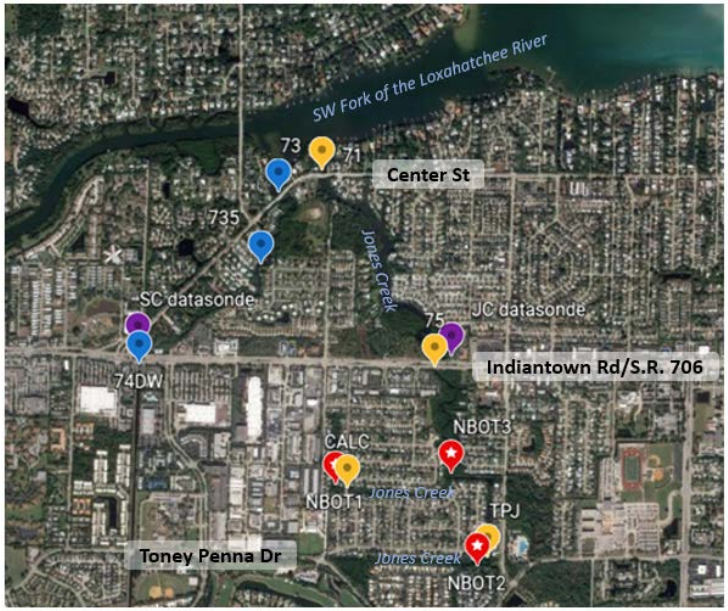
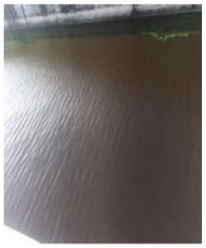
Nano Bubble Ozone Technology Project in Jones Creek



Map of Jones and Sims Creek monitoring sites, Jupiter, Florida. Loxahatchee River District (LRD) sample locations in Sims Creek in blue (74DW, 735 and 73) and Jones Creek in yellow (CALC, TPJ, 75 and 71). Red stars depict proposed NBOT deployment locations, purple points show continuous datasonde locations.

