FSA Winter Conference

December 2024

Kissimmee, Florida

Exposing Sewage Pollution with Microbial Source Tracking

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City of Titusville

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Geosyntec Consultants

Background

Fecal Pollution of Waterbodies

- Public Health Risk
  - Infection and Disease
  - Swimmers at Risk
  - Beach Closures
- Ecological Impact
  - Nutrient Loading
  - Water Quality Decline
  - Algae Blooms
  - Fish Kills
  - Seagrass Loss
  - Habitat Loss

Background

Project Location

- Titusville, Florida
- Downtown
- Indian River Lagoon

Background

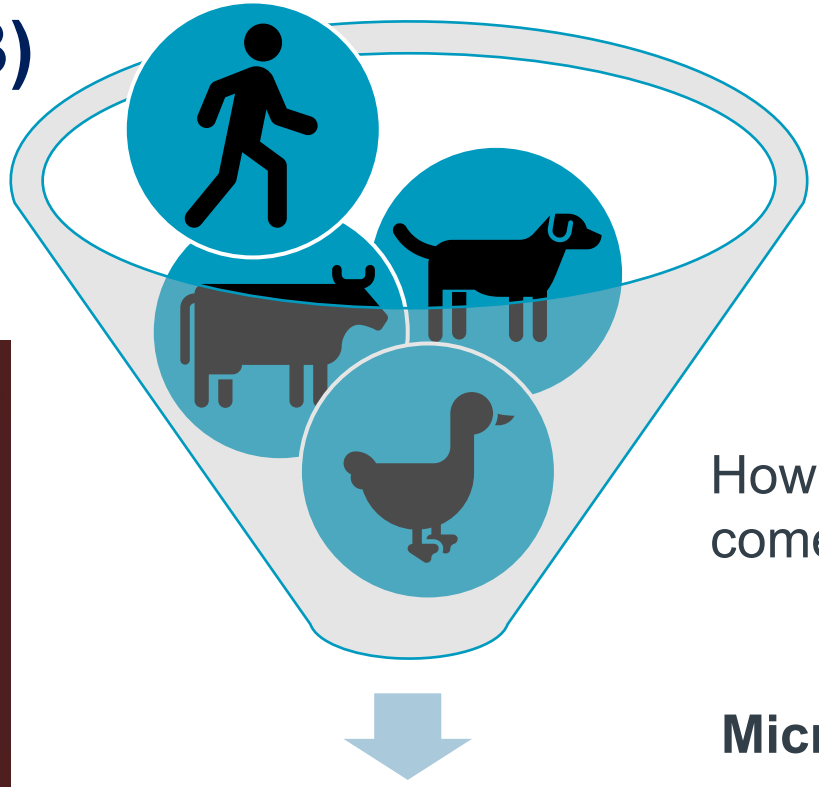
Elevated *E. coli* detected in the Indian River Lagoon.

The City investigates!

Background

Fecal Indicator Bacteria (FIB)

- *Escherichia coli*
- Enterococci



E. coli

E. Coli is present in the human gut

E. Coli is also present in the guts of other warm-blooded animals

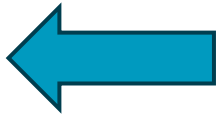
How can I know if *E. coli* comes from a human source?

Microbial Source Tracking!

Background

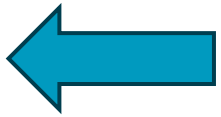
Microbial Source Tracking (MST)

- A suite of methods & investigative strategies used to determine the sources of fecal pollution in environmental waters.
- Biological Tracers
  - HF183 Human Marker
  - DG72 Dog Marker
  - CF128 Cow Marker
  - GFD Bird Marker



Genetic sequences identified using qPCR

- Chemical Tracers
  - Sucralose
  - Caffeine
  - Pharmaceutical drugs



Human ingested chemical compounds

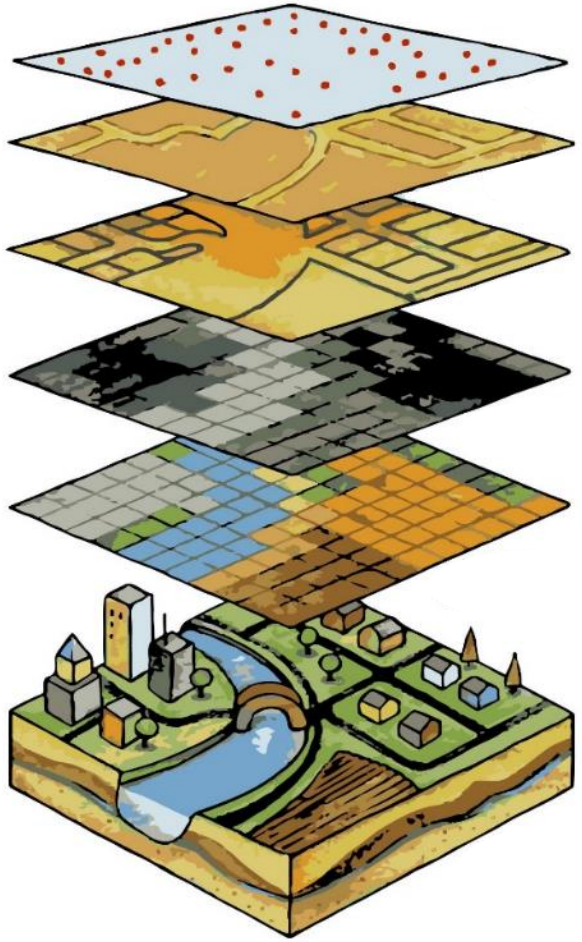
- Stable Nitrogen Isotopes

Project Design

1. Data Collection & Review
2. Field Reconnaissance
3. Sampling Plan
4. Field Sampling
5. Laboratory Analysis
6. Data Analysis
7. Identify Hot Spots
8. Locate Source
9. Fix the Issue

Data Collection & Review

- Historic Water Quality Data
- Stormwater Infrastructure
- Sanitary Sewer Infrastructure
  - Including pipes that have been previously repaired or lined
  - Lift Stations
- Dog Parks
- Public Marinas
- WWTP Outfalls
- Septic Parcels
- Bird Rookeries
- Agricultural Land / Cow Pastures



Data Collection & Review

Relevant Data

- Stormwater Pipes
- Sanitary Pipes – Gravity
- Sanitary Pipes – Pressurized
- Sanitary Laterals
- Stormwater Inlets
- Stormwater Manholes
- Sanitary Manholes

