

Good to Great – The City of Chattanooga/Hamilton County Monitoring Network

SESWA – Hilton Head Island
Annual Conference
October 6, 2022



Historical Data Collection

- Prior independent, specific objectives
- Primarily driven by flooding or MS4 permit/TMDL water quality requirements



Data Collection	Stations	Responsible Party	Duration	Comments
Grab samples	114	City/County	Since 2001	E Coli, TSS only
Macro invertebrates	30	City/County	Since 2002	Semiannual samples
Datasondes	2	County	3-4 years	Not continuous dataset
Stage	5	City/USGS	Varies	For flood alert purposes
Flow	4	City	Varies	AV sensors on stream bed

Total Maximum Daily Loads

Listed Waterbody	TMDL Pollutant Parameter						
	pH	<i>E. coli</i>	Siltation, habitat alteration	pH, iron	Dioxins, PCBs	<i>E. coli</i>	PCBs, dioxin
Year	2005	2006	2006	2006	2009	2010	2010
North Market Street Branch	X	X				X	
Friar Branch	X					X	
Unnamed Trib to Citico Creek	X	X	X			X	
Spring Creek	X					X	
South Chickamauga Creek	X					X	
Lewis Branch	X					X	
Citico Creek	X	X	X				
Dobbs Branch	X	X	X				
Unnamed Trib to Chattanooga Creek	X	X	X				
McFarland Springs Branch	X	X				X	
Gillespie Springs Branch	X		X			X	
Chattanooga Creek	X	X	X		X	X	
Stringers Branch	X	X	X				
Lewis Branch		X	X				
Spring Creek		X					
Friar Branch		X	X				
South Chickamauga Creek		X	X				
South Suck Creek			X	X			
North Suck Creek				X			
Ninemile Branch			X				
N. Chickamauga Creek			X				
Unnamed Trib to Chattanooga Creek			X				
Mountain Creek			X			X	
Unnamed Trib to South Chickamauga Creek						X	
Macky Branch						X	
Wolfe Branch						X	

Listed Waterbody	TMDL Pollutant Parameter						
	pH	<i>E. coli</i>	Siltation, habitat alteration	pH, iron	Dioxins, PCBs	<i>E. coli</i>	PCBs, dioxin
Long Savannah Creek (incl. unnamed trib to Long Savannah Creek)						X	
Bivens Branch						X	
Shoal Creek						X	
Short Creek						X	
Stanley Branch						X	
Bee Branch						X	
Stringers Branch						X	
Rogers Branch						X	
Little Wolftever Creek						X	
Chestnut Creek						X	
Wilkerson Branch						X	
Unnamed Trib to Wolftever Creek						X	
Wolftever Creek						X	
Nickajack Reservoir							X

Entity	MS4 Designation	Permit Number	Original Expiration Date
City of Chattanooga	Phase 1 – Individual Permit	TNS008063	Nov 30, 2015
Hamilton County	Phase 2 – General Permit	TNS000000	Sept 30, 2021

Partnership - Purpose

- *To comply with state and federal clean water laws*
 - *To enhance regional emergency management preparedness and response*
 - *To ensure consistent water quality monitoring*
-
- So where do we start?

MEMORANDUM OF UNDERSTANDING
BETWEEN City of Chattanooga Public Works/Water Quality
AND
Hamilton County Water Quality Program
For Participation in a Joint Watershed Data Sharing Program

Purpose:

In an effort to comply with State and Federal Clean Water laws, to enhance regional emergency management preparedness and response, and to ensure consistent water quality monitoring, the City of Chattanooga Water Quality (City) and the Hamilton County Water Quality Program (the Program) enters into a Memorandum of Understanding (MOU) to participate in a joint watershed data sharing program, as outlined below. The objective of this agreement is to develop a network by which stream gauge and water quality stations are installed in various watersheds throughout the region, which will be installed and maintained jointly between the City and the Program. Data collected will be used to monitor stream flow and water quality in selected watersheds, as well as predict the impact of rain events on infrastructure and public health.

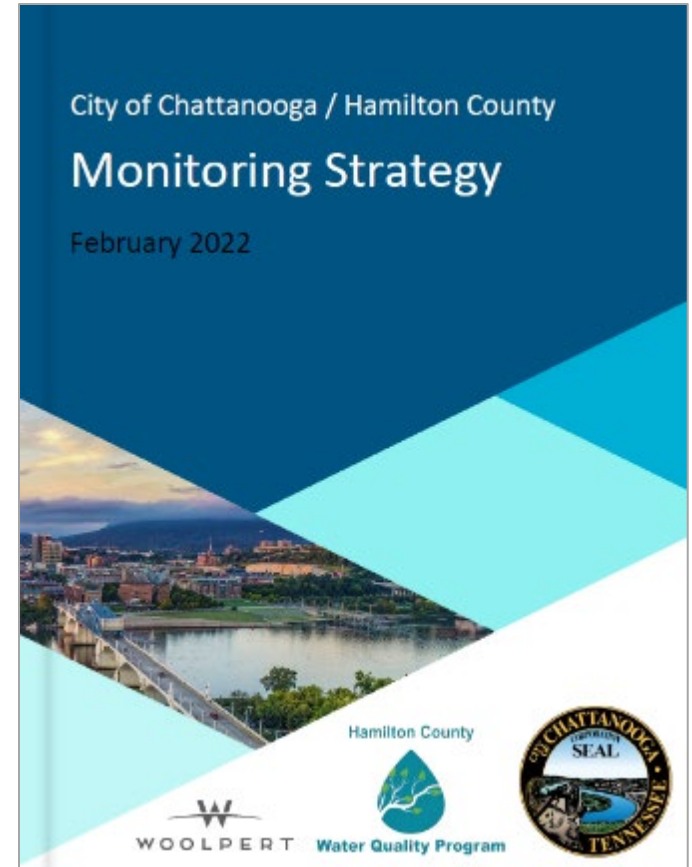
Understandings:

- The City and the Program will invest in the same water quality software and equipment for consistency in data collection and standard operating procedures. Data will be available for review by all pertinent agencies.
- The City and the Program will install stream gauge stations and/or water quality stations at designated areas within selected watersheds. The City and the Program may also coordinate with third party agencies and/or vendors to install stream gauge and water quality stations.
- The City and the Program will use the data collected to identify watershed-scale solutions to protect water quality and address problems that span across multiple jurisdictional boundaries. It is important that a set Standard Operation Procedure (SOP) exists for data collection, and consistent QA/QC protocols are followed; therefore, the City and the Program will establish one set of SOPs and QA/QC protocols.
- The City and the Program will openly collaborate for data analysis, data storage, and hosting a web-based public information system. The City and the Program may elect to use a third party to perform data analysis, host data storage, or host a web-based public information system.

IN WITNESS WHERE OF, the parties have executed this MOU by the signatures of the duly authorized representative of each on the dates indicated. This agreement is effective upon the last signature date.

Strategy Purpose

- Too many needs, too few dollars
- Provides macro/watershed level direction and focus
- Demonstrates alignment with mission and council goals
- Allows for budgeting and management of limited resources
- Justifies program priorities



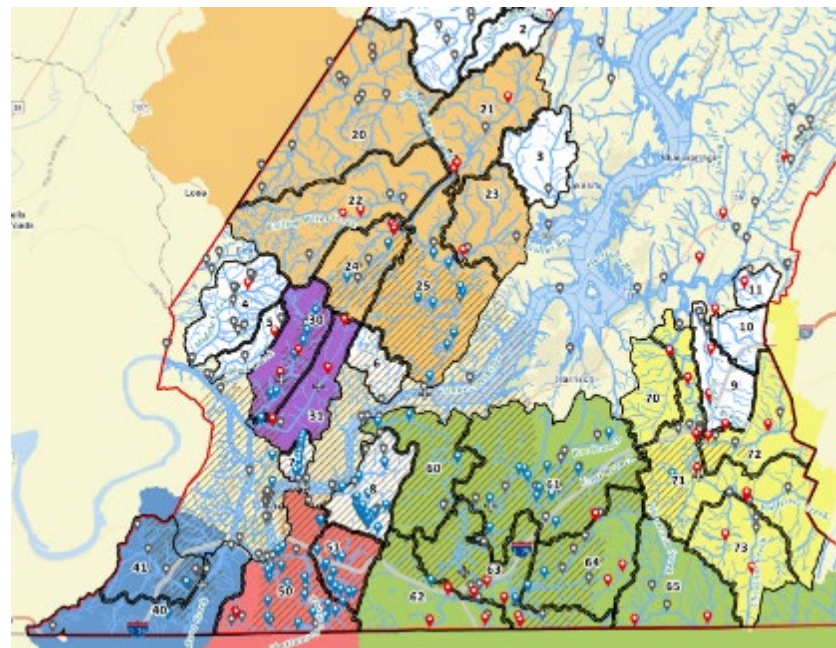
Strategy Components

- Alignment with Leadership Goals
- Assess Regulatory Requirements
- Supplement Current Stations
- Analyze Historical Data
- Perform Risk-Based GIS Analysis
- Develop Summary Matrix



Supplement Current Stations

Major Watershed	Reference Number	Subwatershed	Total Unique Sites	Total Number of Stations by Source		
				City of Chattanooga	Hamilton County	TDEC
Other	1	Soddy Creek	9		1	8
	2	Little Soddy Creek	2		1	1
	3	Daisy Dallas Tributary	1			1
	4	Middle Creek	8			8
	5	Shoal Creek	3		1	2
	7	North Market St Branch	12	12		1
	8	Citico Creek	18	17		4
	9	Rogers Branch	4		3	1
	11	Ison Springs Branch	1			1
	20	US North Chickamauga Creek	12			12
	North Chickamauga Creek	21	Poe Branch	3		2
22		Falling Water Creek	4		2	2
23		Lick Branch	3		1	2
24		Pitts Branch	8	2	3	5
25		DS North Chickamauga Creek	13	10	1	3
Stringers Branch	30	Mountain Creek	11	7	3	4
	31	Stringers Branch	5	1	4	3
Lookout Creek	40	Lookout Creek	3	1		3
	41	Black Creek	6	1		6
Chattanooga Creek	50	Chattanooga Creek	28	20	1	10
	51	Dobbs Branch	10	10		1
South Chickamauga Creek	60	Downstream SDS South Chickamauga Creek	3	1		3
	61	Friar Branch	15	11		7
	62	Spring Creek	4	1	3	2



Dissolved Oxygen (mg/L)

