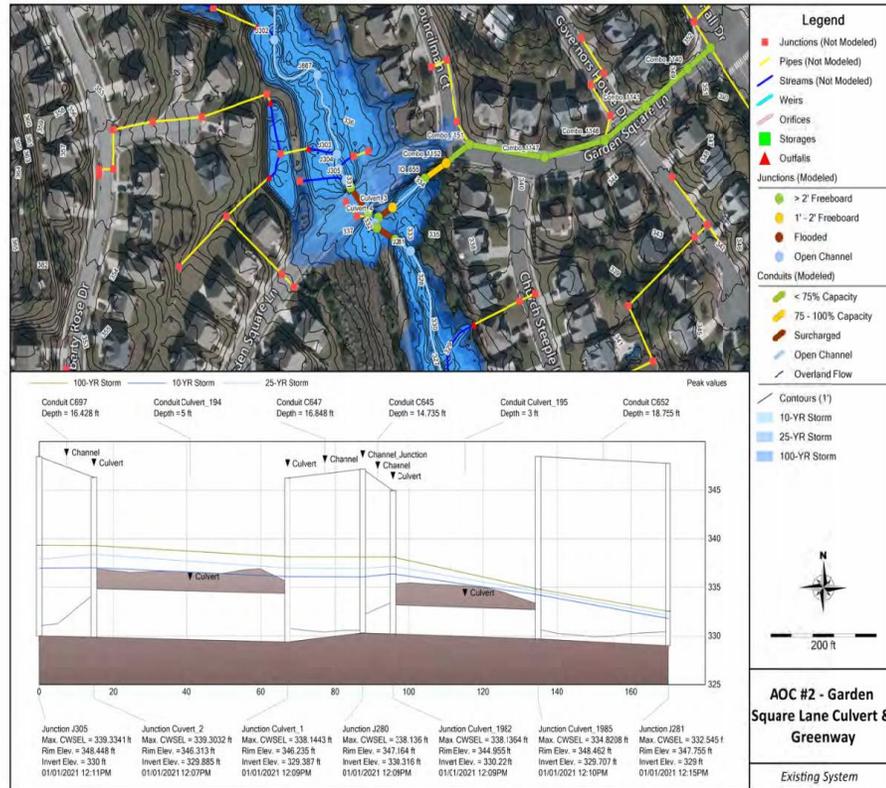


Recommendation Development

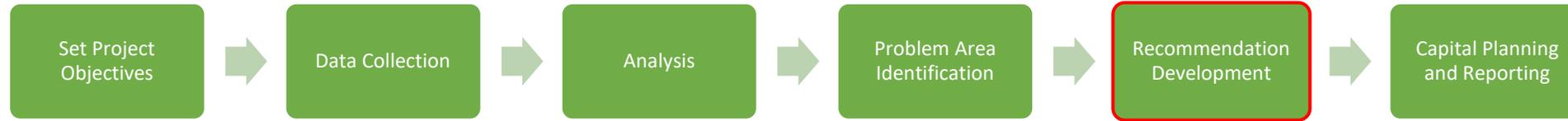


Current Conditions

Improved Conditions



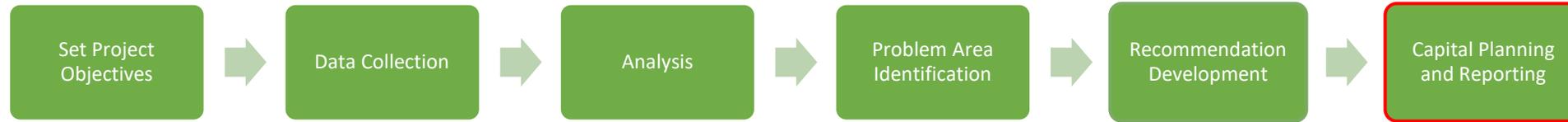
Recommendation Development



Prioritization Scoring and Matrix

| Prioritization Matrix | Weighted % | Area of Concern | | | | | | | | | |
|-------------------------------------|-------------|-----------------|----------------|--------------|----------------|-------------|----------------|--------------|----------------|-------------|----------------|
| | | 8 | | 4 | | 1 | | 2 | | 6 | |
| | | Raw Score | Weighted Score | Raw Score | Weighted Score | Raw Score | Weighted Score | Raw Score | Weighted Score | Raw Score | Weighted Score |