Field Reconnaissance

- Stormwater Outfall
- Upstream Hydraulic Connectivity

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- RVs
- Homeless Camps

Field Reconnaissance

- Stormwater Outfall
- Upstream Hydraulic Connectivity
- RVs
- Homeless Camps
- Wildlife & Pets

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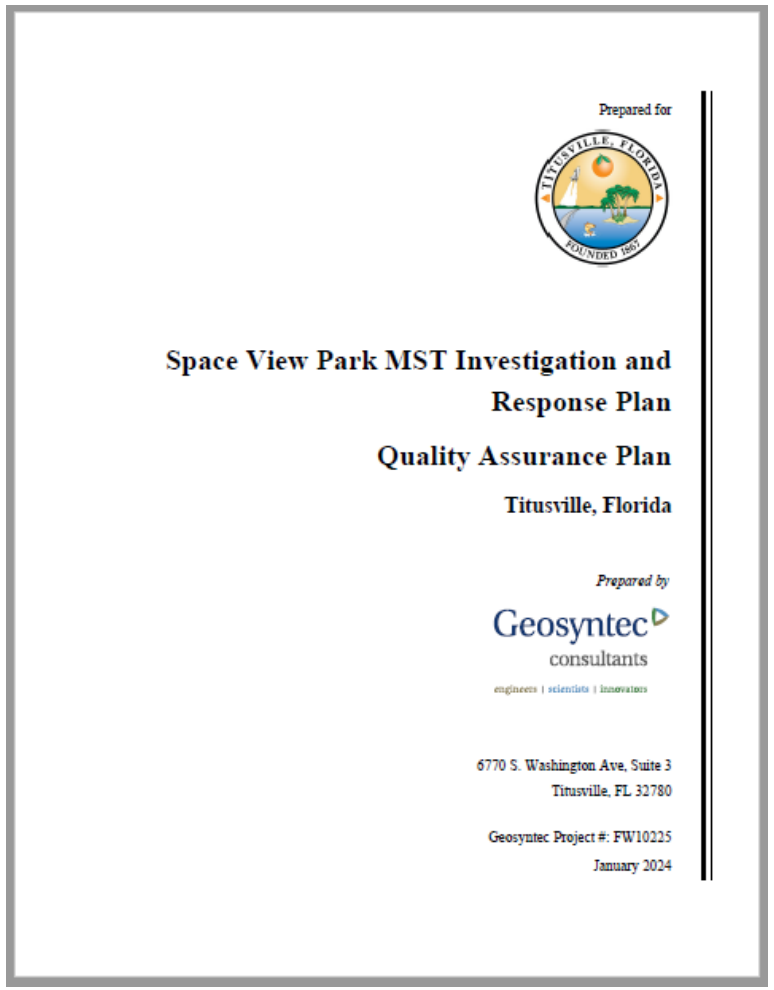
Sampling Plan

Sampling Plan


Prepared for

Space View Park MST Investigation and Response Plan

Quality Assurance Plan

Titusville, Florida

Prepared by

Geosyntec consultants

engineers | scientists | innovators

6770 S. Washington Ave, Suite 3
Titusville, FL 32780

Geosyntec Project #: FW10225

January 2024

- Roles and Responsibilities
- Sampling Locations
  - Flexible, data-driven, forensic approach
  - Adjusted each week based on data from the previous week
- Sampling Methods
- Laboratory Methods
- Quality Control
- Data Processing

