Prioritization Matrix for Monitoring and Detection of Fecal Pollution in Urban Streams
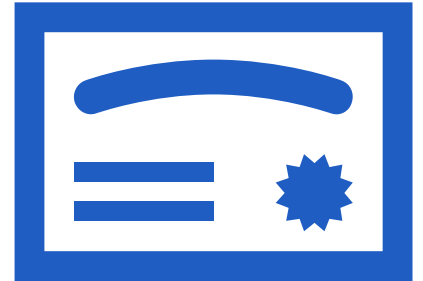
January 15, 2026 | 10:30 a.m. – 11:30 a.m. (Eastern)

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Today's Presenters

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Prioritizing Watersheds for Fecal Pollution Reduction in Mecklenburg County

John Thao and Robert Sowah

Charlotte-Mecklenburg County Storm Water Services

January 15th, 2026

Outline

◁ **Background**

◁ **Water Quality Challenges**

◁ **Prioritization Scheme**

◁ **Implementation**

◁ **Results**

◁ **Ongoing Efforts**

◁ **Conclusions & Lessons Learned**

Charlotte-Mecklenburg County Storm Water Services (CMSWS)

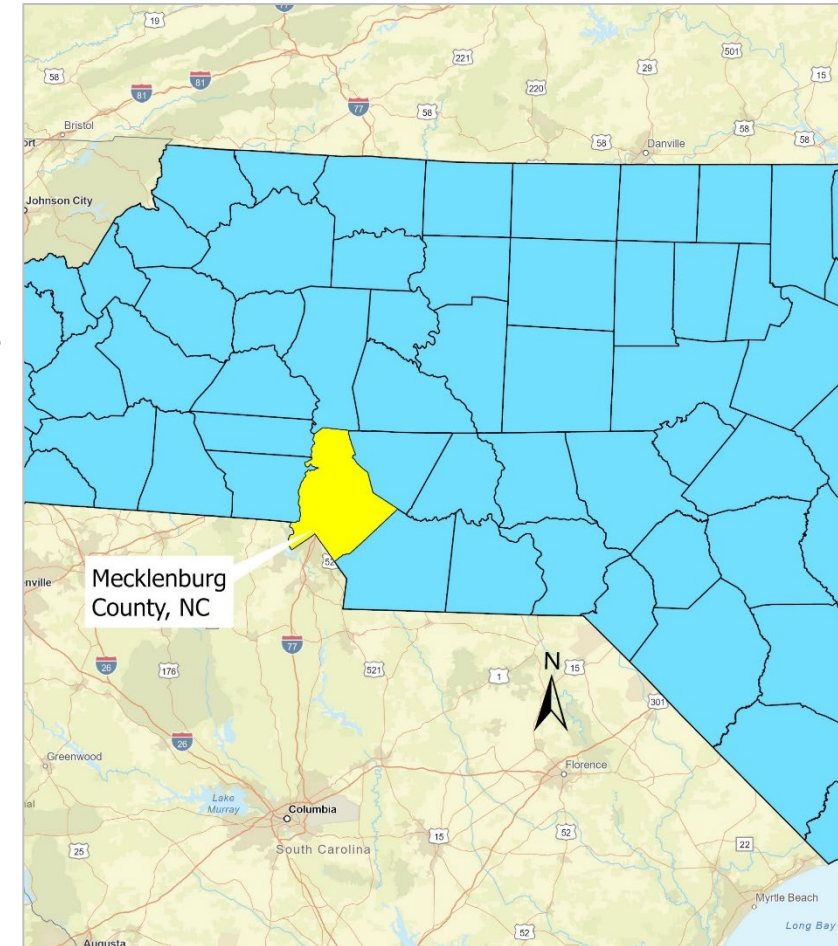◁ **Joint municipal/county stormwater utility**
  - City of Charlotte
  - Townes – Cornelius, Davidson, Huntersville, Matthews, Mint Hill, Pineville, and Mecklenburg County

◁ **Phase I and II MS4 NPDES Permit**
  - IDDE Program

◁ **Stream miles – Over 3,000 miles**

◁ **Over 36,000 stormwater outlets**

Mecklenburg County, NC

Charlotte-Mecklenburg County Storm Water Services (CMSWS)

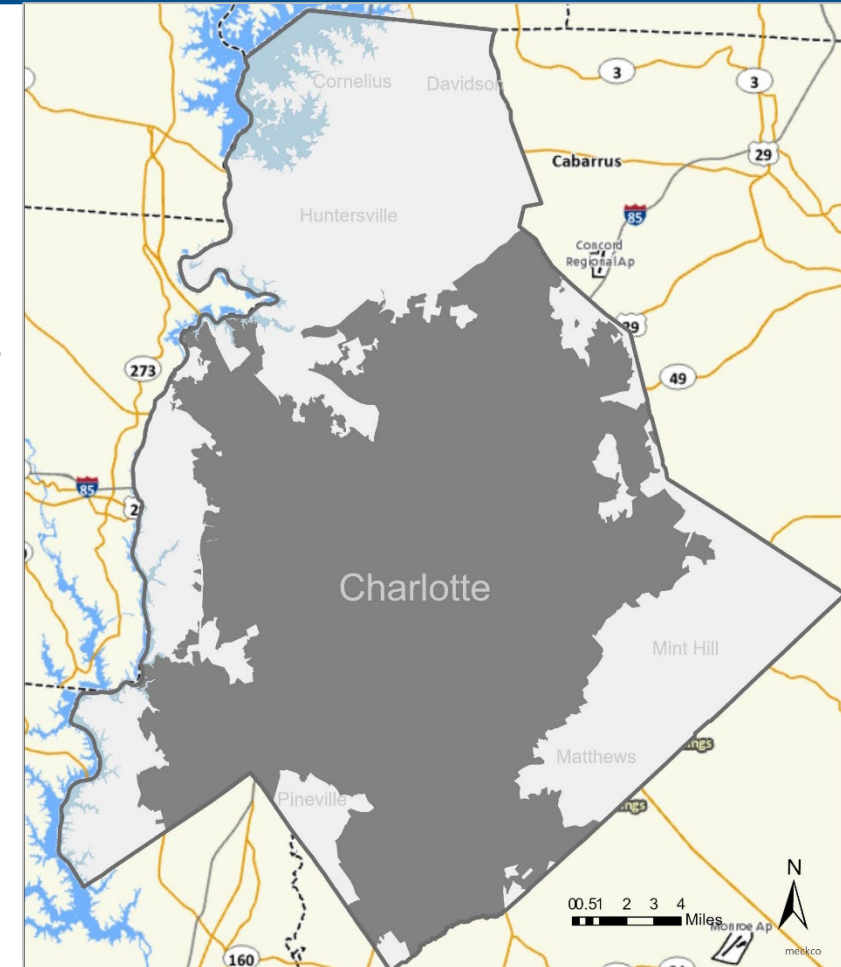▷ **Joint municipal/county stormwater utility**
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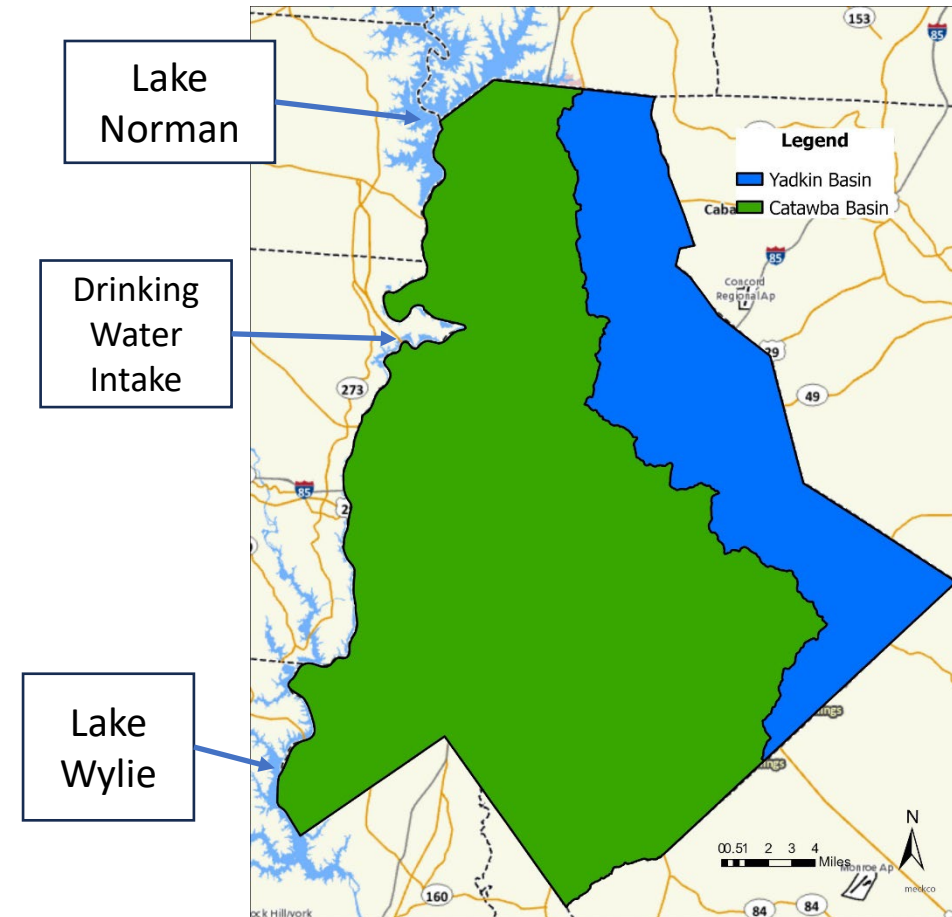- IDDE Program