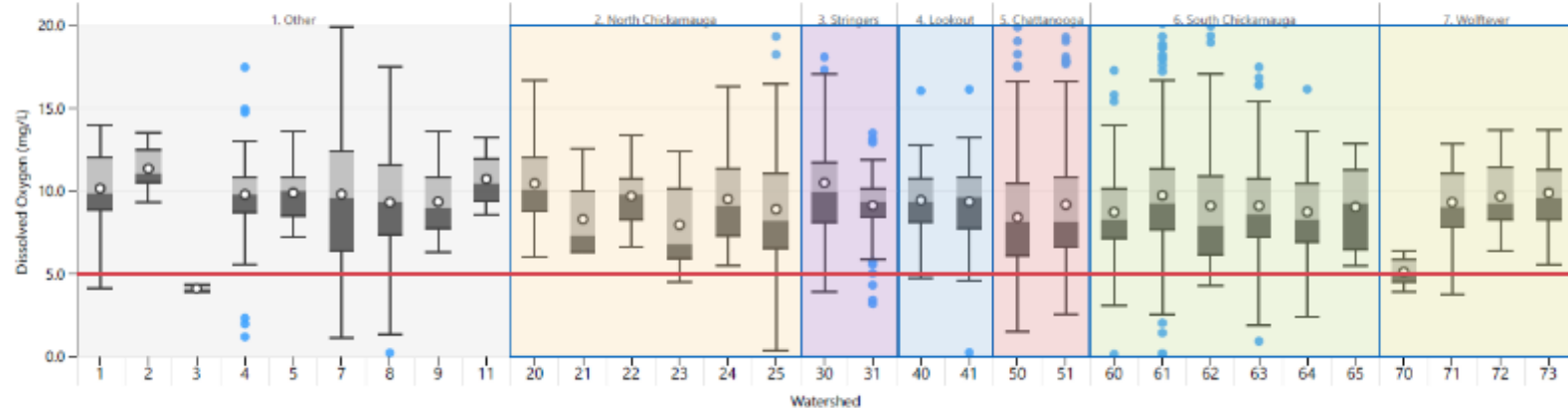
*Whiskers equal the max/min value within 1.5x the interquartile range.

— = TDEC Standard

○ = Mean ● = Outlier

Ref #	Watershed	Count	Avg	Med	Min	Max	Std Dev
1	Soddy Creek	49	10.2	9.9	4.1	14.0	2.2
2	Little Soddy Creek	6	11.4	11.1	9.4	13.5	1.3
3	Daisy Dallas Trib	2	4.1	4.1	3.9	4.4	0.2
4	Middle Creek	152	9.8	9.9	1.2	17.5	2.1
5	Shoal Creek	33	9.9	10.1	7.2	13.6	1.7
7	North Market St Branch	151	9.8	9.6	1.2	19.9	4.5
8	Citico Creek	377	9.3	9.4	0.2	20.9	3.4
9	Rogers Branch	27	9.4	9.0	6.3	13.6	2.0
11	Ison Springs Branch	5	10.7	10.5	8.6	13.3	1.7
20	US North Chickamauga Creek	97	10.5	10.1	6.0	16.7	2.2
21	Poe Branch	6	8.3	7.3	6.3	12.6	2.3
22	Falling Water Creek	40	9.7	9.8	6.7	13.4	1.6
23	Lick Branch	11	8.0	6.8	4.5	12.4	2.7
24	Pitts Branch	82	9.5	9.1	5.5	16.4	2.6
25	DS North Chickamauga Creek	237	8.9	8.3	0.4	19.4	3.2

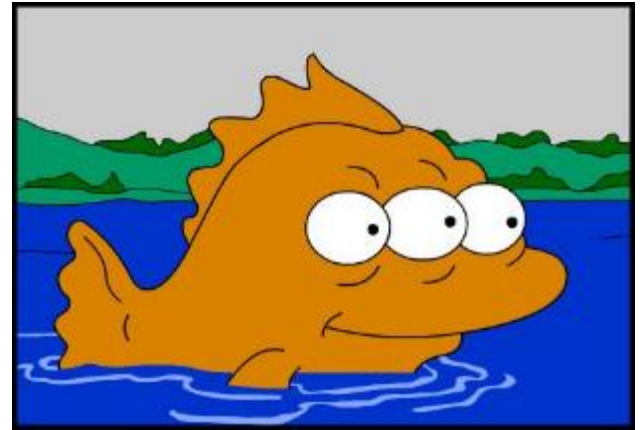
Ref #	Watershed	Count	Avg	Med	Min	Max	Std Dev
30	Mountain Creek	255	10.5	10.0	3.9	94.3	6.0
31	Stringers Branch	87	9.1	9.4	3.2	13.5	1.8
40	Lookout Creek	37	9.5	9.4	4.8	16.1	2.1
41	Black Creek	47	9.4	9.7	0.3	16.2	2.5
50	Chattanooga Creek	498	8.4	8.2	1.5	19.9	3.3
51	Dobbs Branch	197	9.2	8.2	2.6	23.8	3.9
60	DS South Chickamauga Creek	137	8.7	8.3	0.1	17.3	2.4
61	Friar Branch	580	9.8	9.3	0.2	47.5	3.6
62	Spring Creek	59	9.1	7.9	4.3	21.4	4.3
63	US South Chickamauga Creek	145	9.1	8.7	0.9	24.5	3.0
64	Mackey Branch	74	8.8	8.3	2.5	16.2	2.5
65	Hurricane Creek	26	9.1	9.3	5.5	12.9	2.2
70	Hunter Branch	5	5.1	4.9	4.0	6.4	0.9
71	Wolfvever Creek	39	9.3	9.1	3.8	12.9	1.9
72	Little Wolfvever Creek	35	9.7	9.3	6.4	13.7	1.9
73	Chestnut Creek	44	9.9	9.6	5.6	13.7	1.9



*Data were compiled between 2009-2021 from TDEC, City of Chattanooga, and Hamilton County

Risks/Consequences

- Criticality-based analysis (asset management approach)
- GIS centric using available data only
- Consider human health and recreational impacts
- Risks include sources outside of City's or County's control