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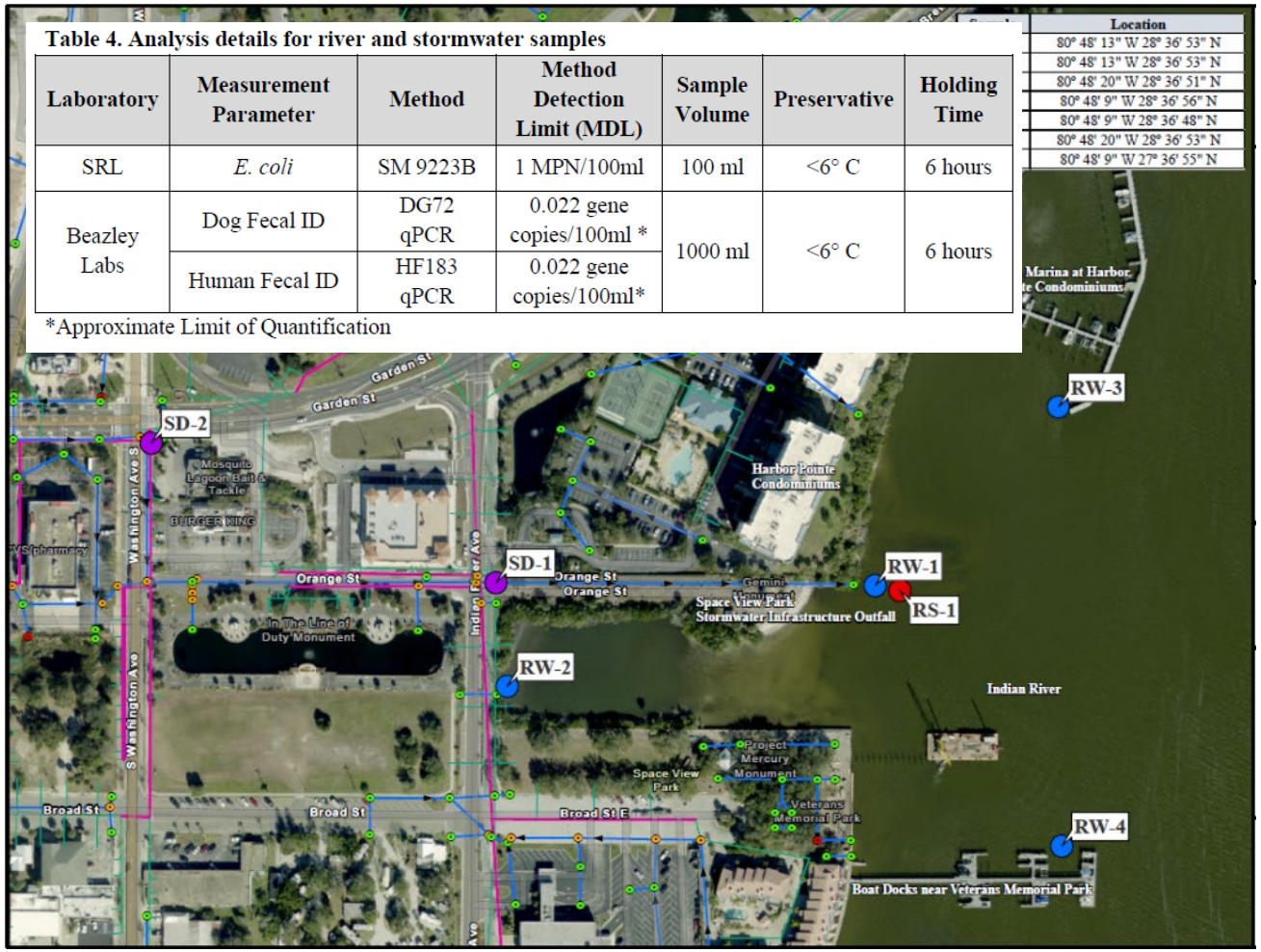
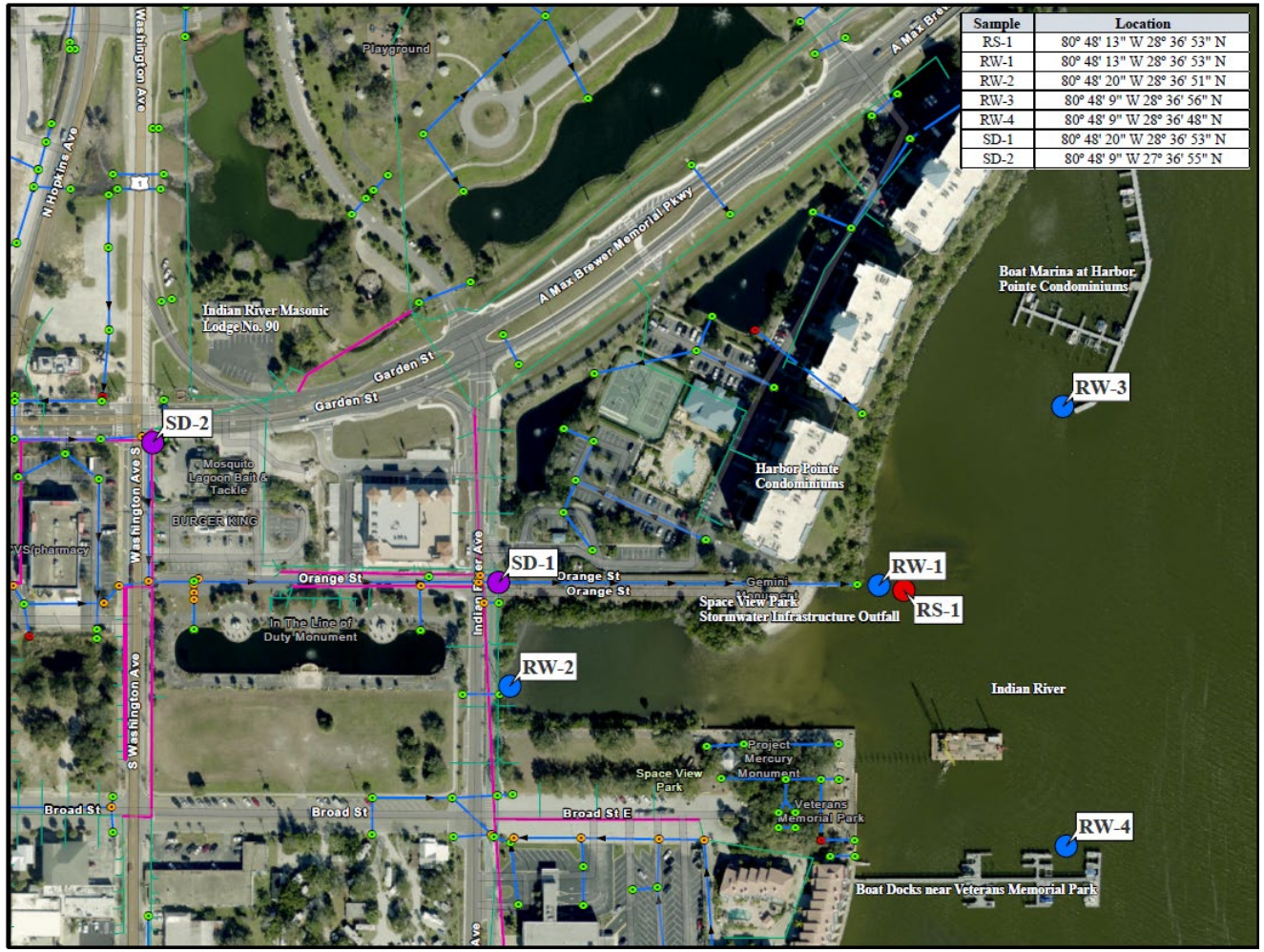
Table 4. Analysis details for river and stormwater samples

Laboratory	Measurement Parameter	Method	Method Detection Limit (MDL)	Sample Volume	Preservative	Holding Time
SRL	*E. coli*	SM 9223B	1 MPN/100ml	100 ml	<6° C	6 hours
Beazley Labs	Dog Fecal ID	DG72 qPCR	0.022 gene copies/100ml *	1000 ml	<6° C	6 hours
	Human Fecal ID	HF183 qPCR	0.022 gene copies/100ml*			

*Approximate Limit of Quantification



Field Sampling



Sample	Location
RS-1	80° 48' 13" W 28° 36' 53" N
RW-1	80° 48' 13" W 28° 36' 53" N
RW-2	80° 48' 20" W 28° 36' 51" N
RW-3	80° 48' 9" W 28° 36' 56" N
RW-4	80° 48' 9" W 28° 36' 48" N
SD-1	80° 48' 20" W 28° 36' 53" N
SD-2	80° 48' 9" W 27° 36' 55" N