▷ **Stream miles – Over 3,000 miles**

▷ **Over 36,000 stormwater outlets**

Mecklenburg County

◁ **Population ~1.2 million**

Land Use	Percent
Developed	70.6
Forest	20.2
Agriculture	4.3
Water	3.8
Other	1.1

Water Quality Challenges

- Sanitary sewer overflows
- Failing septic systems
- Discharges from industrial facilities
- Stormwater runoff
- Offsite sedimentation
- Nutrient loading into lakes and reservoirs
- Harmful Algal Blooms

Fecal Pollution

◁ Sanitary sewer overflows
 - Pipe failures, blockages
 - Lift stations, Private laterals, Multifamily systems

◁ Septic system failures

◁ Stormwater runoff

◁ Others

Broken pipe spills nearly 5 million gallons of sewage into Charlotte creek

BY BRUCE HENDERSON

OCTOBER 25, 2017 03:17 PM, UPDATED OCTOBER 25, 2017 06:58 PM

Water Quality Monitoring and Assessment Tools

CMANN (Real-time Sensors) - 35 monitoring locations	FIM (Fixed Interval Monitoring)	IDEP Inspections	Stream walk program
Predictive Fecal Models	Trend analysis	Resident Request for Service	Dry Weather Flow Sampling
TMDL	Microbial Source Tracking (MST)	Canine - SEARCH	

Prioritization Matrix

Proactive approach to fecal pollution reduction

Identify and mitigate sources

Objectives

Characterize point and non-point sources of fecal pollution

Rank watersheds based on vulnerability to fecal pollution

Identify drivers of fecal pollution at the watershed level

Implementation

Targeted monitoring to identify sources of fecal pollution

Eliminate sources

Prioritization Matrix

Watershed characterization

- 32 watersheds
- Fecal coliform trends – short & long-term
- Sewage – infrastructure, SSOs
- Illicit discharges
- Impervious cover
- Septic system
- Animal - Hay/pasture land use
- Turbidity trends

Prioritization scheme

- Normalize data
- Weighted
- Scored

Prioritization Matrix

◁ **Sanitary Sewer Features**

- SSO counts/watershed
- Wastewater main line density
- Percent of vitrified clay pipe (VCP) and terracotta pipe
- Summarized into one sewer index

Number of SSOs per Year

Legend: Debris In Line, Grease, Pipe Failure, Roots, Other
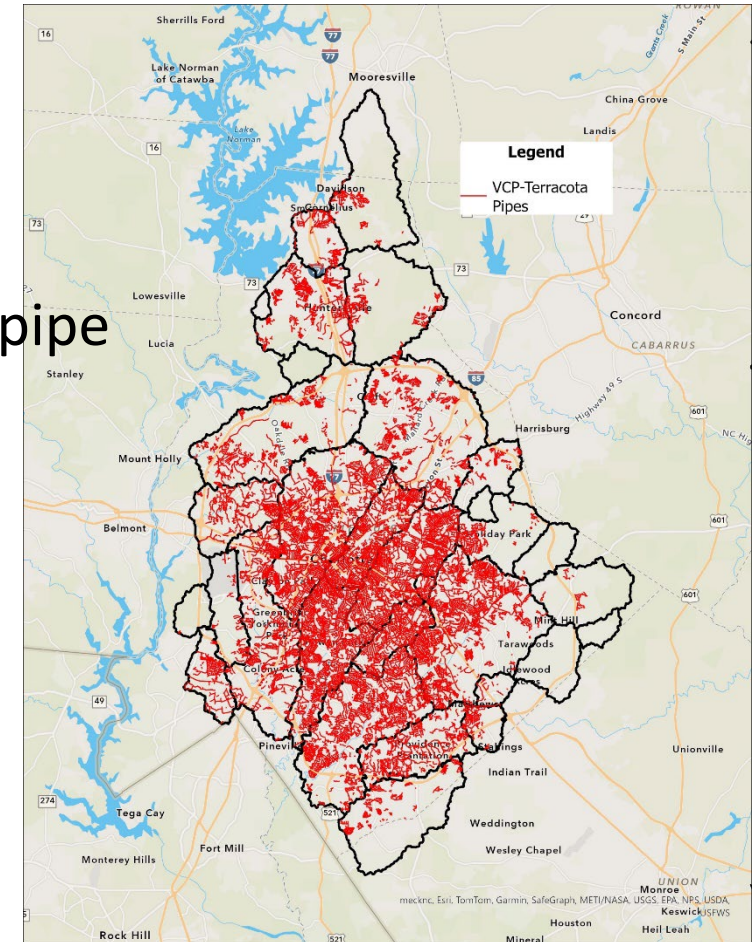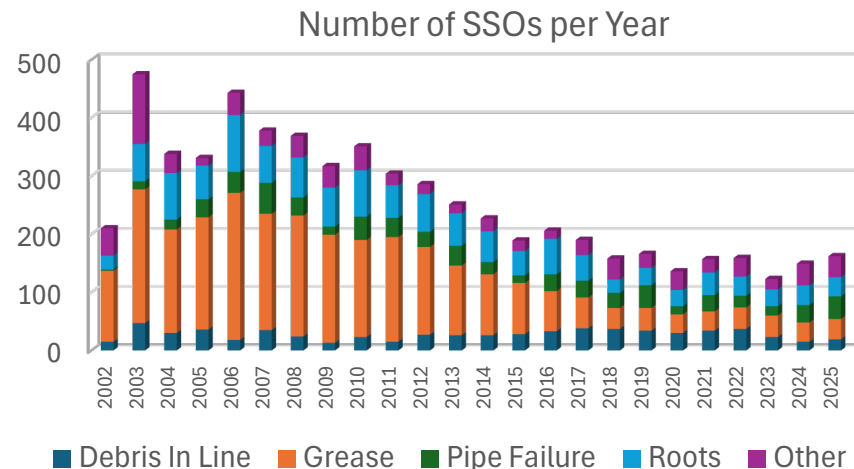
Prioritization Matrix

◁ **Other Indicators**

- Septic systems
- Outfall density
- Impervious cover
- Animal sources
- Fecal coliform and turbidity trends