Pre-Treatment – Aug 14 @ 5pm

Post-Treatment 12 08/15 7:00am



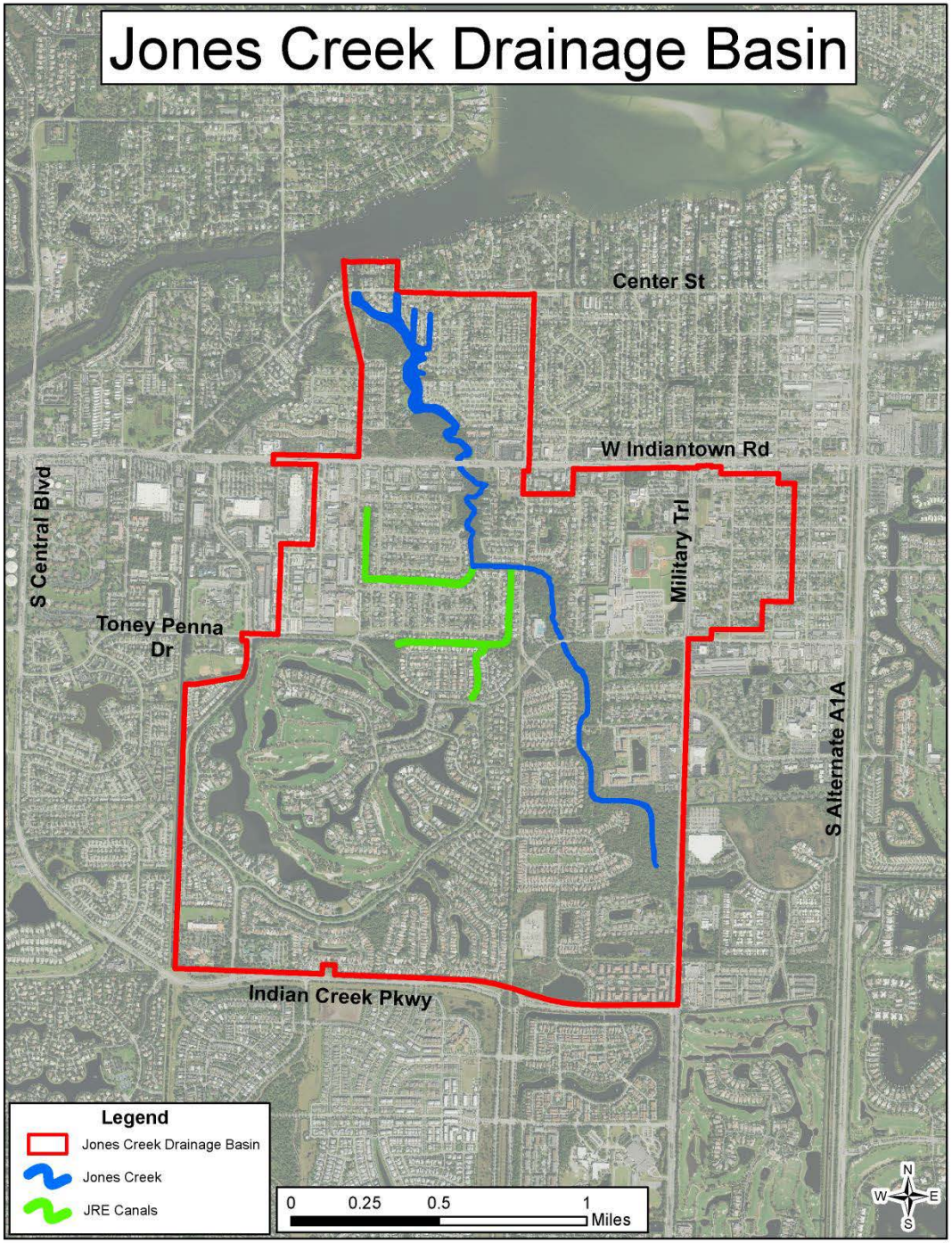
Post-Treatment – Aug 19 10am

Overview

- Introductions
- Background – Water Quality Issues
- Nano Bubble Ozone Treatment (NBOT) Project
- What To Expect
- Schedule
- Questions & Answers

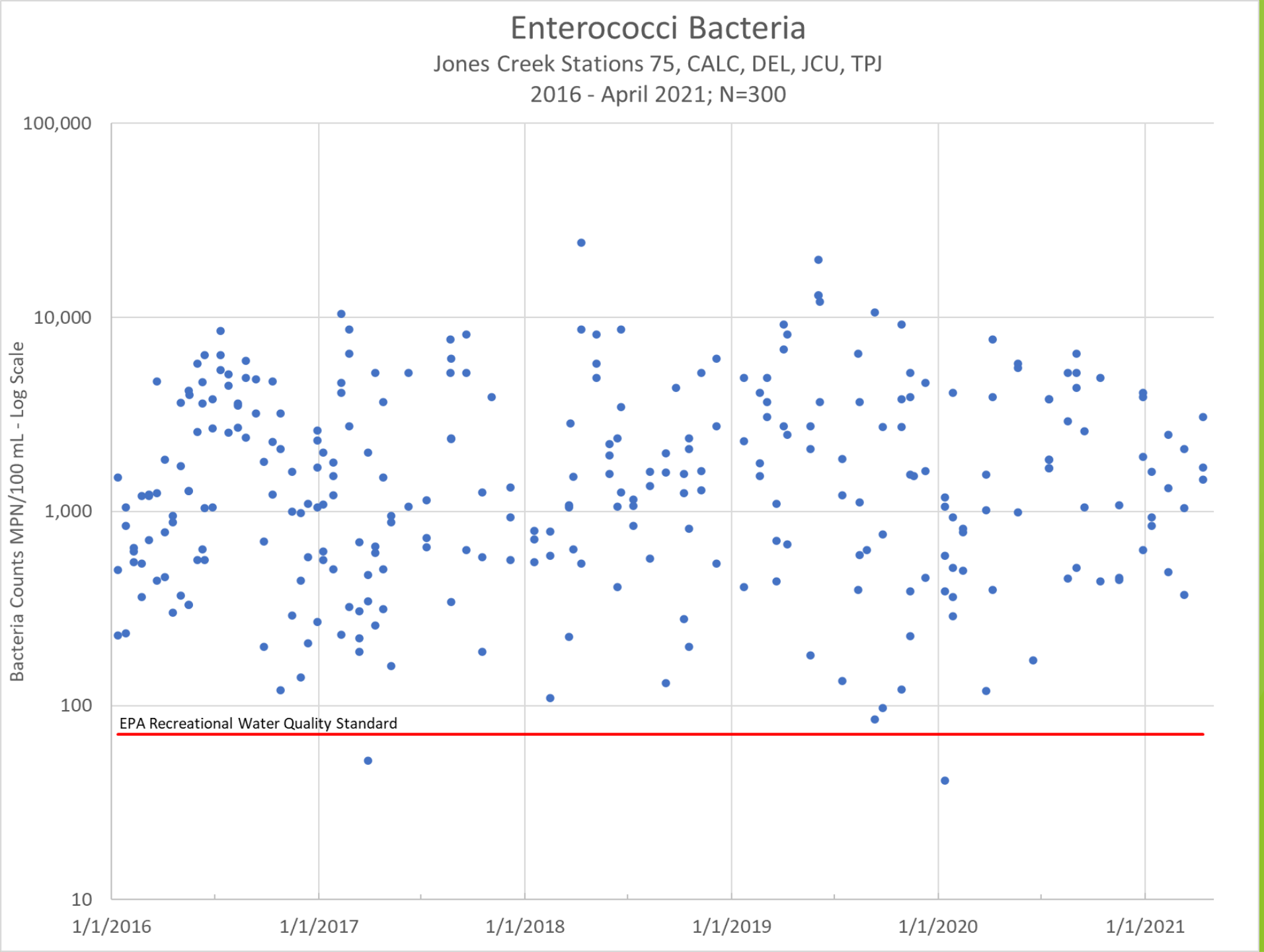
Introductions

- Loxahatchee River District
  - Project and Contract Manager
    - Bud Howard, Division Director
  - WildPine Laboratory
    - Sue Noel, Lab Manager
    - Rachel Harris, Ph.D., Sr. Scientist
- Green Water Solutions – NBOT System
  - Chas Antinone, President
  - Peter Moeller, Ph.D., NOAA
- Town of Jupiter
  - Rebecca Wilder & Staff
- Residents – Special thanks to the 3 property owners for equipment deployment locations