| Age of Infrastructure | 5% | 50 | 2.5 | 60 | 3 | 80 | 4 | 50 | 2.5 | 80 | 4 |
| Severity of Flooding | 25% | 100 | 25 | 55 | 13.75 | 30 | 7.5 | 50 | 12.5 | 35 | 8.75 |
| Frequency of Flooding | 20% | 80 | 16 | 100 | 20 | 30 | 6 | 90 | 18 | 50 | 10 |
| Capital Costs | 15% | 18 | 2.7 | 100 | 15 | 100 | 15 | 75 | 11.25 | 50 | 7.5 |
| Jurisdiction | 15% | 50 | 7.5 | 90 | 13.5 | 100 | 15 | 100 | 15 | 83 | 12.45 |
| Coincides with Proposed Improvement | 20% | 75 | 15 | 10 | 2 | 80 | 16 | 20 | 4 | 80 | 16 |
| Total Weighted Score | 100% | 68.7 | | 67.25 | | 63.5 | | 63.25 | | 58.7 | |
| CIP Priority Ranking | --- | 1 | | 2 | | 3 | | 4 | | 5 | |

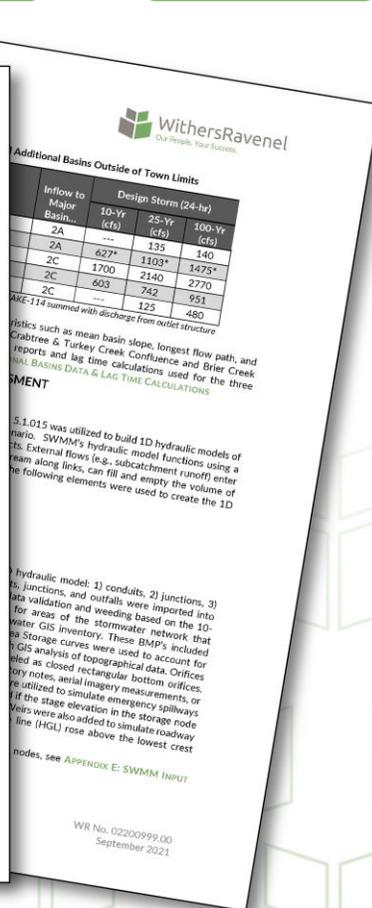
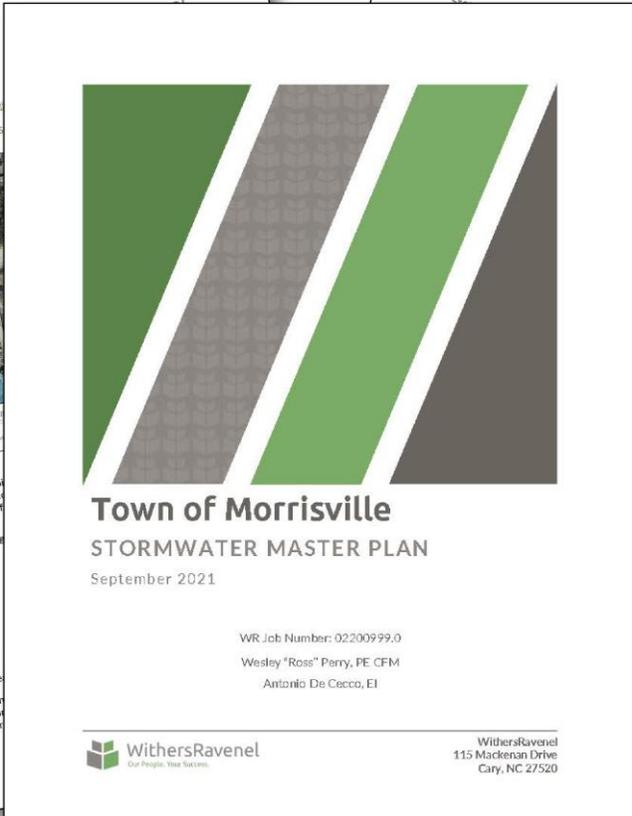
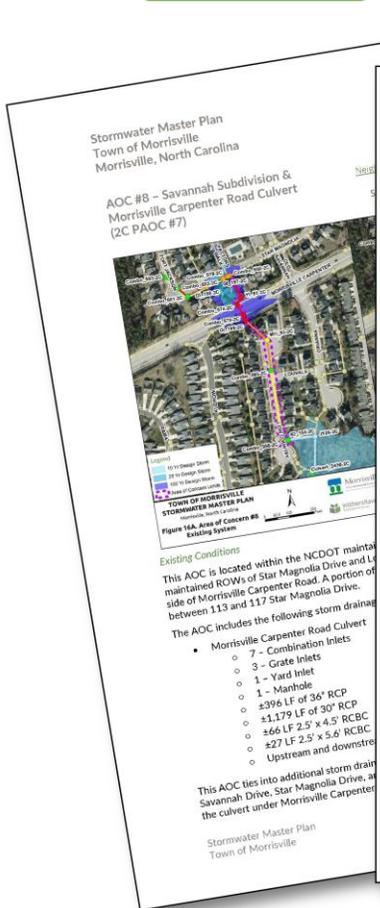
Capital Planning and Reporting



