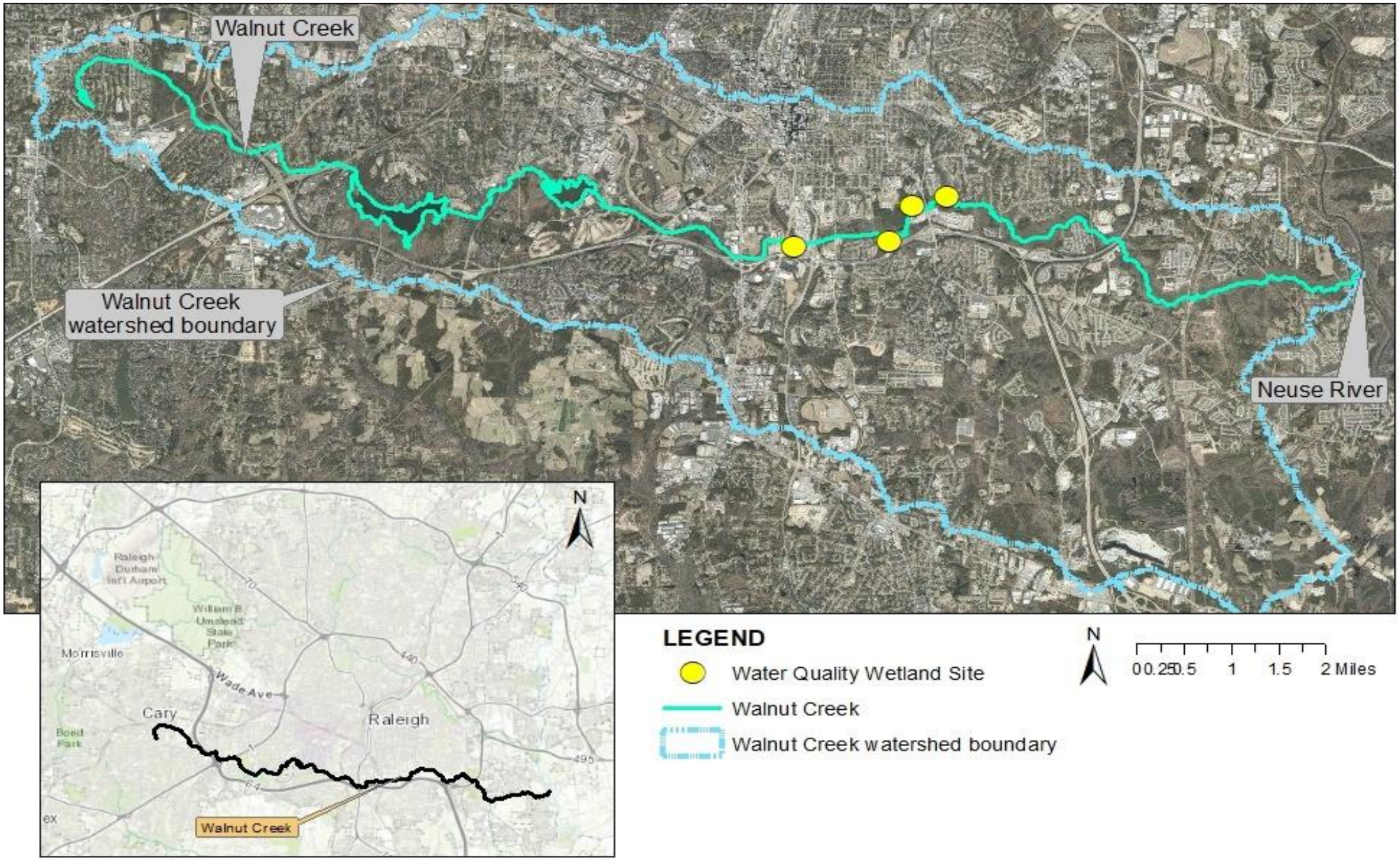
Assessment of the Quality of Surface Water Entering and Leaving Natural Wetlands in an Urban Landscape

Greg Rubino (presented by Kristie Gianopulos)
NC Division of Water Resources
EPA Region 4 401/Wetlands Conference
November 2022

DEQ
NORTH CAROLINA
Department of Environmental Quality

Project Goal: Assess the capability of natural urban wetlands (Raleigh) to ameliorate stormwater versus constructed wetlands and stormwater BMPs, to provide a framework for NCDEQ stormwater regulators to assess requests for stream and wetland credits for stormwater retrofits in urban settings.

South Raleigh urban stream: Walnut Creek



Four intensive study sites: two on south and two on north side of Walnut Creek

Wetlands with mostly perennially flowing streams through to Walnut Creek

Culverted Inlets

Walnut Creek: flashy, incised urban Piedmont stream; ~20 foot wide by 7 foot deep

Frequent Overbanking: 20 times a YEAR!! [Flooding after 3.32 inches Feb 2020]

Beaver Sanctuaries

Unstable sites: No autosamplers possible!