Prioritization Matrix

Weighted Model

- Watershed characteristics
  - Long term trends in Fecal and Turbidity
  - Percent Impervious Cover
  - Outfall Density
- Sewage Characteristics
  - Sanitary Sewer Overflows
  - Waste Water Main
  - Vitrified Clay Pipe Density
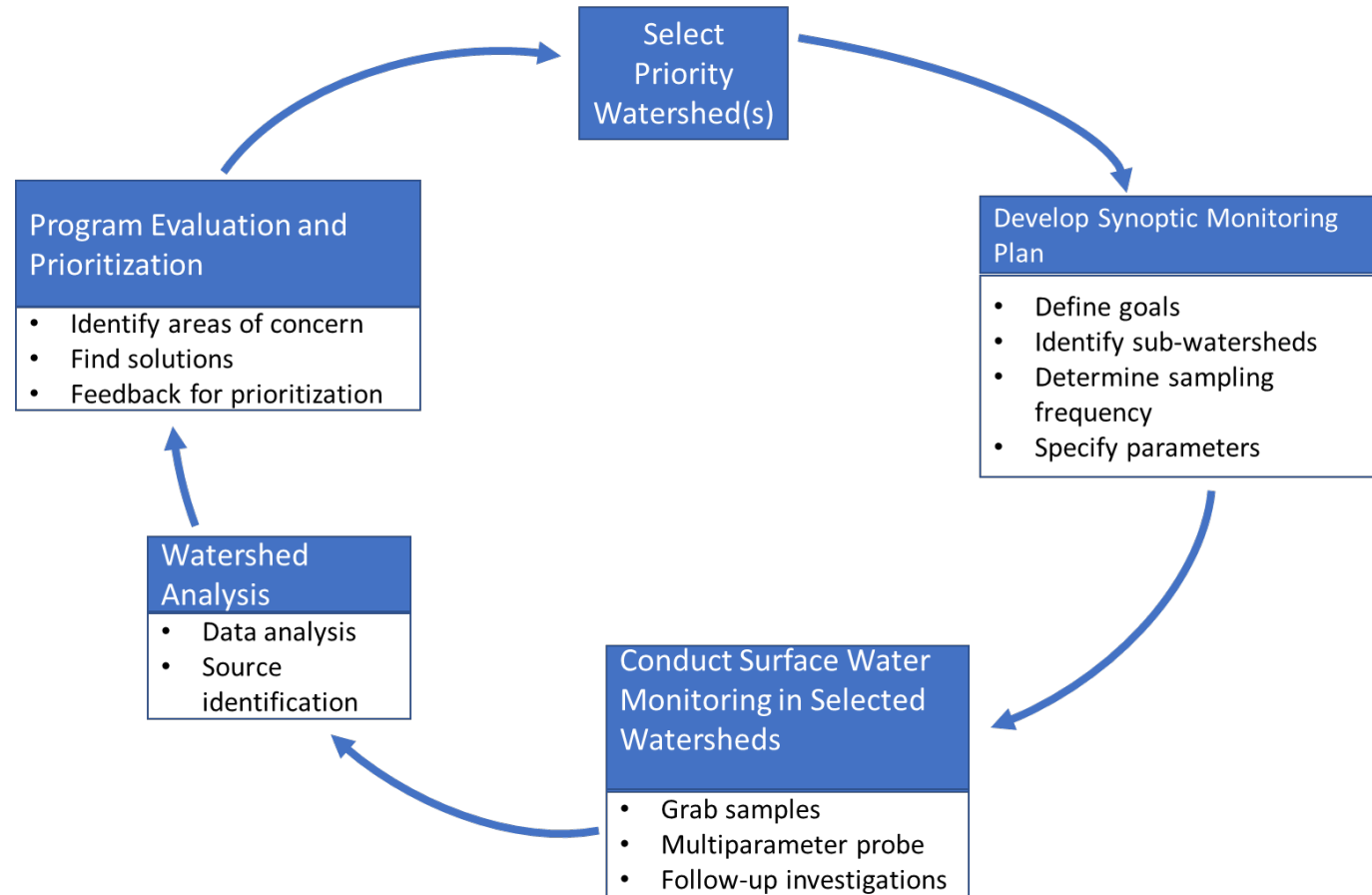- Septic Characteristics

| Overall Weights			Sewage Weights		
Parameters	Importance	Weights	Parameters	Importance	Weights
Sewage score	4	0.19	SSO #/acre/yr	5	0.36
Outfall	1	0.05	WW Main ft/acre	3	0.21
Septic score	2	0.10	VCP/Total Pipe	4	0.29
Pct_Imp_2021	2	0.10	IDDE #/acre/yr	2	0.14
Hay/Rangeland	1	0.05	**Septic Weights**		
Fecal Upward Trend	5	0.24	Septic Density #/acre	1	0.17
Turbidity Upward Trend	3	0.14	Septic_IDDE #/acre/yr	2	0.33
Current Fecal Mean	3	0.14	Septic_Repairs #/acre/yr	3	0.50

Higher Scores → Higher Priority
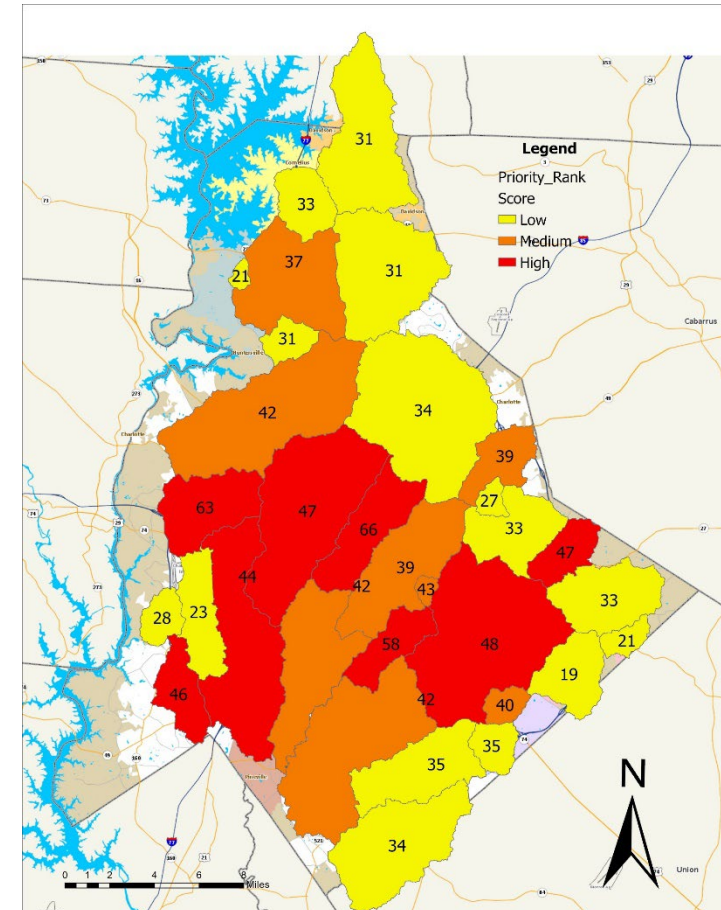
Priority ranking based on Sanitary Sewer, Septic, Outfall, Impervious cover, Hay land use and Fecal and Turbidity trends

Implementation

Select Priority Watershed(s)

Develop Synoptic Monitoring Plan
- Define goals
- Identify sub-watersheds
- Determine sampling frequency
- Specify parameters

Conduct Surface Water Monitoring in Selected Watersheds
- Grab samples
- Multiparameter probe
- Follow-up investigations

Watershed Analysis
- Data analysis
- Source identification

Program Evaluation and Prioritization
- Identify areas of concern
- Find solutions
- Feedback for prioritization