Capital Improvement Plan

| Project Description | Cumulative Costs | Budget FY 2022 | Budget FY 2023 | Budget FY 2024 | Budget FY 2025 | Budget FY 2026 | Budget FY 2027 | Budget FY 2028 | Budget FY 2029 | Budget FY 2030 | Budget FY 2031 | Budget FY 2032+ |
|---------------------|---------------------|--------------------------|------------------|------------------|------------------|------------------|------------------|--------------------|------------------|------------------|------------------|--------------------|
| | | % Cost Escalation Factor | | | | | | | | | | |
| | | 0% | 2% | 4% | 6% | 8% | 10% | 12% | 14% | 16% | 18% | 20% |
| Project Area A | \$1,374,600 | \$150,000 | \$663,000 | \$561,600 | | | | | | | | |
| Project Area B | \$220,000 | \$220,000 | | | | | | | | | | |
| Project Area C | \$180,000 | \$180,000 | | | | | | | | | | |
| Project Area D | \$934,600 | | | \$114,400 | \$604,200 | \$216,000 | | | | | | |
| Project Area E | \$966,800 | | | | \$84,800 | \$486,000 | \$396,000 | | | | | |
| Project Area F | \$1,935,200 | | | | | | \$154,000 | \$1,120,000 | \$661,200 | | | |
| Project Area G | \$2,236,000 | | | | | | | | \$114,000 | \$754,000 | \$708,000 | \$660,000 |
| Project Area H | \$600,000 | | | | | | | | | | | \$600,000 |
| Project Area I | \$1,608,000 | | | | | | | | | | | \$1,608,000 |
| Project Area H | \$1,260,000 | | | | | | | | | | | \$1,260,000 |
| TOTAL | \$11,315,200 | \$550,000 | \$663,000 | \$676,000 | \$689,000 | \$702,000 | \$550,000 | \$1,120,000 | \$775,200 | \$754,000 | \$708,000 | \$4,128,000 |

Capital Planning and Reporting



AOC#1 McCrimmon Parkway Culvert

Existing Condition

Proposed Condition

PROBLEM

Open channel flows from an approximately 13.8-acre drainage area are conveyed under McCrimmon Parkway via CMP culverts that also receive flow from the stormwater network along McCrimmon Parkway. The 100-Year backwater upstream of the AOC overtops the roadway, resulting in flooding within the traffic lanes. The area upstream of the AOC is currently undeveloped and thus no structures or additional infrastructure is impacted.