Data Sources

- Risks

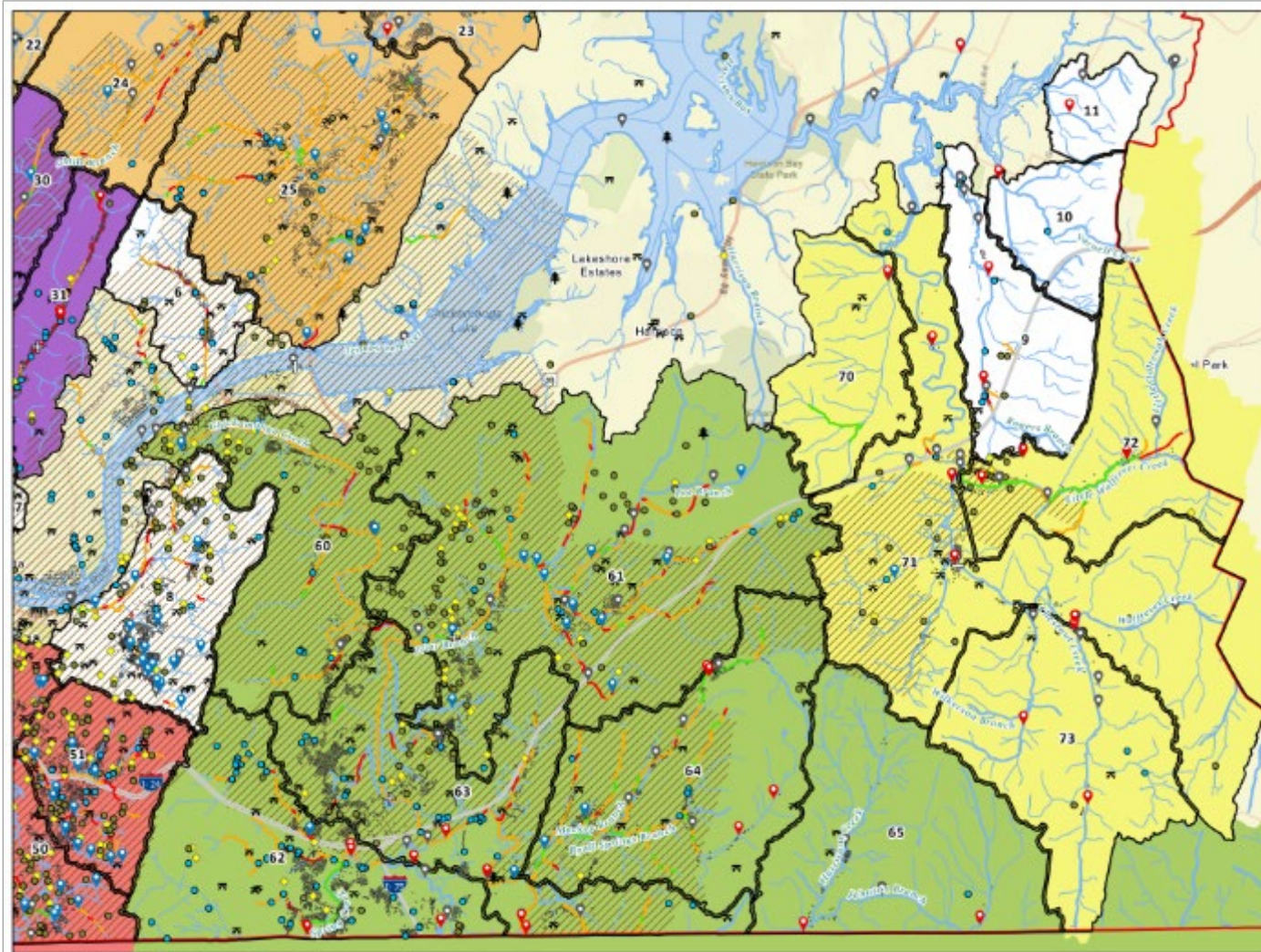
- Impervious Area
- SSOs
- Remediation Sites
- Industrial Facilities
- Visual Stream
Assessment Score

- Consequences

- Structures in floodplain
- Vulnerable parks
- Managed natural areas
- TMDLs
- Impaired waters

*Risks and consequences to water quality and flooding

South Chickamauga Creek and Wolfvever Creek



Legend

Existing Stations

- USGS Gauges
- Hamilton County Sampling Stations
- Chattahoochee Sampling Stations
- TN DEC Sampling Stations

Other Information

- Interstates
- Streams
- Hydro Layer
- Hamilton County
- Subwatersheds
- Chattanooga City Limits
- Major Watersheds
- Individual
- Chattahoochee Creek
- Lookout Creek
- North Chickamauga Creek
- South Chickamauga Creek
- Strainers Branch
- Wolfvever Creek

Risks

- Active Landfills
- Wastewater Treatment Facility
- Reported 303D SIDs
- Industrial Permits
- Recreation Sites
- Visual Stream Assessment Score
- Low
- Medium
- High

Consequences

- Managed Natural Areas
- Recreational Facilities
- Structures in the 500 Year Floodplain

*Impaired waters and TMDL watersheds are not depicted here, but are included in the accompanying summary matrix
 *Structures within the 500 year floodplain are those located within City limits only
 *All watershed boundaries were approximated by the City using Arc Hydro and have not been further refined