Six stormwater parameters monitored via grab samples
Baseflow and storm samples

Parameter
Oil and Grease (Hexane Extractable Material – HEM)
Total Suspended Solids (TSS)
Nutrients
Ammonia
Nitrate - Nitrite NO2 & NO3
Total Kjeldahl Nitrogen (TKN)
Total Phosphorus (TP)
Metals
Copper (Cu)
Lead (Pb)
Zinc (Zn)

190 total samples (70 inlet, 57 center, 63 outlet)

- Inlet/center/outlet on 4 intensive sites (sampled 13 times – 5 storm/9 baseflow)
- Inlet/center/outlet on 8 supplemental sites for baseflow concentration comparison (sampled 2 times)

Median Concentrations

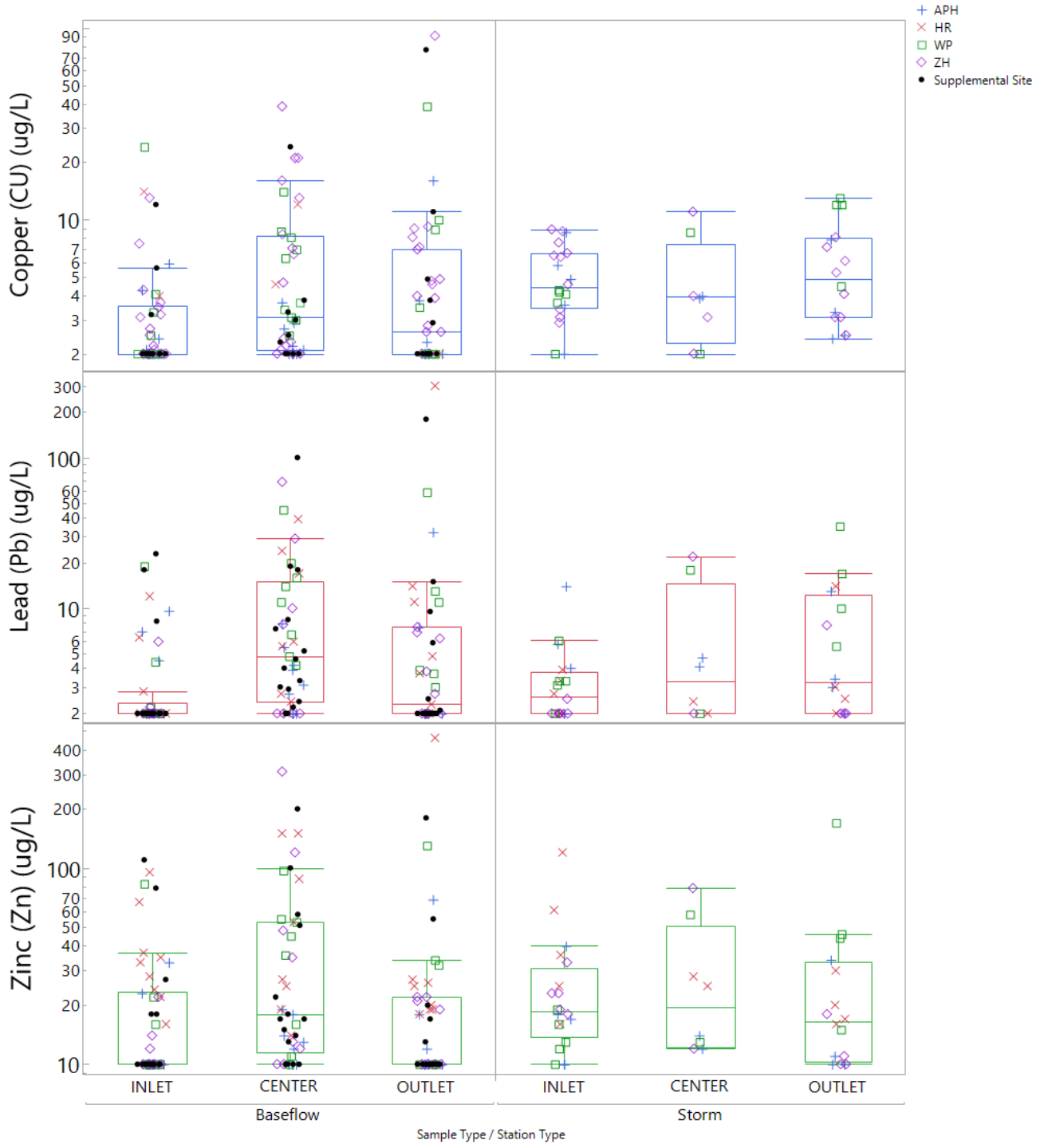