Jones Creek Drainage Basin
Center St
W Indiantown Rd
S Central Blvd
Military Trl
Toney Penna Dr
S Alternate A1A
Indian Creek Pkwy
Legend
Jones Creek Drainage Basin
Jones Creek
JRE Canals
0
0.25
0.5
1
Miles
N
W
E
S

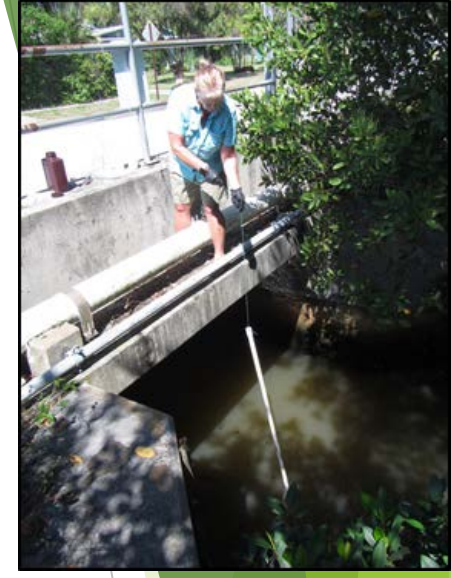
Condensed Background

- Historically Poor Water Quality
- 1997 – LRD Septic to Sewer Conversion
- 2003 – TOJ and LRPI Muck Dredging & Exotic Removal
- 2009 – TOJ and LRPI Swale Reconstruction
- Expanded Water Quality Monitoring 2016-2019
  - Chronically High Bacteria & Turbidity
- 2017 LRD Sewer Overflow & Signage mandated by DOH
  - Jupiter River Estates Residents concerned & organize
- 2019 & 2020 – LRD & FDEP Molecular Bacteria Study
- 2020 – LRD, Green Water Solutions & partners seek DEP Innovative Technology Grant; awarded January 26, 2021


Enterococci Bacteria
Jones Creek Stations 75, CALC, DEL, JCU, TPJ
2016 - April 2021; N=300
Bacteria Counts MPN/100 mL - Log Scale
100,000
10,000
1,000
100
10
EPA Recreational Water Quality Standard
1/1/2016
1/1/2017
1/1/2018
1/1/2019
1/1/2020
1/1/2021

Monitoring Findings To Date

- Thoroughly evaluated all tributaries
- No “smoking gun”
- Bacteria experts – decaying vegetation likely a major factor
- Turbidity events – still a mystery; biochemical process?
- 2019/2020 FDEP Molecular Analysis
  - Live cells of human sewage
  - Small volume & small population
  - Not present in 2014
  - LRD conducting TV inspections
- Combination of Factors:
  - Limited flushing of waterway
  - Decaying vegetation
  - Sewage
  - Behavior - Dog waste, carcasses, grass clippings
  - Reduced sunlight/UV treatment
  - Possibly Others



Water Quality Improvement Opportunities

- NBOT Project – Short Term ***Experiment***
- Find and resolve low volume sewage source - LRD
- Vegetation Trimming - Town of Jupiter & Residents
  - Provide access for cleanup projects
  - Reduce loading of vegetation
  - Increase sunlight and UV water treatment
- Cleanup projects to remove decaying vegetation
  - Residents, school groups, scouts, etc.
  - Grant for waders, long gloves, etc.

Nano Bubble Ozone Technology (NBOT) Project

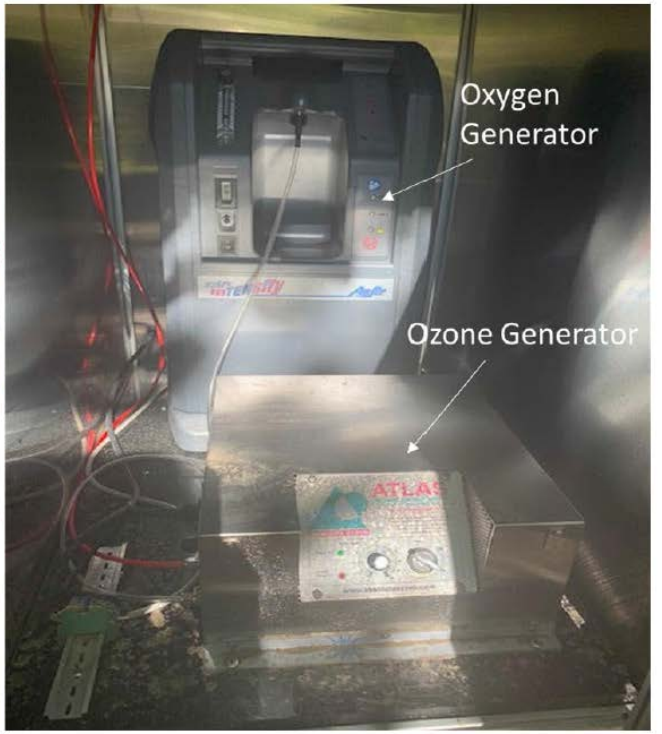
- Research Opportunity
  - Evaluate this Innovative Technology
  - Highly effective in treating freshwater systems – Ohio, Port Mayaka
  - How effective is this treatment in a highly impaired, tidal, brackish-water system?
  - How long does treatment last?
  - 60-day commitment of treatment equipment