Sub-Watershed Name	Reference Number	Basin	Basin	Watershed	Fielding Monitoring Station					Bios					Consequences					Historical Data Review						Monitoring Priority Level									
		Drainage Area	Drainage Area Within City Limits	External Outside County	Total	City	County	THOC	UGG	Impervious Area	Reported SSOT	Remediation Sites	Permitted Industrial Facilities	Visual Stream Score	Structure Flood Risk	Vulnerable Period	Managed Natural Areas	Impaired Waters	TMDL	TH	TP	TSS	E. coli	DO	pH										
		sqmi.	Percentage	%	Count	Count	Count	Count	Count	Percentage	2020	2021-2022	Count	Count	Point	Count	Type	Parameter	Parameter	2000-2001	2002-2003	2004-2005	2006-2007	2008-2009	2010-2011										
OBER	Sully Creek	1	28	0%	Yes	11		1	10		2%	1	0		1															Long-Term					
	Little Sully Creek	2	9	0%		9		1	2		0%		1		9															Long-Term					
	Dairy Creek/Tylo	8	8	0%		1		1	1		22%	2	0		1															Long-Term					
	Middle Creek	4	7	0%		20		1	9		0%	11	20		1		8	State Forest		E. coli	E. coli	9000	9000	9000	9000	9000	9000	9000	9000	9000	High				
	280th Creek	9	2	0%		9		1	2		21%	16	62		1	Low				E. coli	E. coli	9000	9000		9000	9000	9000	9000	9000	High					
	Assess Rd/Tylo	6	9	86%		1			1		96%	17	68		2	Medium	192														Priority				
	North Market St Branch	7	1	90%		28	22		1		49%	8	28		8	Medium	77		6	DO	Macroinvertebrates	TP	E. coli		Fair	Poor	Fair	Poor	Poor	Fair	Priority				
	Ober Creek	8	8	100%		80	28		17	1	61%	0	17	28	20	Medium	770		1	ACE, E. coli	Other anthropogenic substrate alterations	Microinvertebrates	TP	DO	E. coli, Nitrate	Nitrate	Ammonia		Fair	Poor	Poor	Poor	Poor	Fair	High
	Eggers Branch	9	0	0%		0		1	0		0%	21	04		4	Medium															Priority				
	Vernal Creek	10	0	0%		1		1			0%	2	0																		Long-Term				
Iron Springs Branch	11	2	0%		2		1	1		0%		1																		Long-Term					
NORTH CHICKAUGA CREEK	Upstream North Chickauga Creek	20	21	0%	Yes	10		10		2%		1				182			Designated Best Management Areas	Physical Substrate	Nitrate	Ammonia	pH	Nitrate	Ammonia		Good	Good	Good	Good	Good	Poor	Priority		
	Fox Branch	21	21	0%		6		2	2		20%	12	10		1	2		4			Physical Substrate	Nitrate	Ammonia	pH			Good					Long-Term			
	Pedding Water Creek	22	26	0%	Yes	0		2	2	1	0%		0		0				1	Designated Best Management Areas				pH	Good	Good	Good	Good	Good	Good	Good	Long-Term			
	Lick Branch	28	8	0%		8		1	2		25%	1	1	1	1		10		1		E. coli			pH		Fair	Good					Long-Term			
	Mills Branch	32	7	85%		10	2	2	7	1	10%	1	1		1	Medium	187			Designated Best Management Areas	Alteration in streamside or littoral vegetation/covers				pH	Good	Good	Good	Good	Good	Good	Good	Priority		
	Downstream Bank Chickauga Creek	25	17	75%		20	9	2	0	0	36%	30	103	6	10	Medium	653		0	Regulated State Wetland Area				pH	9000	9000	Fair	Poor	Poor	Fair	Fair	High			
JORGERS BRANCH	Mountain Creek	30	7	55%		20	7	1	0	0	17%		1	4	3	Medium	106		0	E. coli	Physical substrate habitat alterations			E. coli, Nitrate	Nitrate	Ammonia		Good	Poor	Poor	Fair	Fair	Fair	Priority	
	Jorgers Branch	21	0	10%		24	1	3	0	0	25%	24	140	0	11	High	12		1	E. coli	Microinvertebrates	Other anthropogenic substrate alterations	Nitrate	Ammonia	DO	E. coli, Nitrate	Nitrate	Ammonia		Fair	Good	Fair	Fair	Fair	Fair
SHEPARD CREEK	Lehigh Creek	40	20	24%	Yes	8		1		1%		0	2	7	Medium	8		2	Nature Center and National Military Park				E. coli				Fair	Fair	9000	9000	Fair	9000	Long-Term		
	Back Creek	41	7	24%		0					24%			24	Medium	90		1			Alteration in streamside or littoral vegetation/covers				E. coli				Good	Good	Good	Good	Fair	Good	Priority

Watershed Tiers/Recommendations

- High Priority – continuous data collection during dry and storm conditions
- Priority – two-tiered grab sampling approach
- Long Term Priority – continue current ambient sampling



High Priority Watersheds

- Stringers Branch
- Dobbs Branch
- Downstream North Chick
- Citico Creek
- Friar Branch