BENEFITS

The primary benefit of the project would be to alleviate roadway flooding. In addition, upsizing the culvert would allow for future upstream development while maintaining the required level of service.

SOLUTION

The system needs to be upgraded to a double, 36" RCPs, with the two combination inlets and two headwalls replaced.

OPINION OF PROBABLE PROJECT COST

| | |
|-------------------------------------|------------------------------|
| Construction: | \$68,600 to \$85,750 |
| Land Acquisition: | --- |
| Engineering, Surveying, Permitting: | \$14,000 to \$18,000 |
| TOTAL: | \$82,600 to \$103,750 |

Stakeholder Participation

- Can be incorporated into multiple steps
 - Data Collection
 - Identify Problem Areas
 - Gather Validation Data
 - Present Results
 - Existing Conditions
 - Proposed Concepts

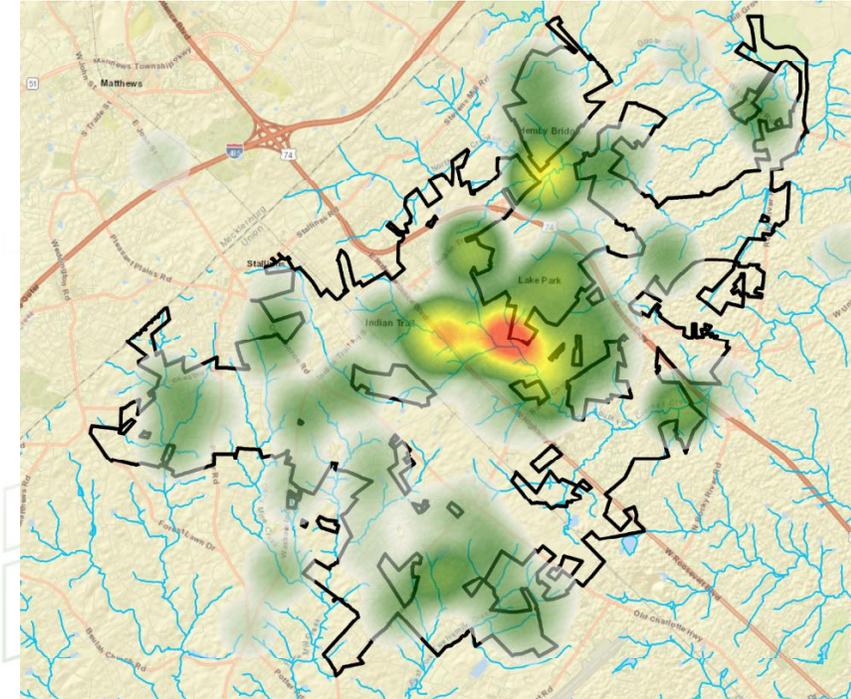


INDIAN TRAIL
Needs Your Help!

Indian Trail is developing a **town-wide Stormwater Management Plan** and we need your input to understand community perspectives on pollution risks to surface water and also flood risks in town. Please scan the QR code to the right, or visit the website below to take a brief survey. If you lack internet access you may call (704) 821-5401 to complete the survey with an Engineering staff member. *Thank you!*

<https://www.surveymonkey.com/r/>

SCAN ME!



See June 2023 DEQ WOW Stormwater Presentation on Communication by Annette Lucas, PE and Daniel Wiebke, PE, CFM

Additional Thoughts

- **Downstream Impacts**
- **Based on the results, is there a need to change local regulatory requirements to meet long term goals**



Now What?



Funding



Design



Construction



ANY QUESTIONS? THANK YOU.

Contact:

Amanda Hollingsworth

919.678.3841

ahollingsworth@withersravenel.com

David Perry

704.351.6495

dperry@withersravenel.com