Laboratory Analysis

Southern Research Laboratories

- *E. coli*

University of Central Florida

- HF183 Human Fecal Marker
- DG72 Dog Fecal Marker

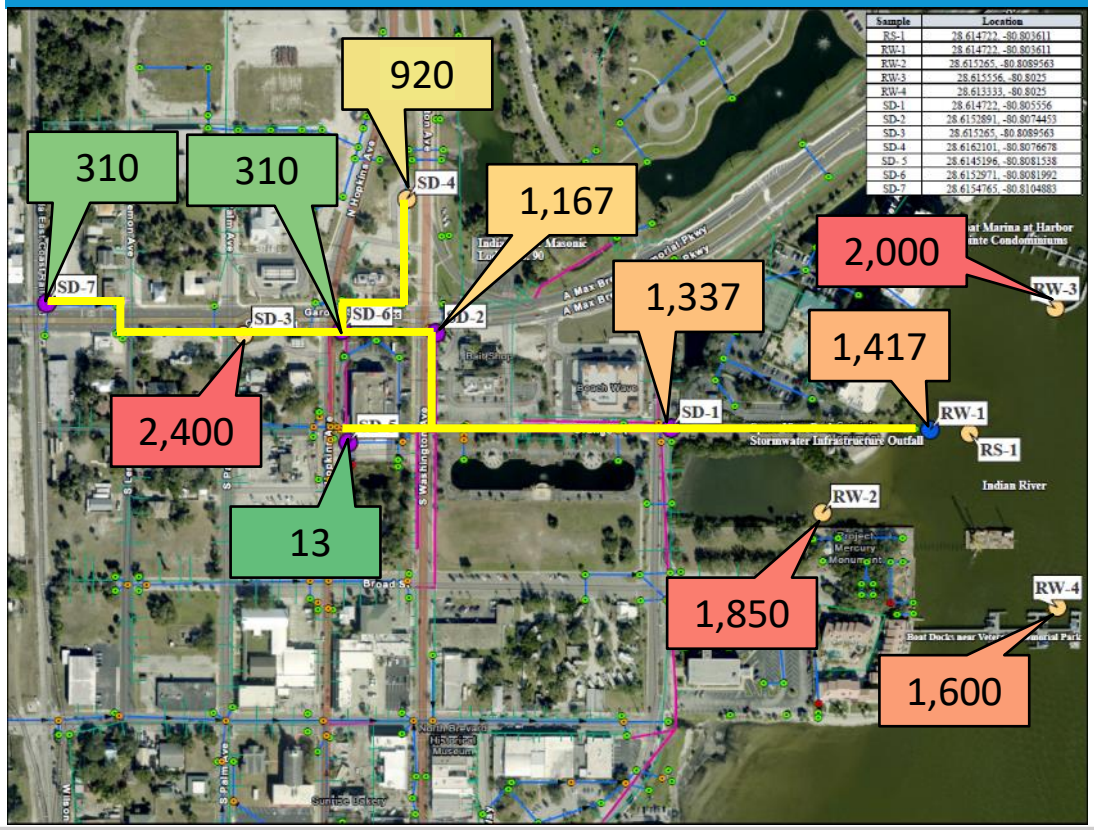
Rapid laboratory turnaround times (< 3 days)

Costs extra but worth it!

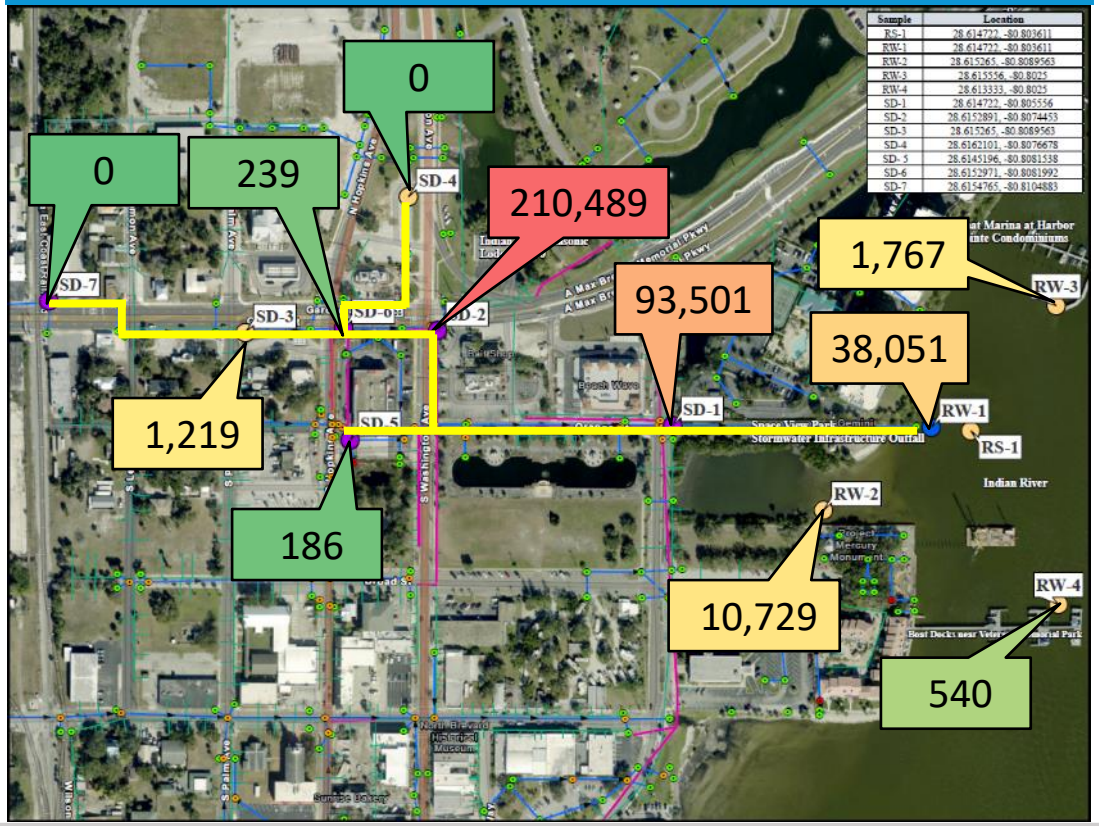
Allows for weekly sampling locations to be adjusted based on the data

Data Analysis & Identifying Hot Spots

E. coli



HF183 Human Fecal Marker



Why do the data not match?