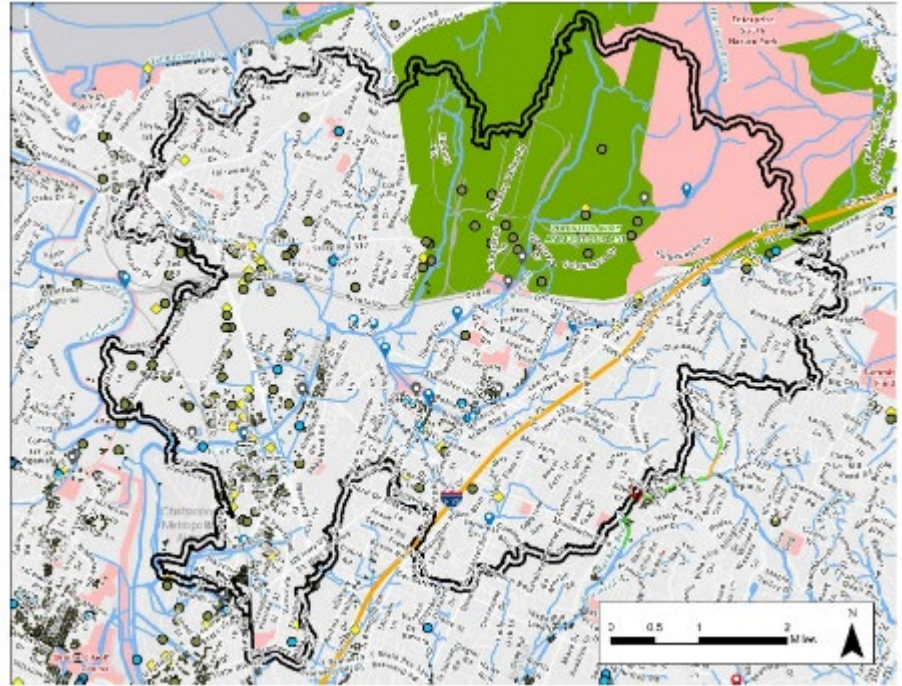


Figure 8: Friar Branch Area Map

Example – Friar Branch

- 72% within City of Chattanooga limits, the remainder of the subwatershed is within Hamilton County
- Second largest subwatershed at 23 square miles
- Heavily assessed with 11 TDEC, 11 City of Chattanooga sample stations, and one (1) USGS station
- Includes the 3rd highest imperviousness at 49% and 3rd highest number of structures at risk of 985
- Contains 2nd highest numbers of permitted industries and remediation sites
- Varied water quality results over the last decade, frequently low pH, and conductivity outliers
- Subject to four (4) 303(d) impairments and four (4) TMDLs

*Four of five high priority watersheds selected for continuous monitoring...

Field Inspections



Equipment Selection

- Water Quality Data
 - Dissolved Oxygen
 - Turbidity
 - pH
 - Conductivity
 - Temperature
 - Stage
 - Nitrate (2 sites originally)



Equipment Selection

- Stage data
 - Explored co-location opportunities with existing gage data
 - Pressure transducers
 - Radar systems



- Rainfall data



Challenges

- Contracting
- Supply chain



Challenges

- Major storm during installation



Challenges



Phased Installation

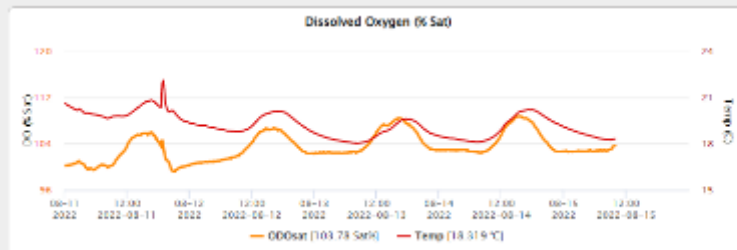
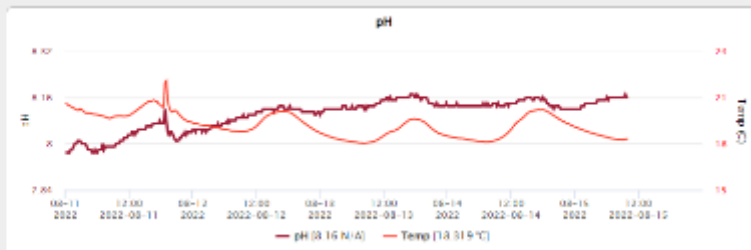
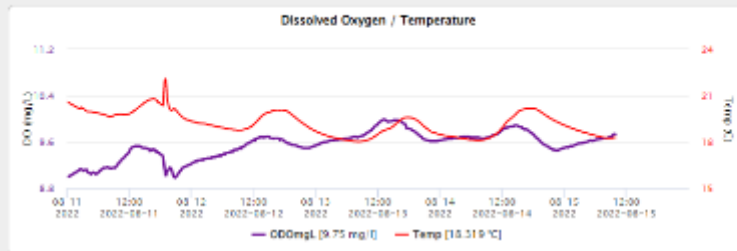
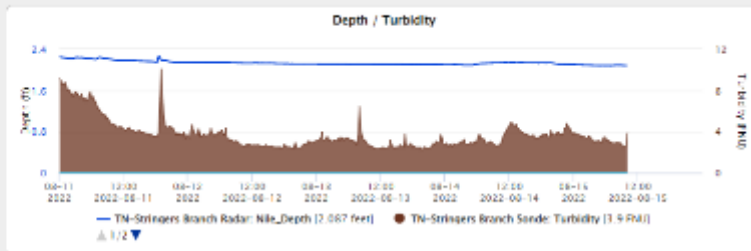
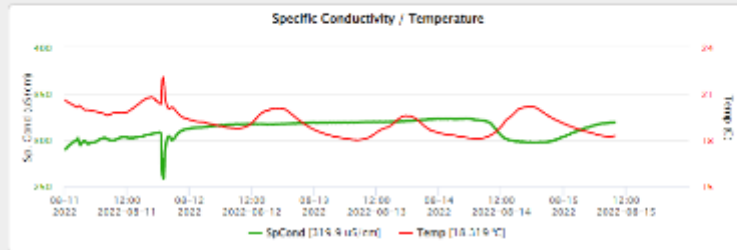
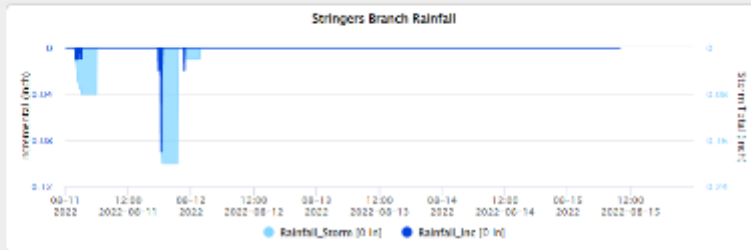