Implementation – Priority Watershed

- **Upper Little Sugar Creek (ULSC) Watershed**
  - 712 Acre drainage
  - Fecal coliform TMDL, Trending up
  - 1552 Outfalls
- **Drains dense residential, commercial and industrial areas**
  - Uptown and Midtown Charlotte
  - High impervious cover
  - Piped tributaries
- **Aging sanitary sewer and stormwater infrastructure**
- **Creek runs along major Wastewater Treatment Plant trunkline**
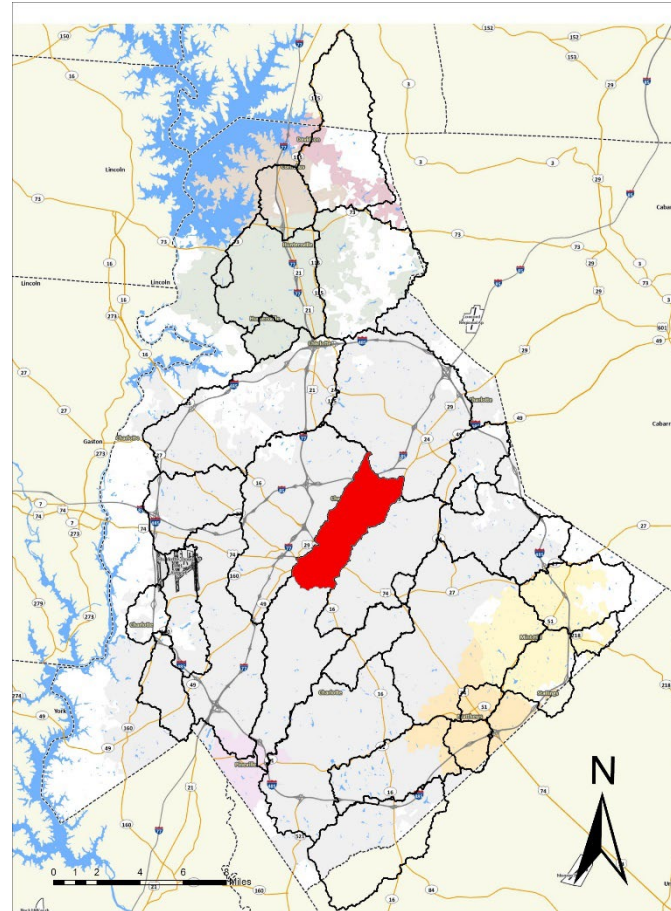
Upper Little Sugar Creek Watershed - High Priority

Priority Watershed Monitoring & Assessment

◁ **Objectives**

- Determine sub-watersheds in the ULSC watershed with elevated fecal pollution.
- Identify and eliminate fecal sources at the sub-watershed level.
- Determine the sources and drivers of fecal pollution in the sub-watersheds with elevated fecal counts.
- Is there a correlation between infrastructure age and type and Fecal counts?

Monitoring and Sampling Methods

Upper Little Sugar Creek Watershed - Subbasins and Monitoring Sites
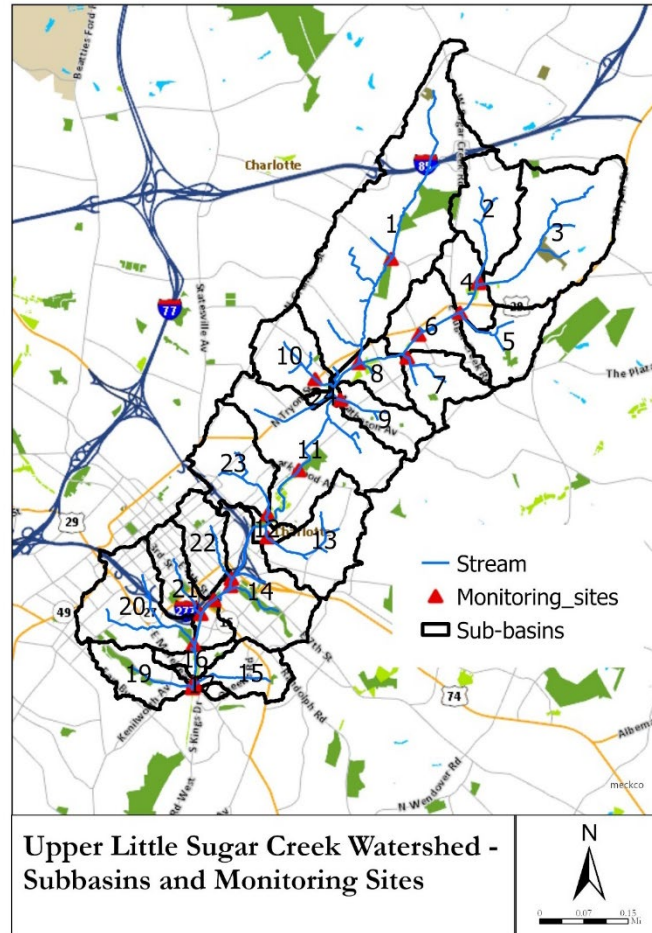
- **6 sampling events over 1 year**
- **20 Sampling Sites isolating subbasins or sections of creek**
- **Collected grab samples and water quality parameters**
  - Fecal Coliform and E.coli
  - Water Temperature
  - Dissolved Oxygen
  - Specific Conductivity
  - Turbidity
  - pH

Results – Follow up Investigations

◁ **Samples with >3000 CFU or MPN/100mL were investigated**

◁ **Areas with average counts of >1000 CFU or MPN/100 ml were targeted for source tracking**

◁ **Tracked discharges through the storm water infrastructure and surface water above the sample site**