Data Analysis & Identifying Hot Spots

E. coli	HF183 (*Bacteroides spp.*)
• Intestinal bacteria of warm-blooded animals	• Intestinal bacteria of humans
• Facultative Anaerobe	• Obligate Anaerobe
• Can survive in the natural environment	• Cannot survive in the natural environment

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Locating the Source

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Smoke Testing

- Smoke escapes through cracks in pipes and is visually detected
- Detects leaks **above** the water line

Dye Testing

- Bright dye escapes throughs cracks in pipes and is detected visually or with sensor.
- Detects leaks **below** the water line

Visual Inspection (CCTV)

- Uses a remote camera to see inside pipes
- Visually detect large cracks and holes

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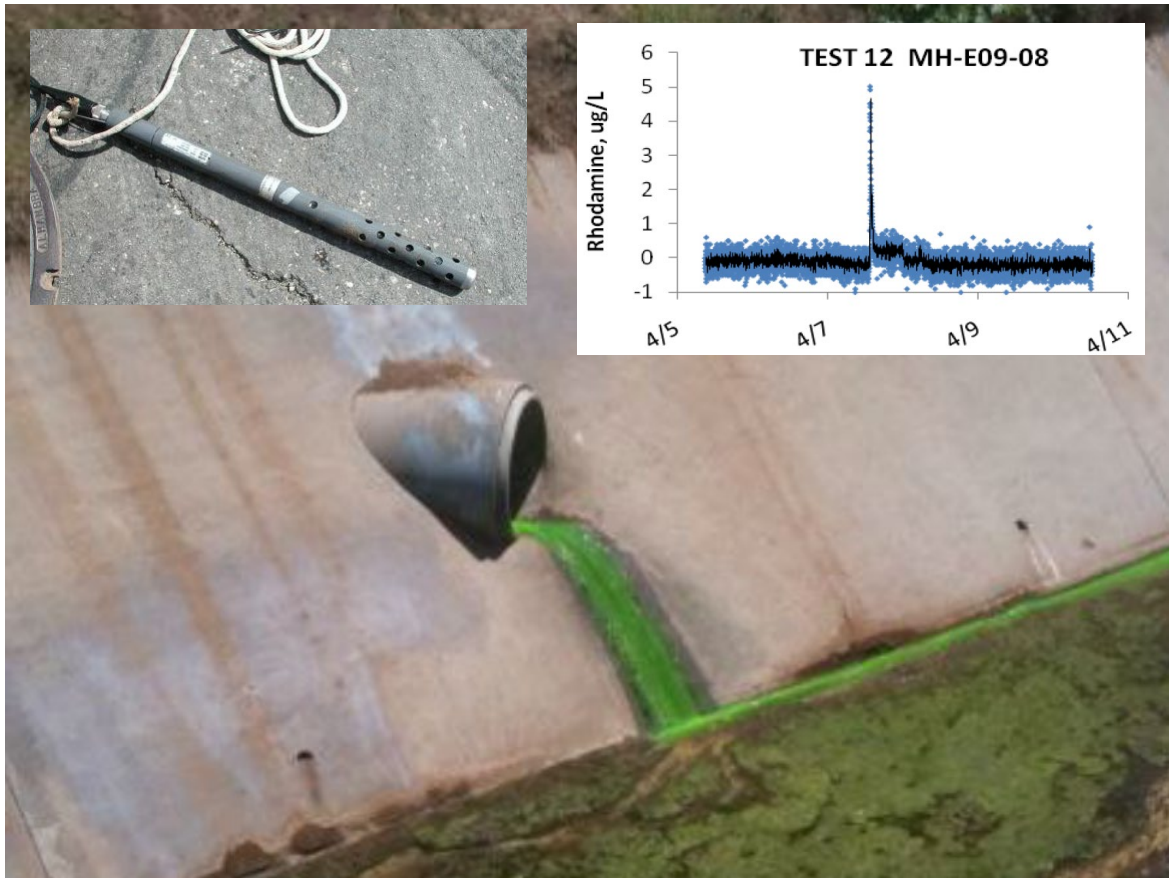