Phased Installation

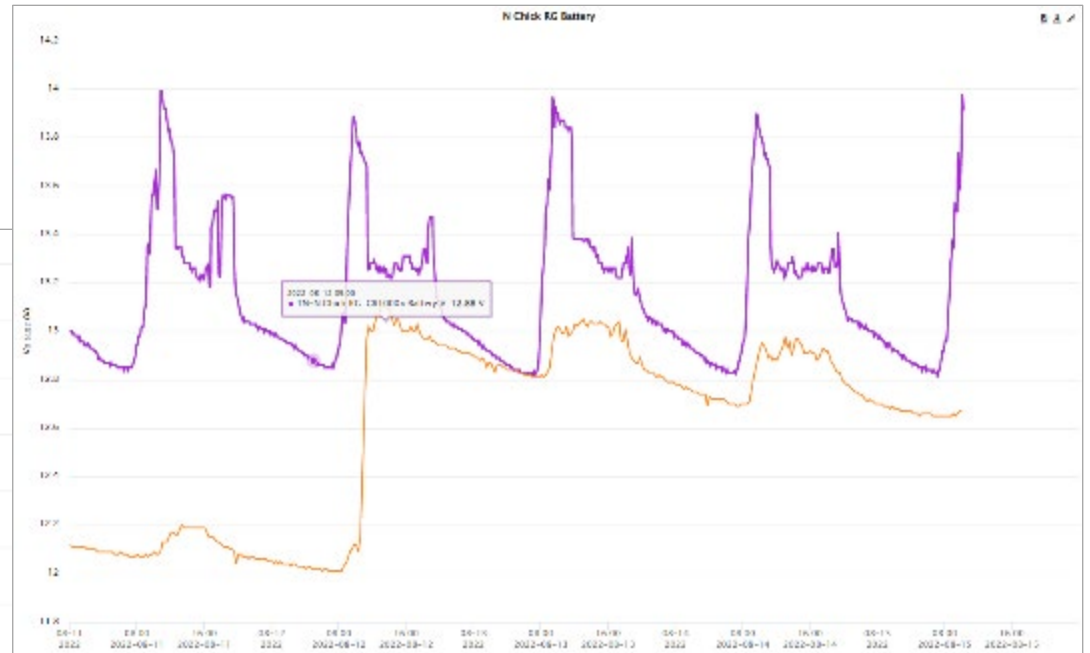
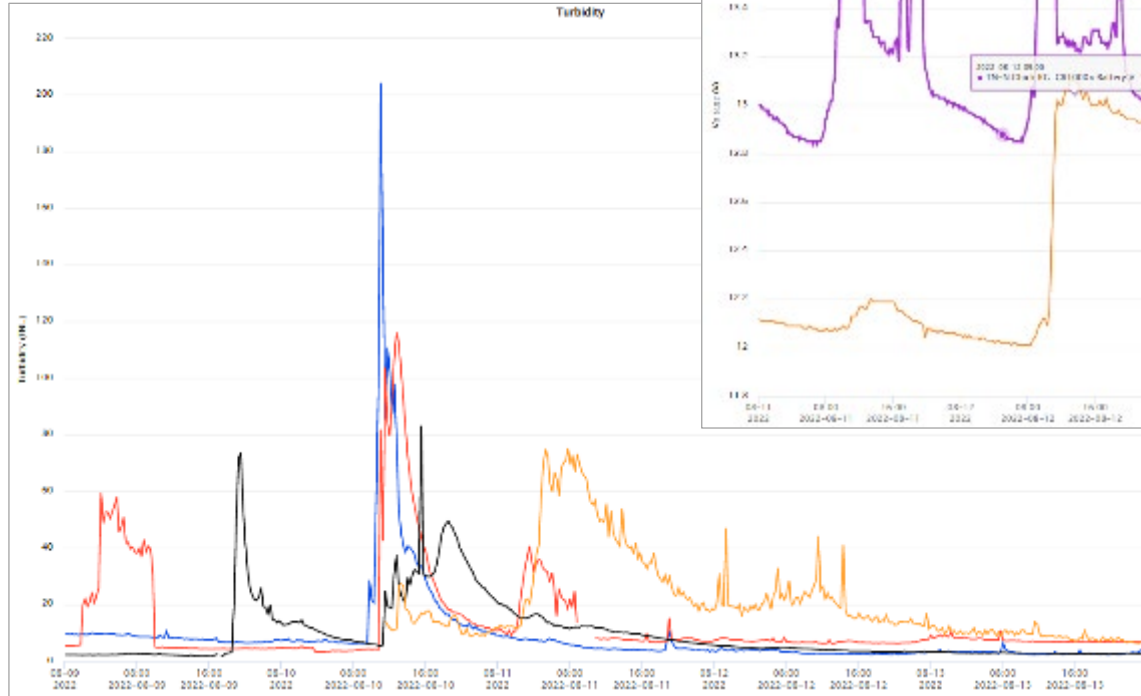