- FDEP Water Quality Improvement Grant - Innovative Technologies - $350,000
  - Local Government Sponsor - LRD
  - Green Water Solutions, Dr. Peter Moeller - NOAA, Town of Jupiter
  - Residents are engaged and supportive

- Heavy Emphasis on the Science
  - Collaboration with Dr. Moeller; TOJ Assistance
  - Rich Dataset; Publication in peer-reviewed scientific journal

NBOT System


Pressure Tank
Pressure gauge
Pump and Motor


Oxygen Generator
Ozone Generator

Nano Bubble Ozone Technology

- Ozone (O_3)
  - Powerful oxidant
  - Used for decades in drinking and wastewater treatment
  - Used to treat water in fish farms and hatcheries

- Nano Bubble
  - Newer innovation
  - Higher surface area for gas exchange
  - Low buoyancy, longer bubble lifetime

- Combined
  - Ozone persists for a longer period of time, more slowly diffuse
  - Increase the production of hydroxyl radicals (OH)
  - Increased reaction times with contaminants (ex. bacteria)

- Treatment
  - Hydroxyl radicals attack essential cell components
  - Lethal to pathogenic viruses and bacteria
  - Humans, animals and plants have evolved to coexist
    - Don’t enter blood stream or tissues

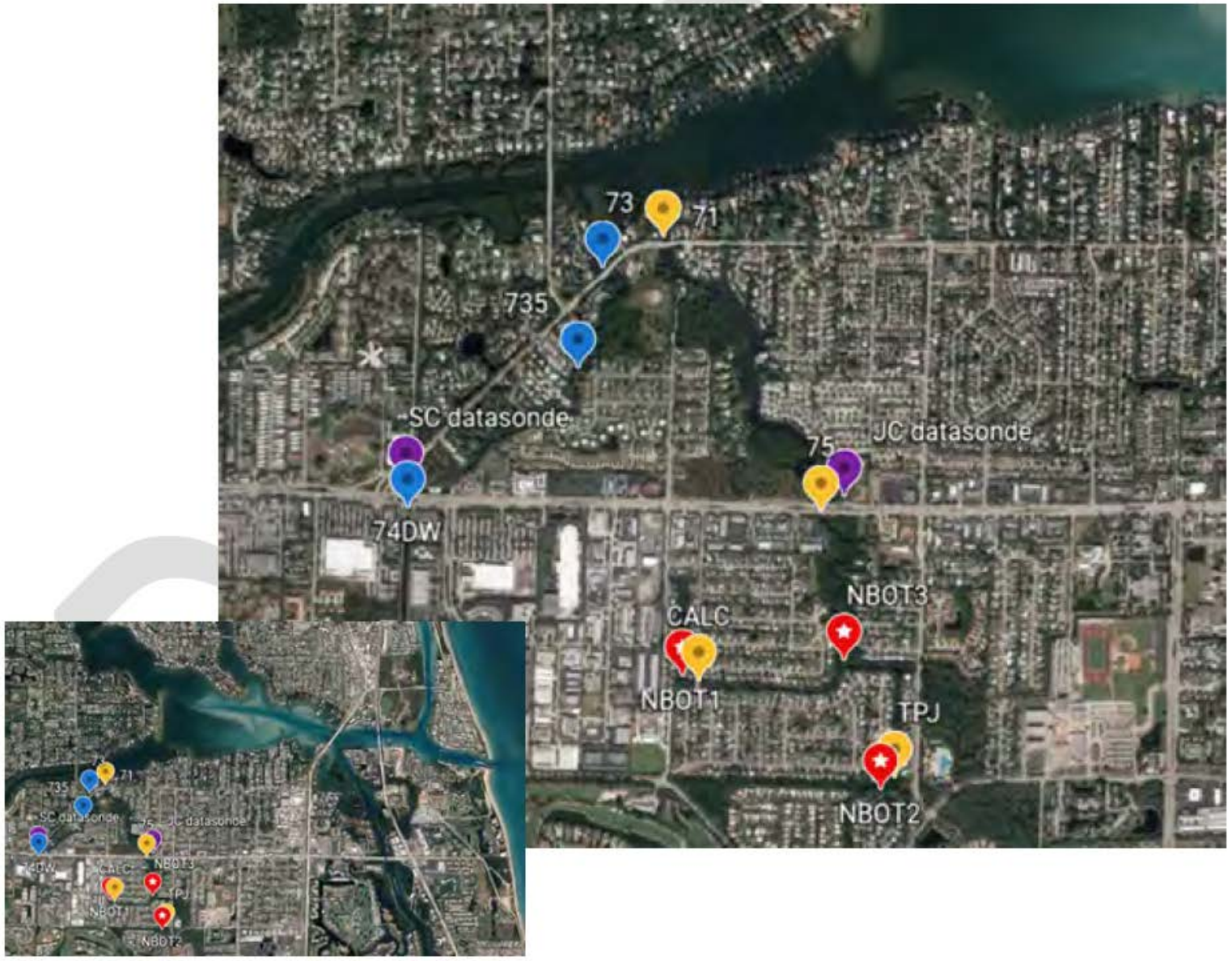
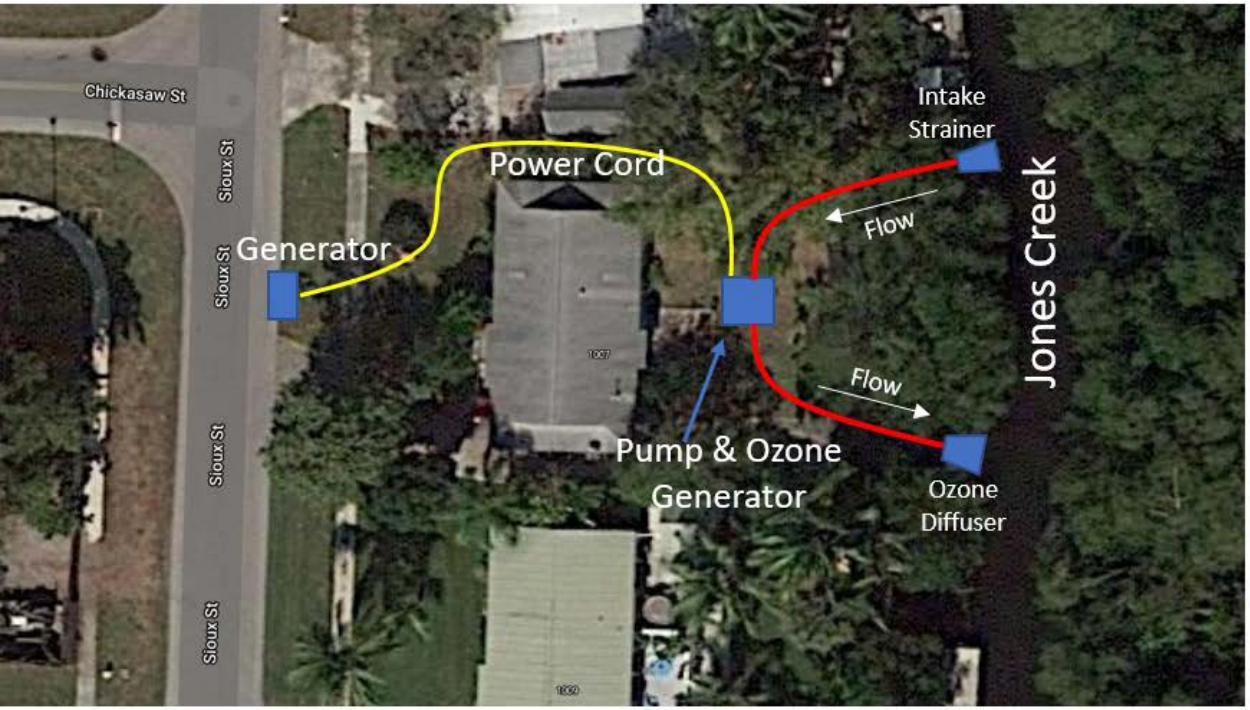


Figure 1. Map of Jones and Sims Creek monitoring sites, Jupiter, Florida. Loxahatchee River District (LRD) sample locations in Sims Creek in blue (74DW, 735 and 73) and Jones Creek in yellow (CALC, TPJ, 75 and 71). Red stars depict proposed NBOT deployment locations, purple points show continuous datasonde locations; site coordinates provided in Table 1.