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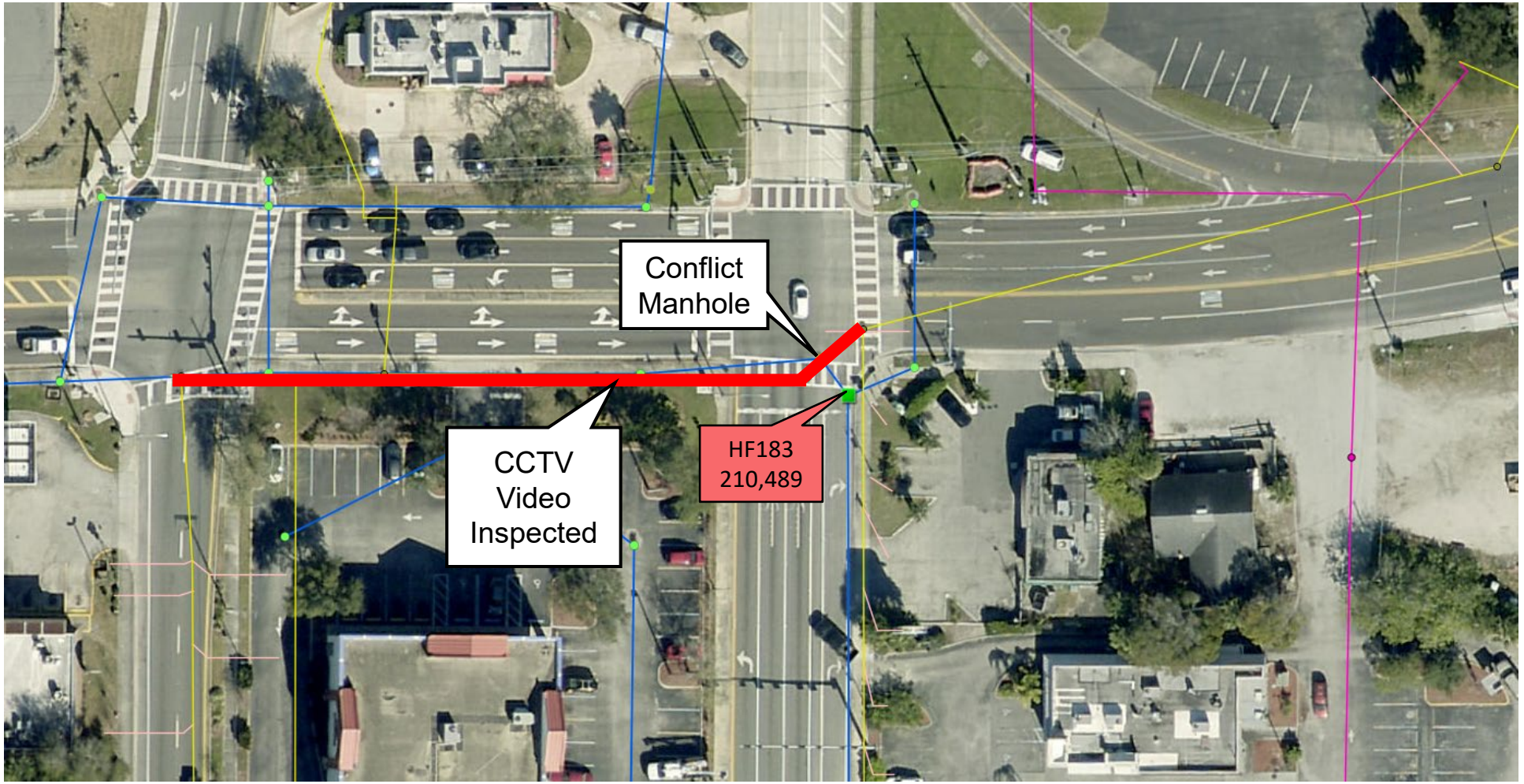
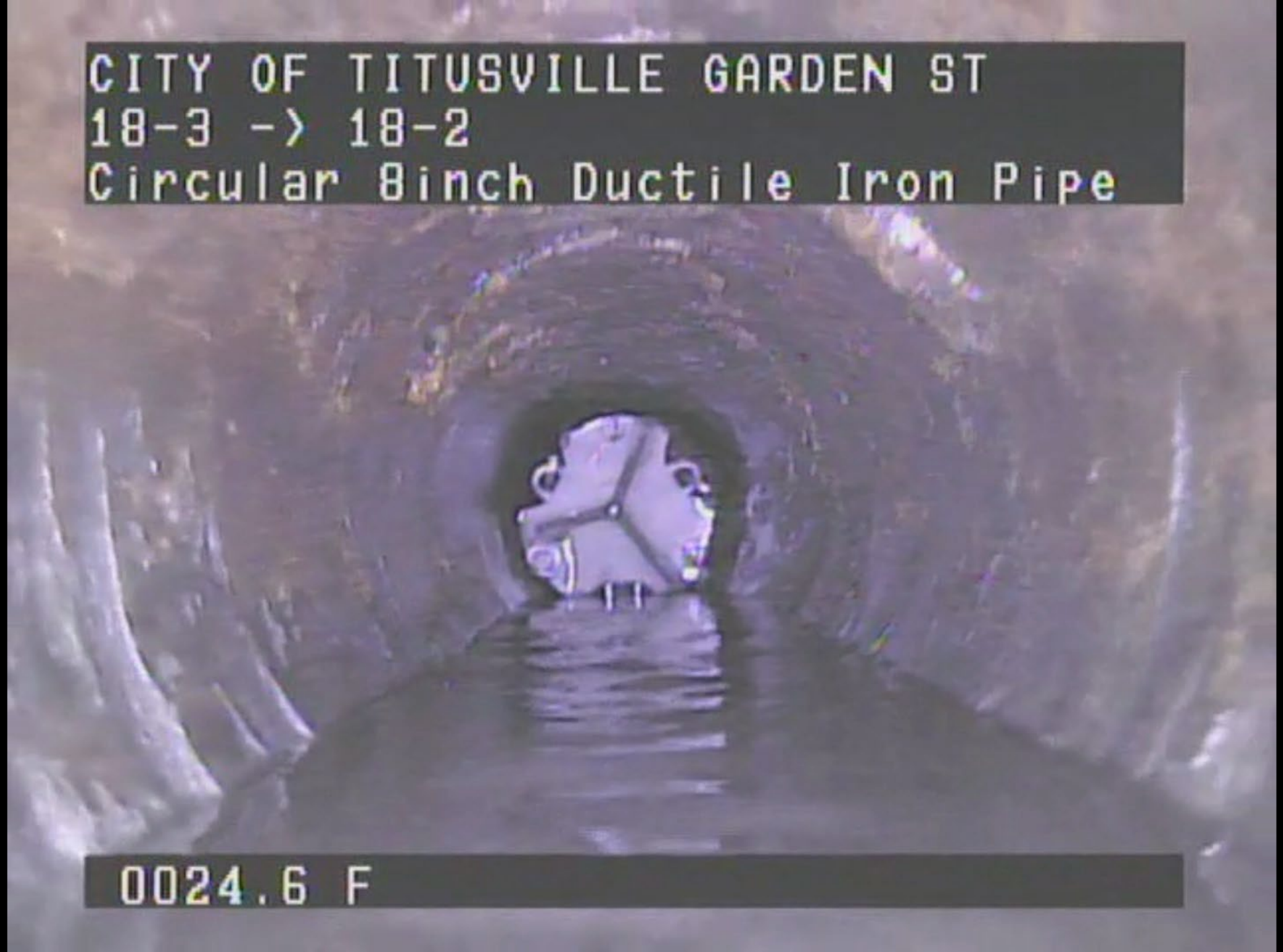
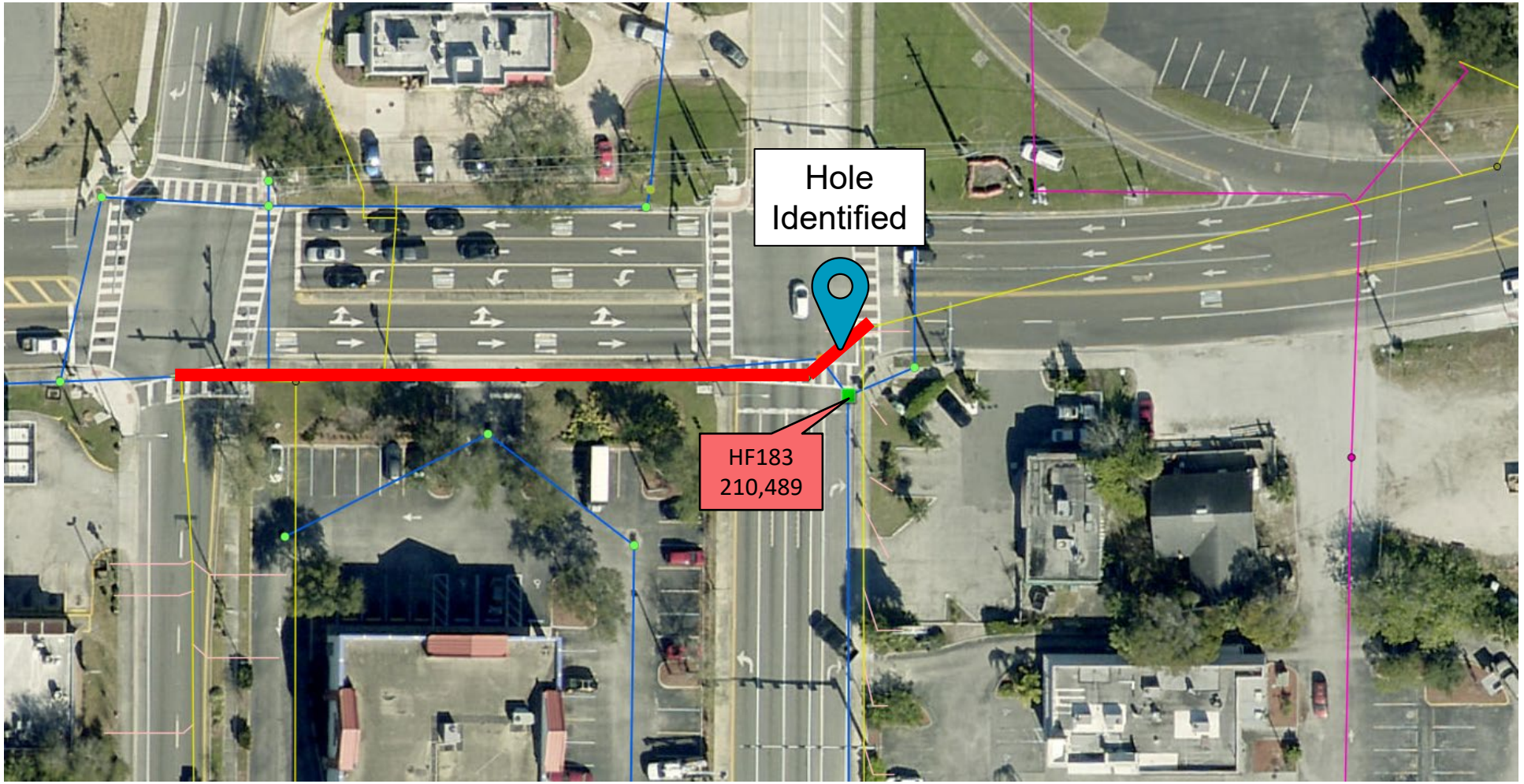