Upper Little Sugar Creek Fecal Coliform Distribution
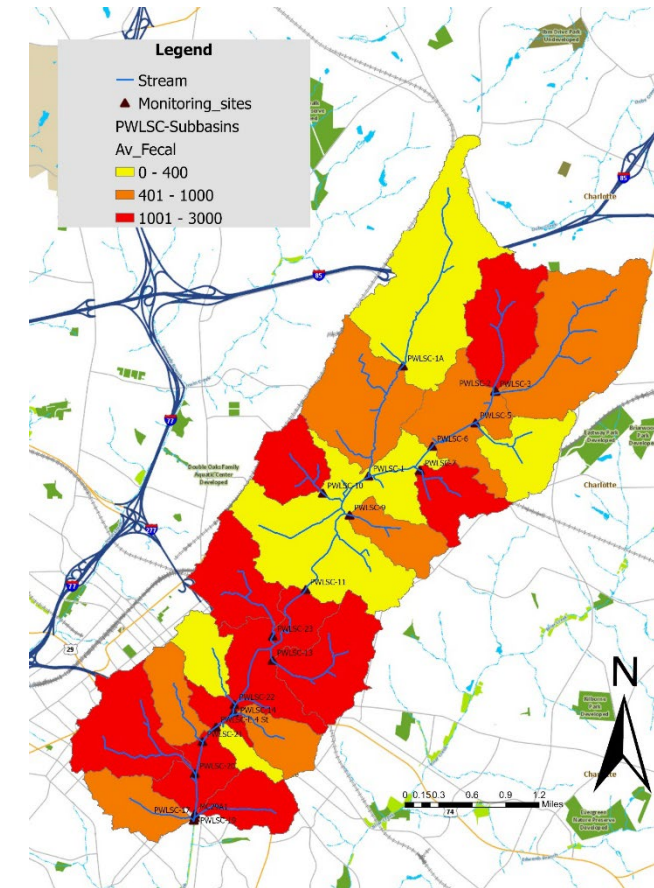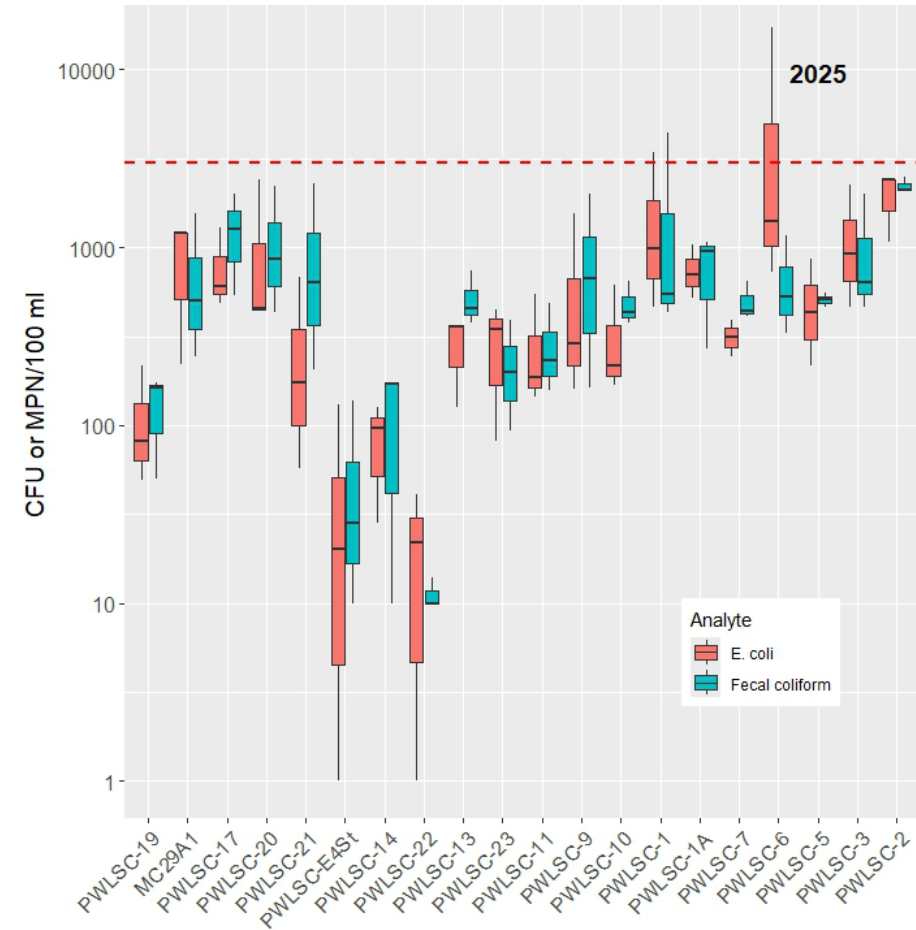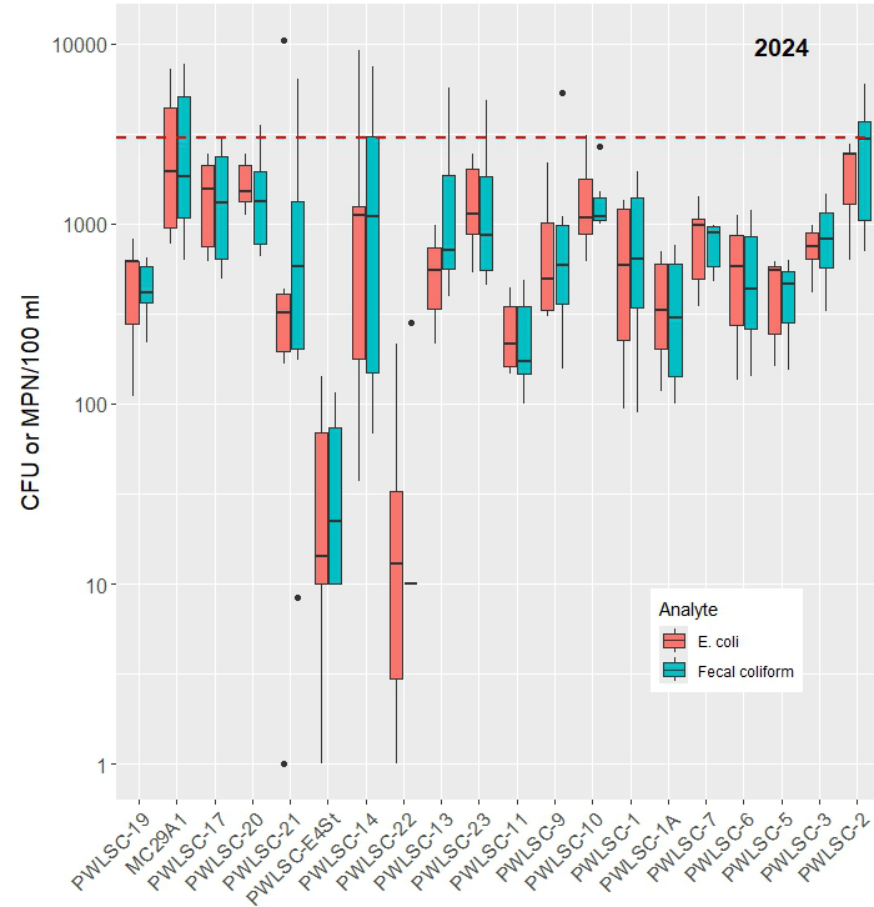
Results - Bacteria