Appendix A.1 List of Analytes with associated cost per sample in WATER

			Sample Count	Sample Cost ($)		Total Cost ($)	
Group	Analyte	Method	Total	LRD	Contract Lab	LRD	Contract Lab
Fecal Indicator Bacteria	Enterococci	Enterolert / Quanti-Tray	112	18		2,016	0
Wet Chemistry - Water	Ammonia-N (un-ionized NH3)	DEP SOP 10/3/83	42		8	0	336
	Bromate	300.1	42		35	0	1,470
	Color	SM2120B	42	0		0	0
	Chlorophyll a (corr. & uncorr.)	SM10200H	42	25		1,050	0
	Total Kjeldahl Nitrogen	351.2	42		15	0	630
	Nitrate (as N)	353.2	42		7	0	294
	Nitrite (as N)	353.2	42		7	0	294
	Total Nitrogen	Calculation	42			0	0
	Total Phosphorus (as P)	365.4	42		15	0	630
	Orthophosphate	365.1	42		25	0	1,050
	Total Organic Carbon	SN5310B	42		12	0	504
	Total Suspended Solids (TSS)	SM2540D	42		15	0	630
	Turbidity	180.1	42	0		0	0
Metals - Water	Aluminum	200.7	42		4	0	168
	Antimony	200.8	42		4	0	168
	Arsenic	200.8	42		4	0	168
	Barium	200.7	42		4	0	168
	Beryllium	200.7	42		4	0	168
	Boron	200.7	42		4	0	168
	Cadmium	200.7	42		4	0	168
	Calcium	200.7	42		4	0	168
	Chromium	200.7	42		4	0	168
	Cobalt	200.7	42		4	0	168
	Copper	200.7	42		4	0	168
	Iron	200.7	42		4	0	168
	Lead	200.8	42		4	0	168
	Magnesium	200.7	42		4	0	168
	Manganese	200.7	42		4	0	168
	Molybdenum	200.7	42		4	0	168
	Nickel	200.7	42		4	0	168
	Potassium	200.7	42		4	0	168

Typical Schematic & Deployment Locations



Planned Deployment Locations:

1. 1007 Sioux St, Jupiter, FL 33458
2. 990 Mohican Blvd, Jupiter, FL 33458
3. 602 S. Caloosahatchee Ave, Jupiter, FL 33458

What To Expect

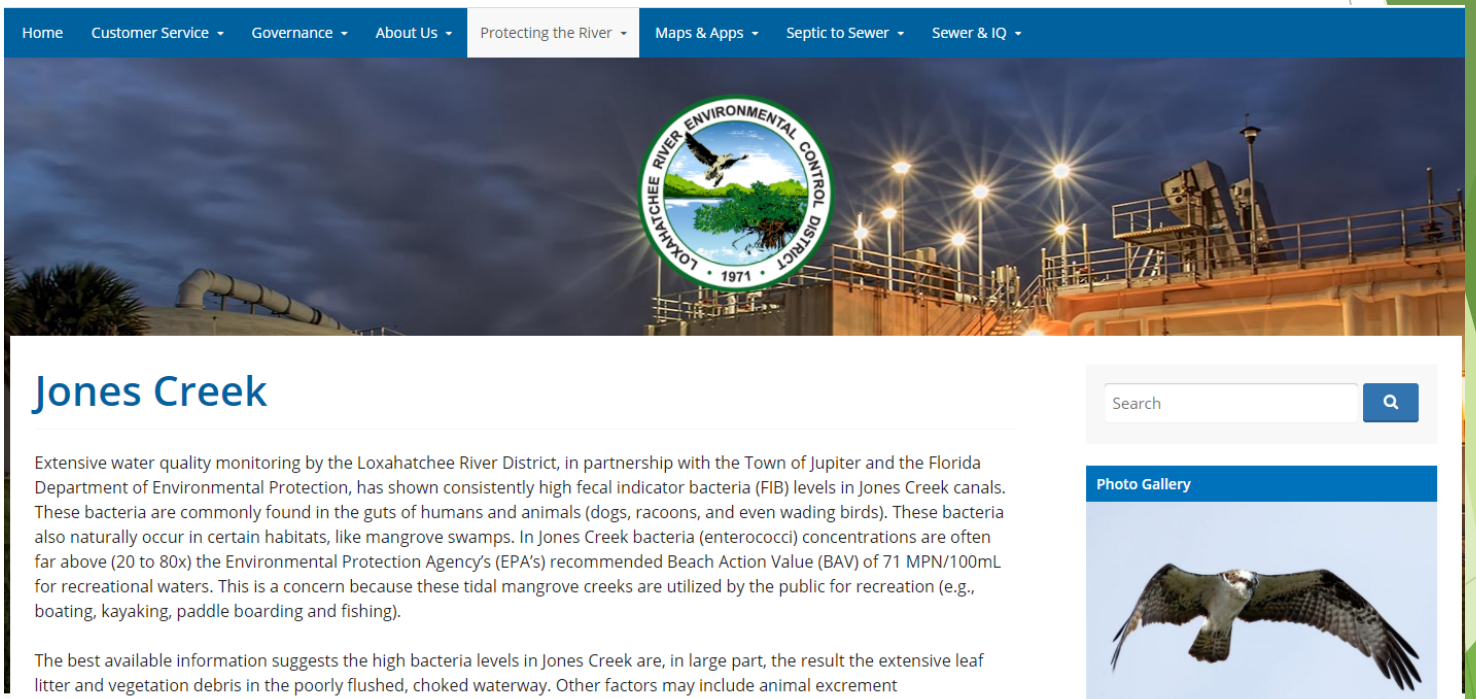
- NBOT System Powered by Generator
  - “Ultra-quiet” but still hum/reverberate
- Estimating a 5- to 10-day initial treatment???
- Retreatment based on bacteria concentrations
  - >500 MPN/100mL; presently 1,000 to 10,000+
  - State standard is 130; EPA Beach Action Value is 71
  - 24 hrs for bacteria results
- Ozone concentration testing to comply with EPA limits
- Results published to web page
- 60 days of treatment equipment availability
- 1 Month and 3 Month post treatment monitoring
- Final report to DEP; publication in scientific journal