CITY OF TITUSVILLE GARDEN ST
18-3 -> 18-2
Circular 8inch Ductile Iron Pipe
0024.6 F

Locating the Source



Fixing the Issue

Pipe Lining

- Repair existing damaged pipe by epoxy lining the inside to create a new surface.
- Trenchless with minimal excavation
- Best if damage is minimal (small isolated leak)

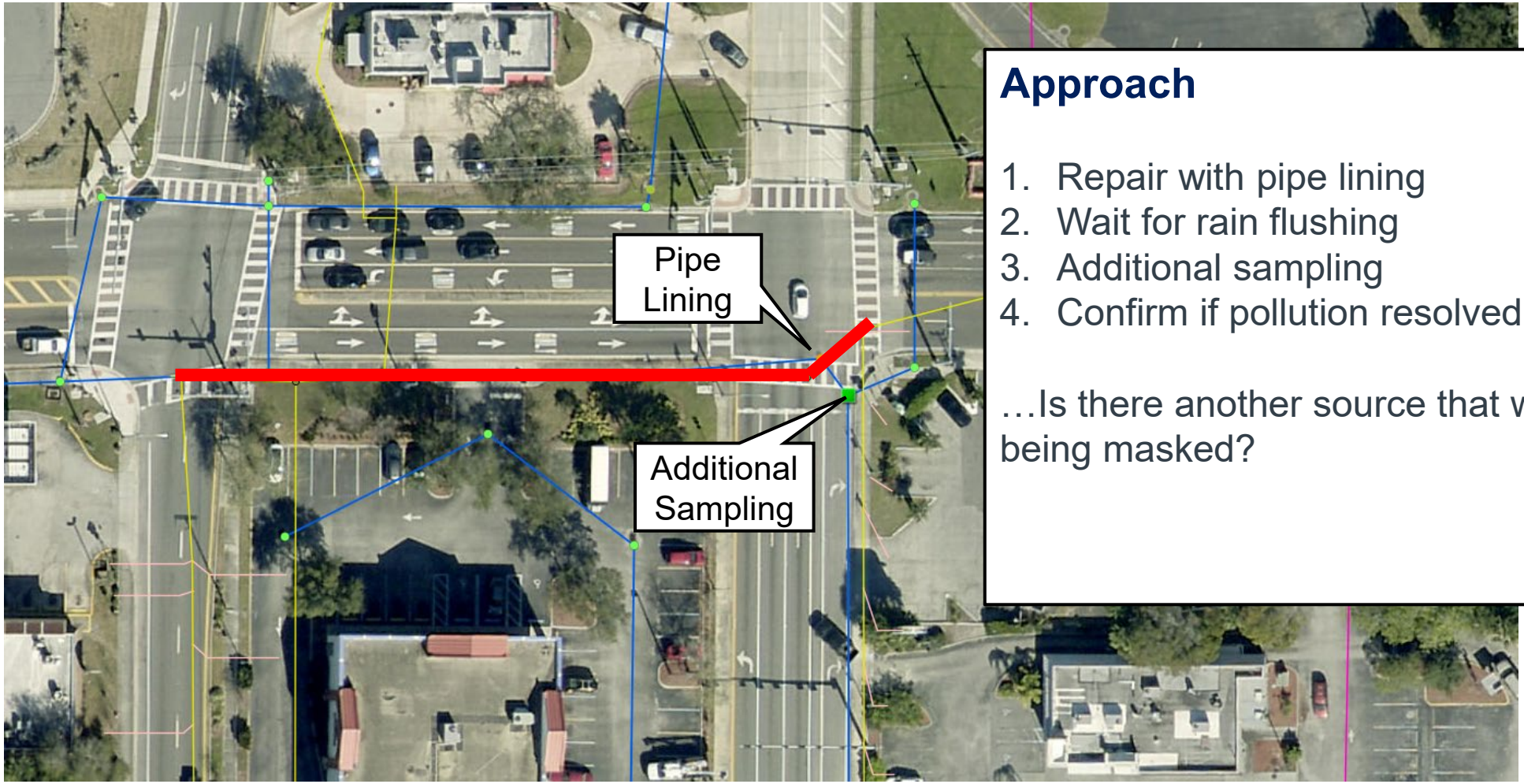
Pipe Bursting & Replacement

- New pipe is pulled through the damaged pipe
- Trenchless with minimal excavation. More invasive than pipe lining.
- Best if damage is moderate (many leaks with some large holes)

Trenched Repair & Replacement

- Dig up and replace damaged pipe
- Best if the damaged section is only a few feet in length and not in a busy road.
- Necessary if pipe is severely damaged (collapsed or back-pitched)