Results – Major Findings

◁ **Project revealed many sources of bacterial pollution**

- Three sewer breaks
  - One major (>5 Gallon/minute) trunkline break
- Two major and one minor illicit connection
  - Proposed code changes to prevent future issues
- Three rediscovered persistent/recurring issues
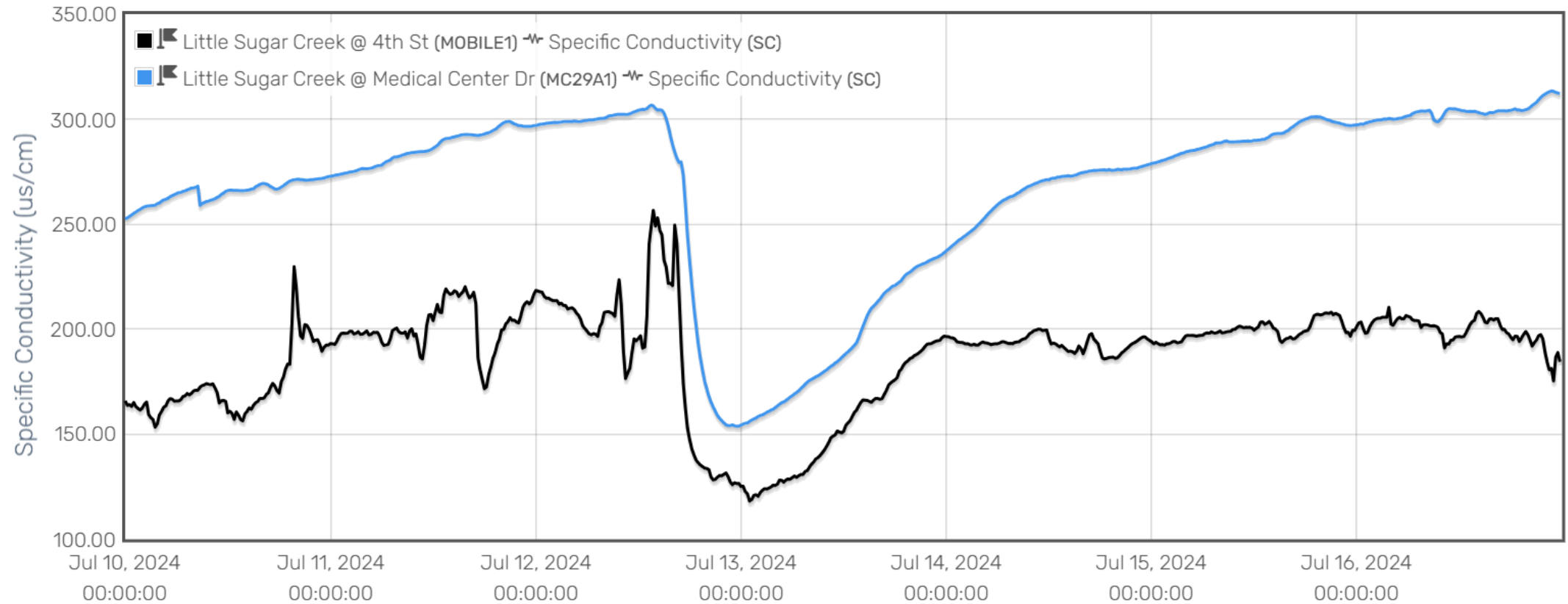- Additional mysteries
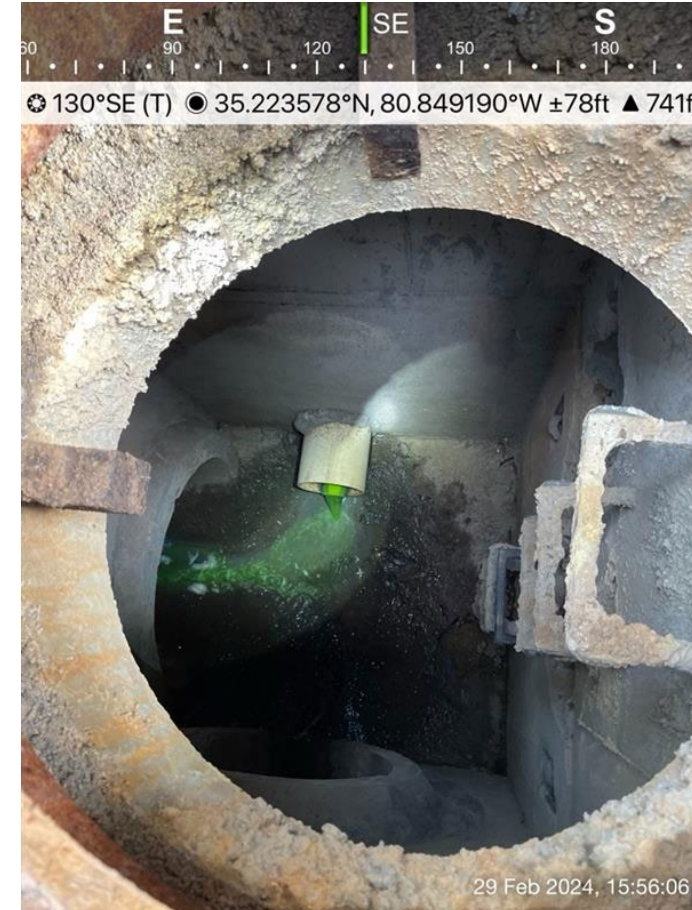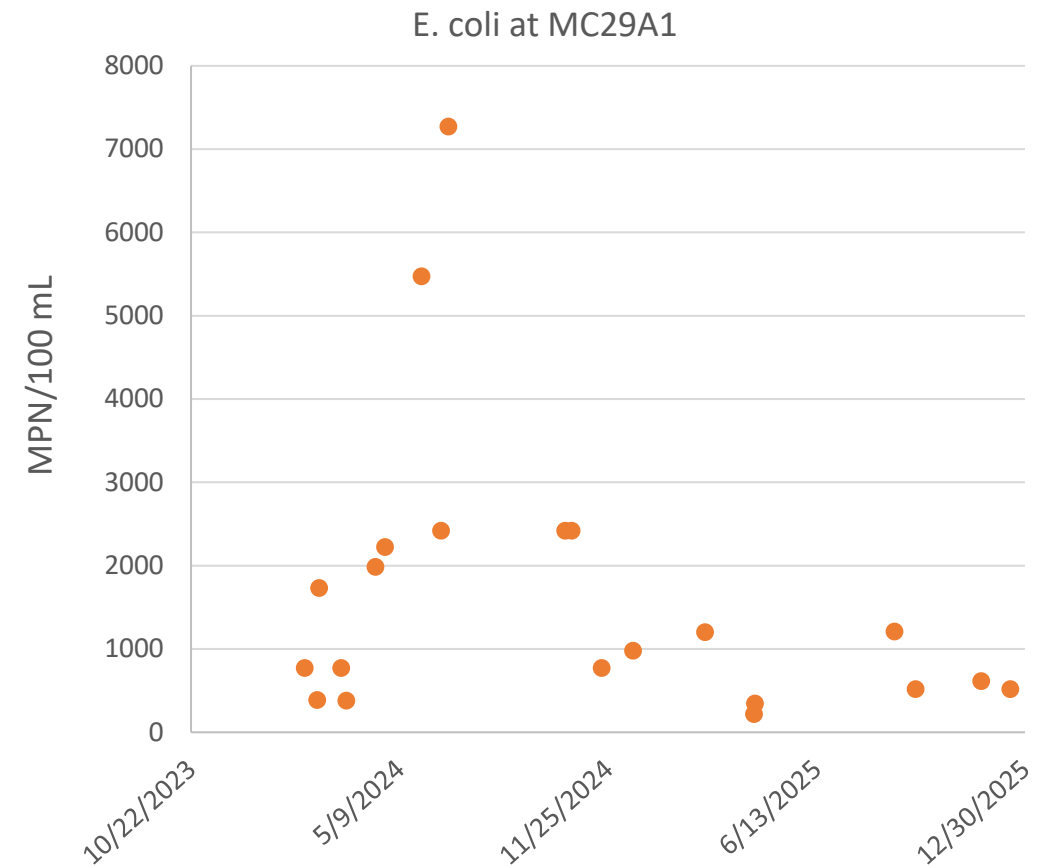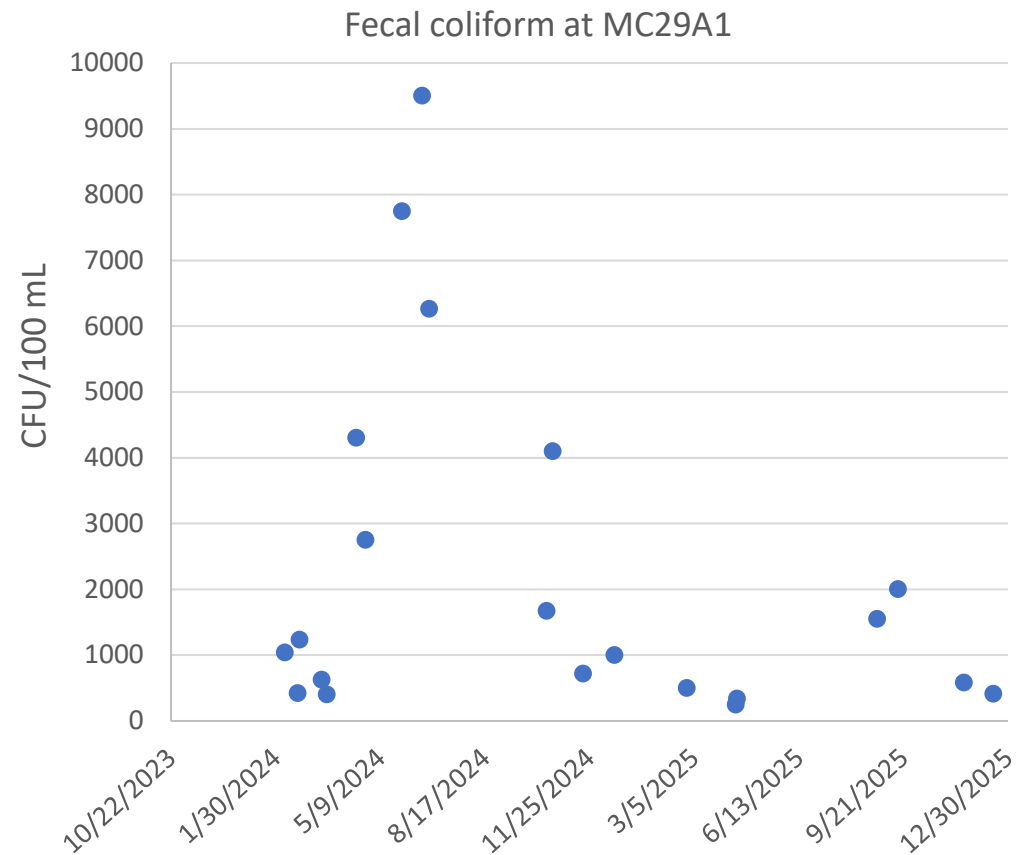
Spotlight: MC29A1 Trunkline Break

◁ **First sign of a problem – Results from April 2024 routine monthly monitoring and priority watershed monitoring**

◁ **Field investigations, sampling, and dye-testing to delineate issue**

- Mainstem of ULSC
- Tributaries
- Outfalls

CMANN Measurements

Results – Overall Watershed

What Happened?

What helped us?

◁ **Combined data from FIM and Priority Watershed Sampling**

◁ **Systematic approach to delineate stream and assess possible sources**

◁ **Repeated sampling overtime to narrow the scope of sources**

Challenges?