Schedule

- Sat & Sun July 17 & 18 – Mobilize NBOT Equipment
- Tues July 20 – Pre-treatment water quality & sediment sampling
- Wed July 21 – NBOT Treatment begins between 1 and 2pm
- Thur July 22 – Day 1 water quality & sediment sampling
- Fri July 23 – Day 2 water quality sampling
- Mon July 26 – Day 5 water quality sediment sampling
- Ongoing bacteria testing and NBOT treatment based on bacteria results
- Sun Sept 19 – 60d commitment of NBOT equipment ends
- October – Month 1 post-treatment water quality sampling
- December – Month 3 post-treatment water quality and sediment sampling
- RiverKeeper Water Quality Monitoring Continues
- February - Final Report

Results

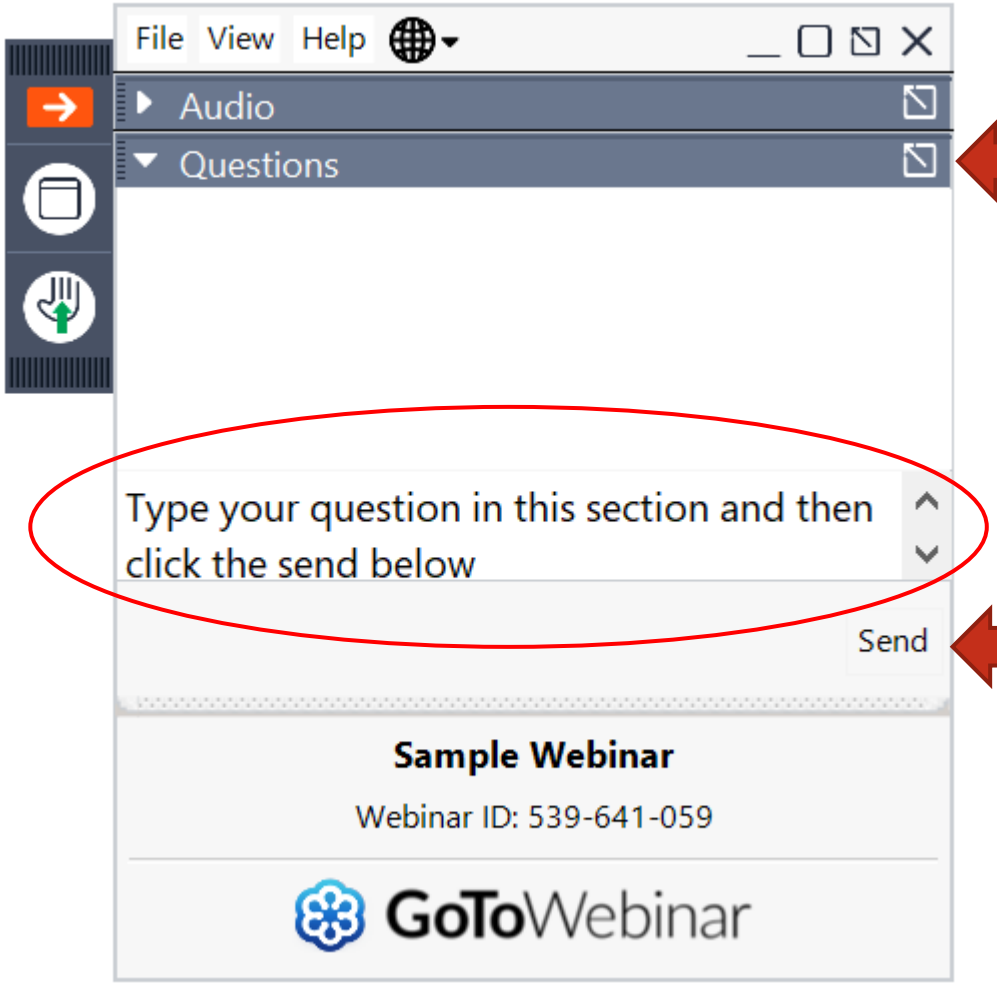
- We will present all results on the Jones Creek web page:
  www.loxahatcheeriver.org/jonescreek
- Interactive data visualization tools & project blog



To ask a question:

You can expand the question box by clicking here

Option 2:
Raise Hand
Then I can activate your microphone

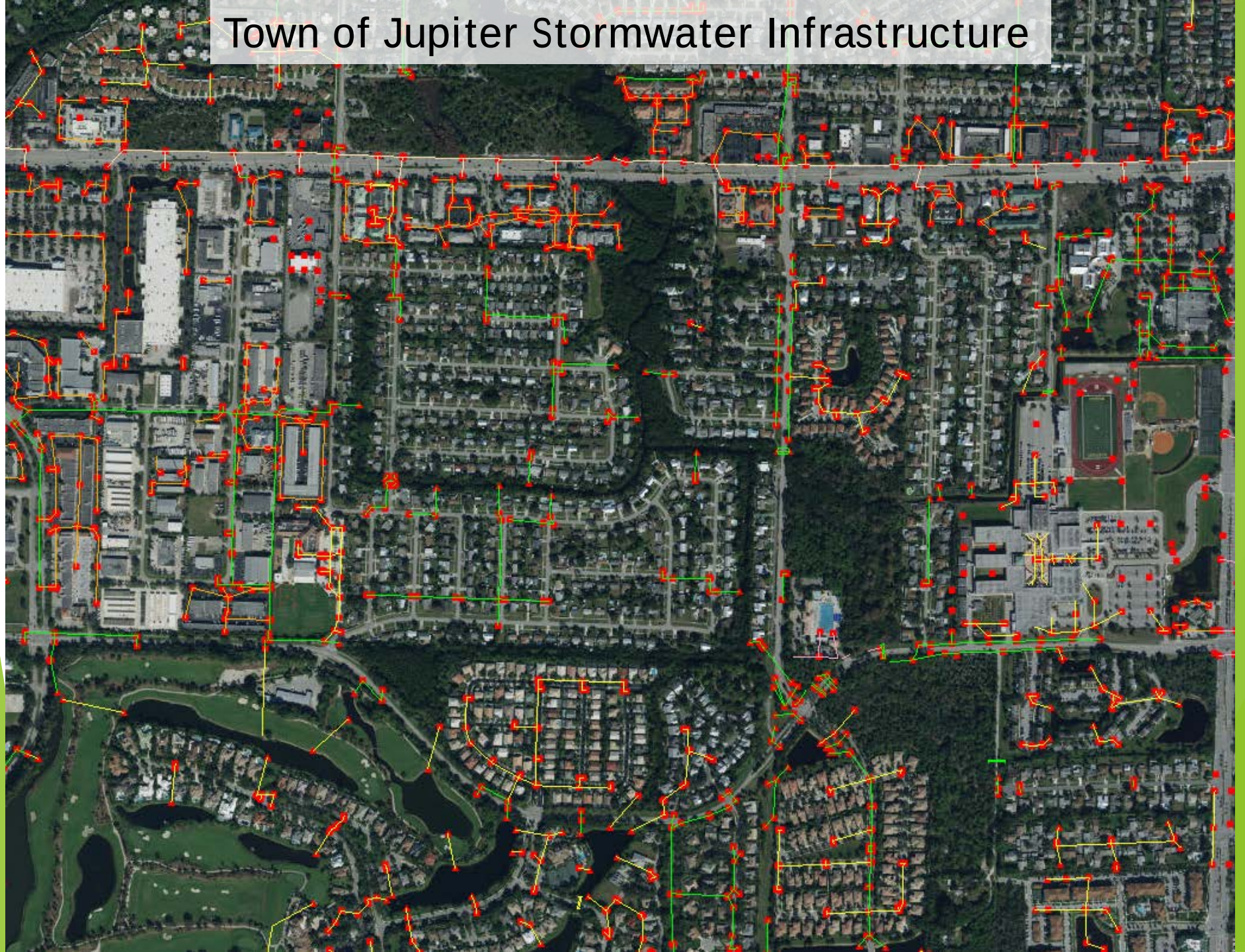


Option 1:
Type your question in the box above the send button, then click send

Contacts

- Loxahatchee River District
  - Bud Howard – bud.howard@lrecd.org; (561) 401-4037
  - Sue Noel, Lab Manager – susan.noel@lrecd.org; (561) 401-4058
  - Rachel Harris, Sr. Scientist – Rachel.harris@lrecd.org (561) 401-4004
- Green Water Solutions
  - Chas Antinone - cantinonejr@gmail.com
- Website – www.loxahatcheeriver.org/jonescreek

Town of Jupiter Stormwater Infrastructure



- Funding
  - Environmental Study
    - District Staff Time (estimated): $ 33,000
    - In-House Lab Analysis: $ 3,570
    - Contract Lab Analysis: $ 22,302
    - District Contribution – Local Match for Grant ($36,444)*
    - Grant Reimbursement for Analysis ($22,428)
  - NBOT Treatment
    - 6 units * 2 month deployment * $1,000/d $360,000
    - Green Water Contribution – Local Match for Grant ($32,428)
  - Total Project Cost $418,872
  - Total Grant Reimbursement ($350,000)
- Outcome
  - Thorough Evaluation this Innovative Technology
    - Effectiveness & Longevity
  - Catalyst for more improvements in the Jones Basin
    - Vegetation clearing & maintenance through the TOJ and Residents
    - Community cleanup efforts for debris removal
- Exciting Opportunity

Tasks

- DEP Contract Development ✓
- Green Water Solutions Contract ✓
- Temporary Access Easements for NBOT Systems ✓
- FDEP Permit/Authorization ✓
- ACOE Permit/Authorization ✓
- Quality Assurance Project Plan ✓
- Monitoring
  - BACI Design – Before, After, Control, Impact
  - Comprehensive Water Quality and Sediment Analysis
- NBOT Treatment
- Final Report & Manuscript Preparation