Chattanooga: WQ: Stringers Branch at Signal Mtn Rd

5 days



Sample Data



Priority Watersheds

- Not ignored – recommended more detailed sampling
- Two-tiered sampling
 - Dry/Storm
 - Ambient

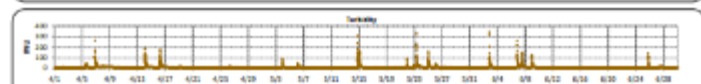
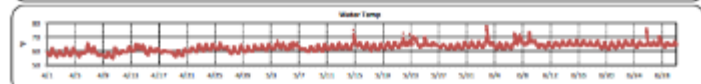
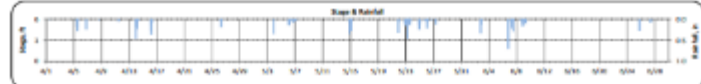
	Sub-Watershed Name	Reference Number	Risks	Consequences	Parameters of Concern						Grab Sampling Recommendations		
			Overall Rating	Overall Rating	TN	TP	TSS	<i>E. coli</i>	DD	pH	Twice/Quarter		Quarterly
			H/M/L	H/M/L							Dry	Storm	Ambient
Other	Middle Creek	4	Low	Low				H		H			o
	Shoal Creek	5	Medium	Low				H					o
	Access Rd Trib	6	High	Low							o	o	
	North Market Ct Branch	7	High	High	X	X	X	X	X	X	o	o	
	Rogers Branch	9	Medium	Low				X					o
North Chickamauga	Upstream North Chickamauga Creek	20	Low	High			X			X	o	o	
	Pitts Branch	24	Low	Medium						H			o
Stringas Branch	Mountain Creek	30	Low	High		X	X	X	X	X	o	o	
Lookout Creek	Block Creek	41	Medium	Medium						H			o
Chattanooga Creek	Chattanooga Creek	50	High	High	X	X	X	X	X	X	o	o	
South Chickamauga Creek	Downstream South Chickamauga Creek	60	High	High		X	X	X	X		o	o	
	Spring Creek	62	High	Medium	X		X	X	X		o	o	
	Upstream South Chickamauga Creek	63	High	High	X	X	X	X	X		o	o	
	Mackey Branch	64	Medium	Medium			X	X	X				o
Wolfcreek	Wolfcreek Creek	71	Medium	Low				H	H				o



The City of Chattanooga and Hamilton County Joint Water Quality Monitoring
 Quarterly Report (April 1, 2022 - June 30, 2022)
 Stringers Branch at Signal Mountain



PARAMETER	DESCRIPTION	SUMMARY STATISTICS				
		MINIMUM OBSERVED	MAXIMUM OBSERVED	MEDIAN OBSERVED	MEAN OBSERVED	STANDARD DEVIATION
STREAM NAME:	Stringers Branch	STAGE (FT):				
LOCATION:	Signal Mountain Rd	TEMPERATURE (°F):				
ADDRESS:	241 Signal Mountain Rd Chattanooga, TN 37405	TURBIDITY (NTU):				
COORDINATES:	30.08026, -85.32691	pH:				
IMC/MPARRENMENT:	C. coli, Siltation, Habitat Alteration	SPECIFIC CONDUCTIVITY (µS/cm):				
APPROX. DRAINAGE AREA:	5.7 square miles	DISSOLVED OXYGEN (mg/L):				
TOTAL NO. STORMS OVER 0.1 INCH:	22					
MAX. DAILY RAINFALL:	1.4 inches					
TOTAL RAINFALL (FOR PERIOD):	10.8 inches					



Note: Data gaps appear when the probe is removed for calibration or when the flow depth is below the sensor.

REPORT GENERATED ON 9/6/2022



The City of Chattanooga and Hamilton County Joint Water Quality Monitoring
 Quarterly Report (April 1, 2022 - June 30, 2022)
 Stringers Branch at Signal Mountain



Explanation of Statistics:

MINIMUM OBSERVED	The minimum of the values recorded by the datasonde in 15 minute intervals.
MAXIMUM OBSERVED	The maximum of the values recorded by the datasonde in 15 minute intervals.
MEDIAN OBSERVED	The median of all the values recorded by the datasonde in 15 minute intervals.
MEAN OBSERVED	The average of all the values recorded by the datasonde in 15 minute intervals.
STANDARD DEVIATION	The standard deviation of all the values recorded by the datasonde in 15 minute intervals.

Sampled Data:

Analyte (units)	Sample 1		Sample 2		Sample 3		Sample 4	
	Time	Results	Time	Results	Time	Results	Time	Results
Escherichia coli (MPN/100mL)								
Total Suspended Solids (mg/L)								
Total Phosphorus (mg/L)								
Total Nitrogen (mg/L)								

Notes:

Pressure transducers were installed following this monitoring period. Stage data will be available in future reports.

Data Gaps

There were no data gaps at the Stringers Branch at Signal mountain location during this monitoring period.

REPORT GENERATED ON 9/6/2022



Take Aways

- Partners much more informed regarding baseline conditions
- Much better tools to quantify impacts from development/BMPs
- Data could affect future land development policy – watershed specific requirements
- Data will help steer MS4 program and CIP needs



Special Thanks

- City of Chattanooga
 - Tiia Sailstad
 - Wyatt Stutts
 - Marty Hawkins
 - Rebecca Robinson
 - Isabel Kirby
- Hamilton County
 - Adam Reynolds
- Woolpert
 - Michael Long
 - Alex Poovey
 - Kendra Zaruba
- YSI
 - Bill Thompson
 - Shawn Sneddon
 - Danny Hutcheson

Questions?

James Riddle, PE
Vice President
Program Director - Water
james.riddle@woolpert.com