◁ **Data gaps**

◁ **Break occurred underground and seeping through the bank**

◁ **Upstream Interference**
- Negative interference from potable water leaks
- Positive interference from sewage in upstream tributaries and outfalls

Spotlight: Uptown Illicit Connections

◁ **Two unintentional connections**

◁ **High traffic retail spaces in uptown**

◁ **Sewage lines tapped into building roof drainage**

- Proposed code changes to mark roof drainage

MECKLENBURG COUNTY

Ongoing Efforts

◁ **Follow-up investigations for fecal hotspots**
- Continuing in unresolved areas
- Coordinating efforts with Charlotte Water to identify leaks – acoustic testing

◁ **Adding 1 more watershed**

◁ **Trying new approaches**

Subbasins with Ongoing Investigations
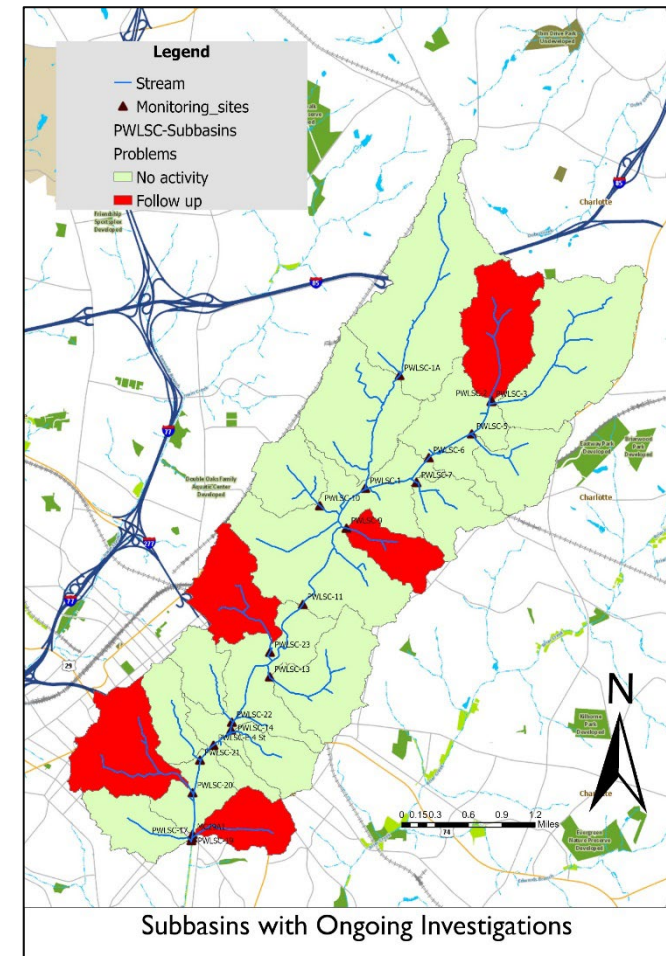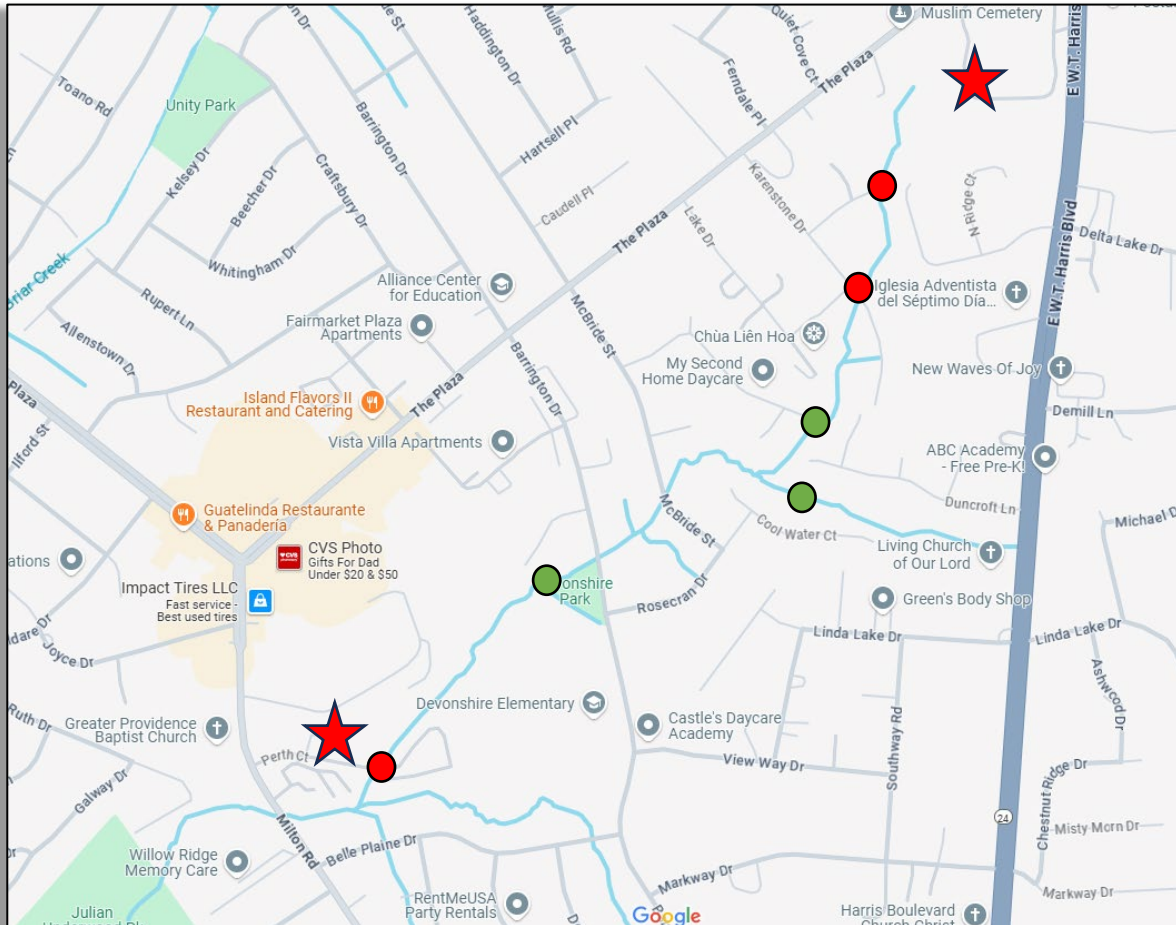
Meet Zelda - SEARCH

Training Methodology:
Sewage Detection

- Initial sample: WWTP influent
- 10-20 drops influent in mason jar on cotton swabs
- Cotton swabs in tins
- Indoor searching
- Outdoor searching
- Positive and Negative controls
- Bottle & Storm Drain searching
- Interferences

# Investigation 1: Perth Ct FINS Site

- Wednesday: IDEP
- Thursday: Additional Samples
- Friday: Finding Sewage
- Results:
  - Apartment complex with sewage leaking directly into creek and under majority of buildings
  - Apartment complex with cracked pipe seeping into detention pond and surrounding area