Fixing the Issue



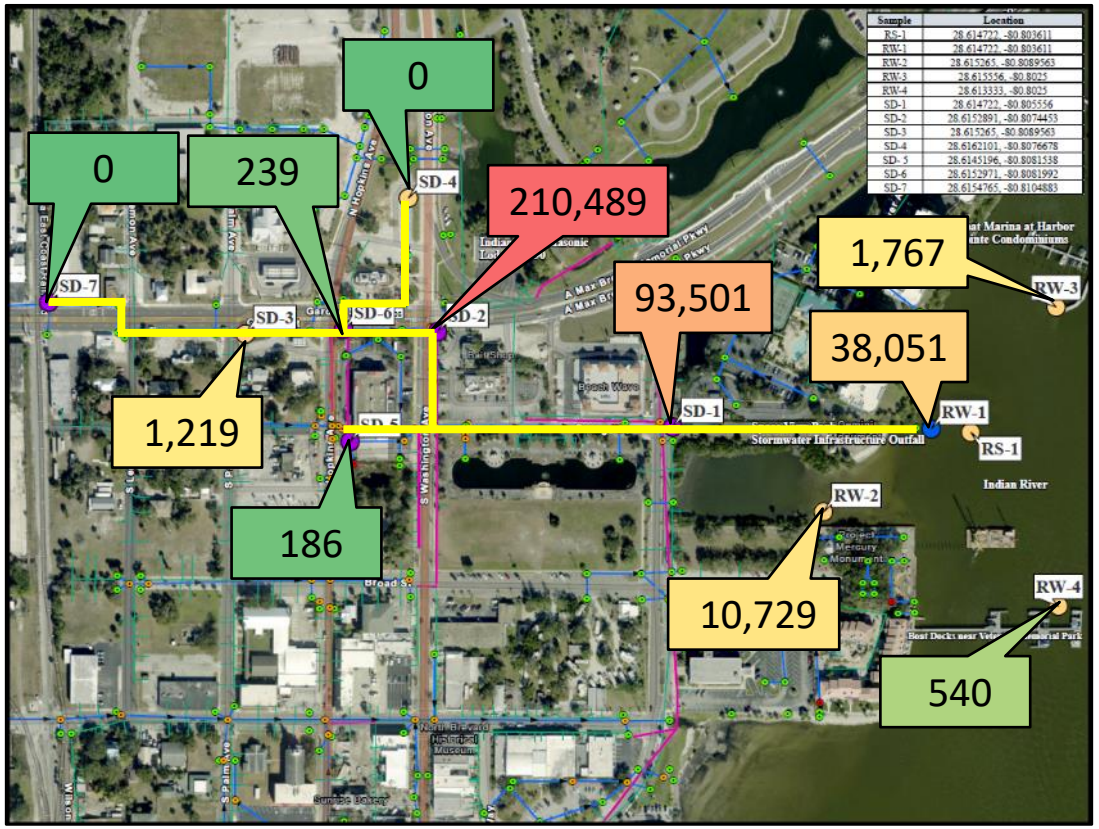
Approach

1. Repair with pipe lining
2. Wait for rain flushing
3. Additional sampling
4. Confirm if pollution resolved

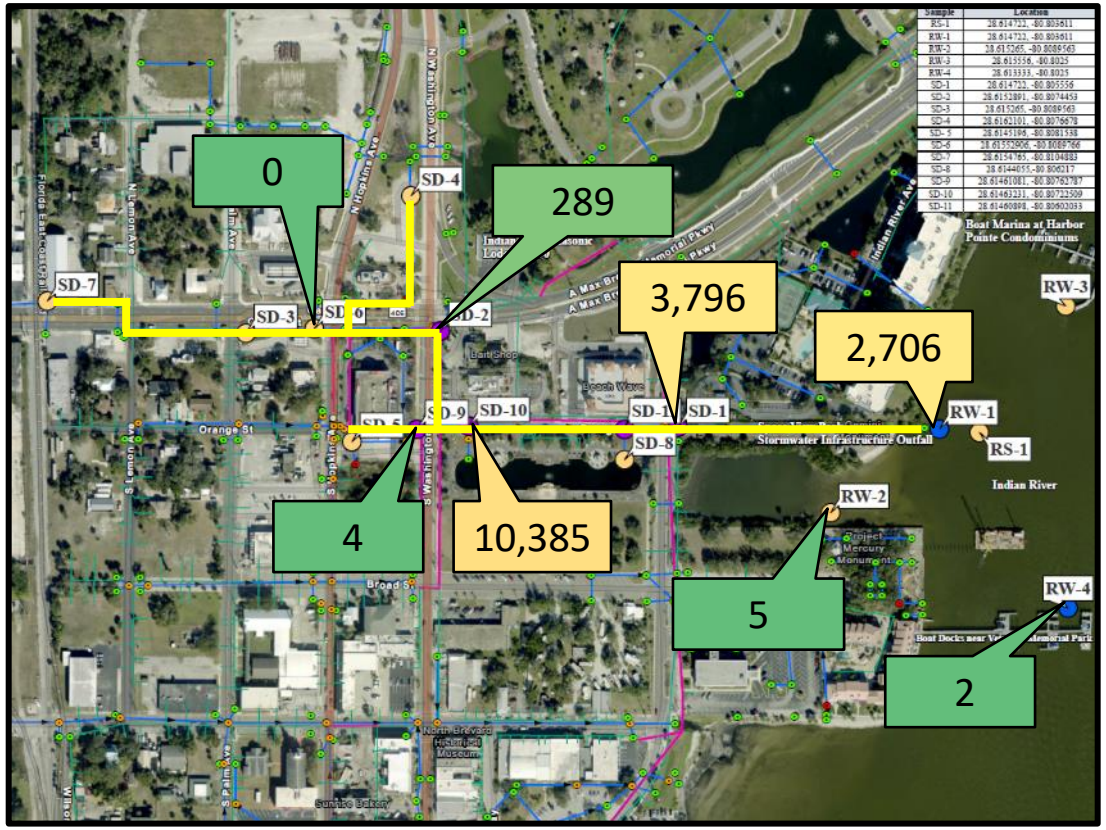
…Is there another source that was being masked?

Fixing the Issue

Before Pipe Repair



After Pipe Repair



With Gratitude…

City of Titusville
- Sandy Reller
- Kevin Cook

Geosyntec Consultants
- Karli Mahoney
- Mike Hardin
- Mark Ellard
- Jacob Kent
- Lexie Foos

Southern Research Laboratories
- Sherri Payne

University of Central Florida
- Melanie Beazley

Questions?

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