Investigation 2: Craig Ave
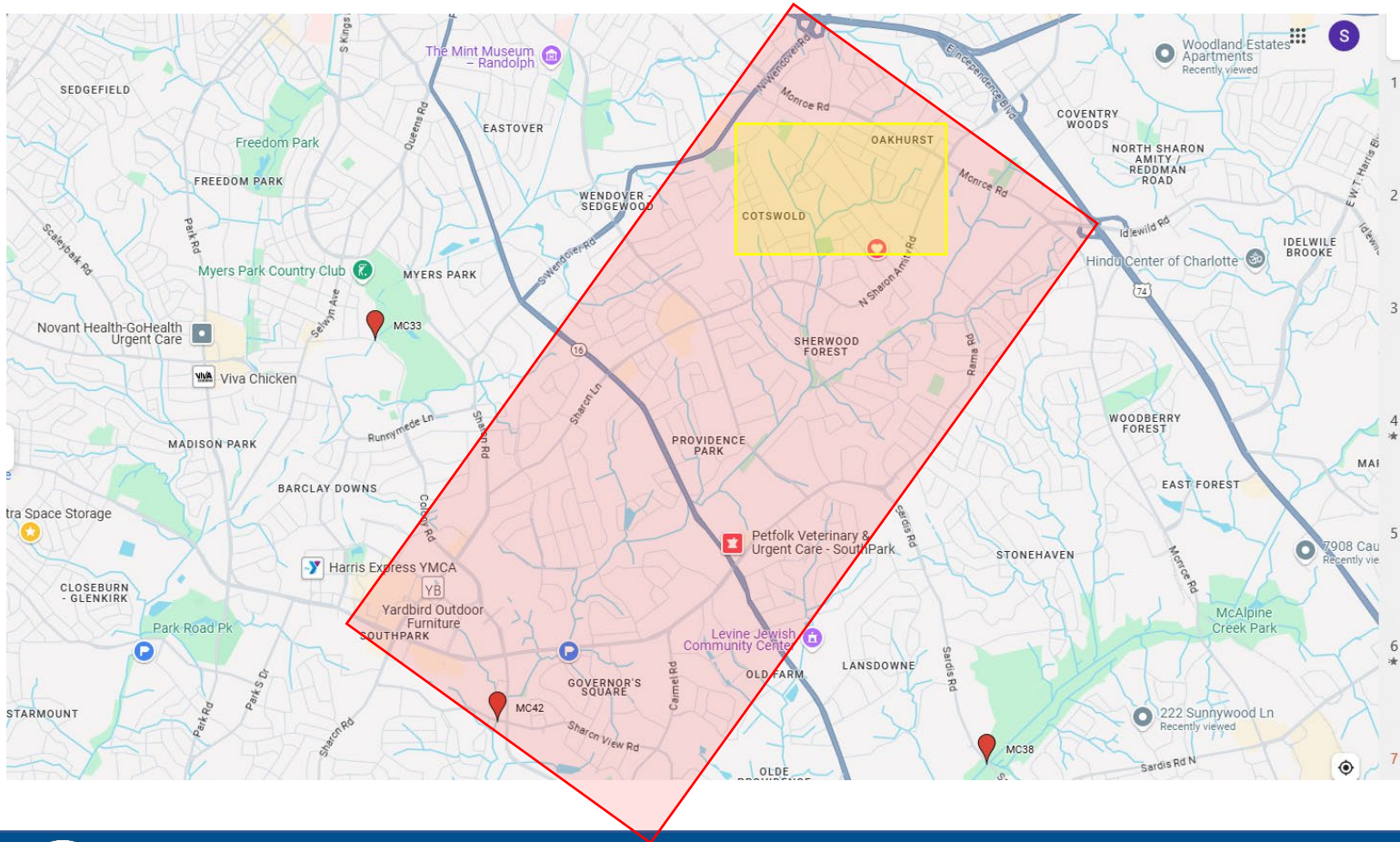
- Small portion of CMANN site MC42 watershed selected
  - MC42 watershed is ranked highly in priority watershed matrix

Investigation 2: Craig Ave
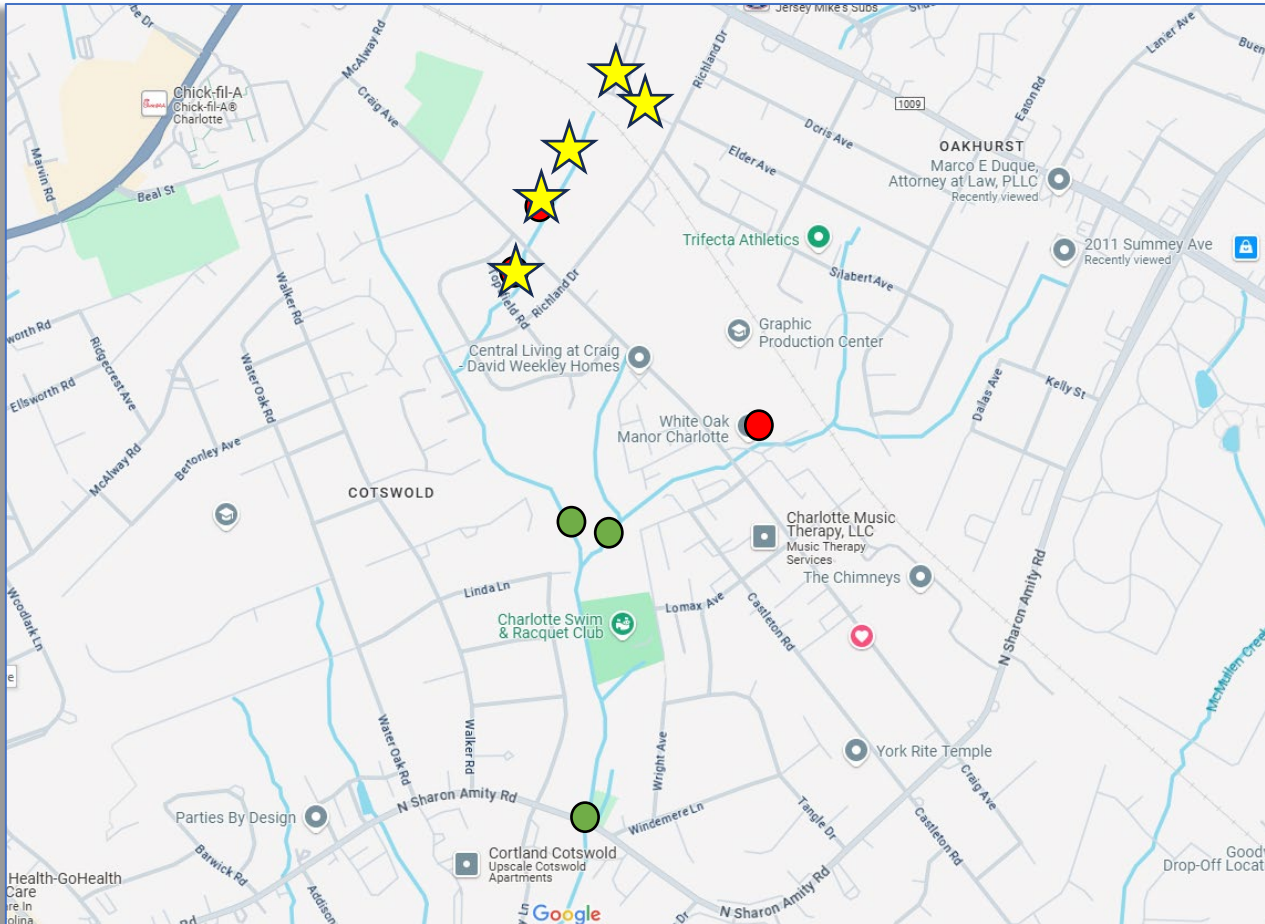
- Collected samples above N. Sharon Amity
- 2 positives around Craig Ave
- Started with branch above Topsfield Rd
- Collected two additional samples, US and DS of bridge
- Round 1 of bacteria samples
- Round 2 of bacteria samples

Investigation 2: Craig Ave

Bacteria samples confirmed leak likely coming from sewage pipe under bridge

Site	Day 1 – Fecal	Day 1 – E. coli	Day 2 – Fecal	Day 2 – E. coli
Craig – Up	3000	1723	600	213
Craig – Down	4106	3200	13800	2187
Mid-Trib	N/A	N/A	440	158

Conclusions & Key Lessons

◁ **Targeted, watershed-based strategies effectively identified and resolved persistent pollution issues**

◁ **Prioritization framework guided the selection of stressed watersheds for focused pollution reduction efforts**

◁ **Enhanced collaboration with Charlotte Water strengthened implementation and outcomes**

◁ **Aging sewer infrastructure poses significant threat to water quality**

◁ **Illicit connections are a problem – proposed code changes to prevent future occurrence**

◁ **There is no one-size-fits-all solution – management of fecal pollution requires watershed-specific strategies**

Acknowledgements

◁ **Charlotte Mecklenburg Storm Water Services**
- Mecklenburg County Staff
- City of Charlotte Staff

◁ **Charlotte Water**
- SSO Response Team
- Laboratory Services