By Growing Season/ Non-Growing Season

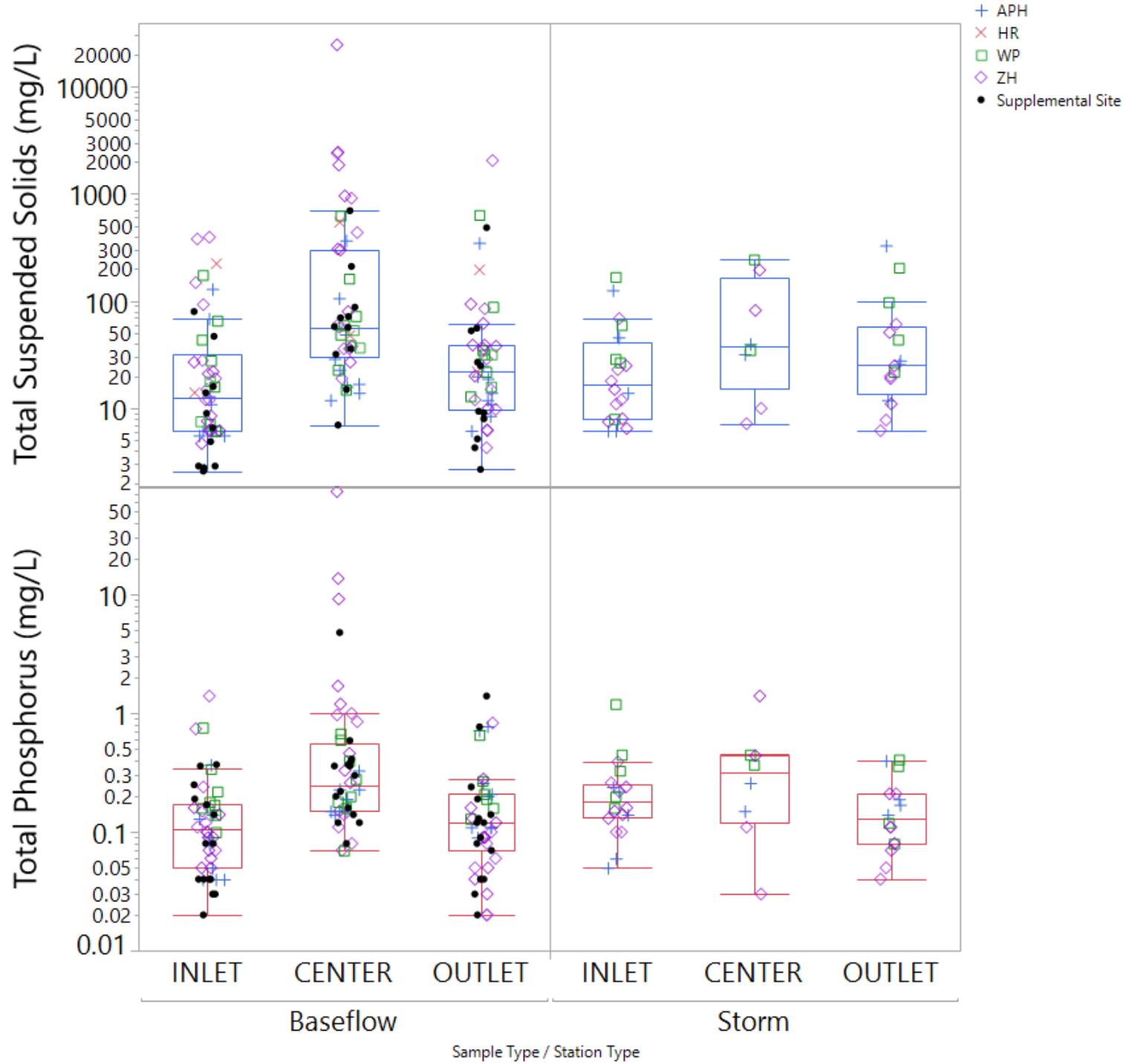
Station	Sample Type (N)	Median Total Suspended Solids (TSS) (mg/L)	Median Total Phosphorus (TP) (mg/L)	Median Ammonia (mg/L)	Median Nitrate / Nitrite NO2 & NO3 (mg/L)	Median Total Kjeldahl Nitrogen (TKN) (mg/L)
INLET	Growing Season (27)	12.0*	0.16	0.10	0.43*	0.65*
CENTER	Growing Season (22)	37.5	0.30	0.07	0.02/ND	1.10
OUTLET	Growing Season (26)	27.0*	0.18	0.16	0.03*	0.81*
INLET	Non-growing Season (28)	18.5	0.11	0.12	0.46*	0.55
CENTER	Non-growing Season (20)	66.5	0.20	0.07	0.02/ND	0.89
OUTLET	Non-growing Season (23)	20.0	0.09	0.07	0.03*	0.54

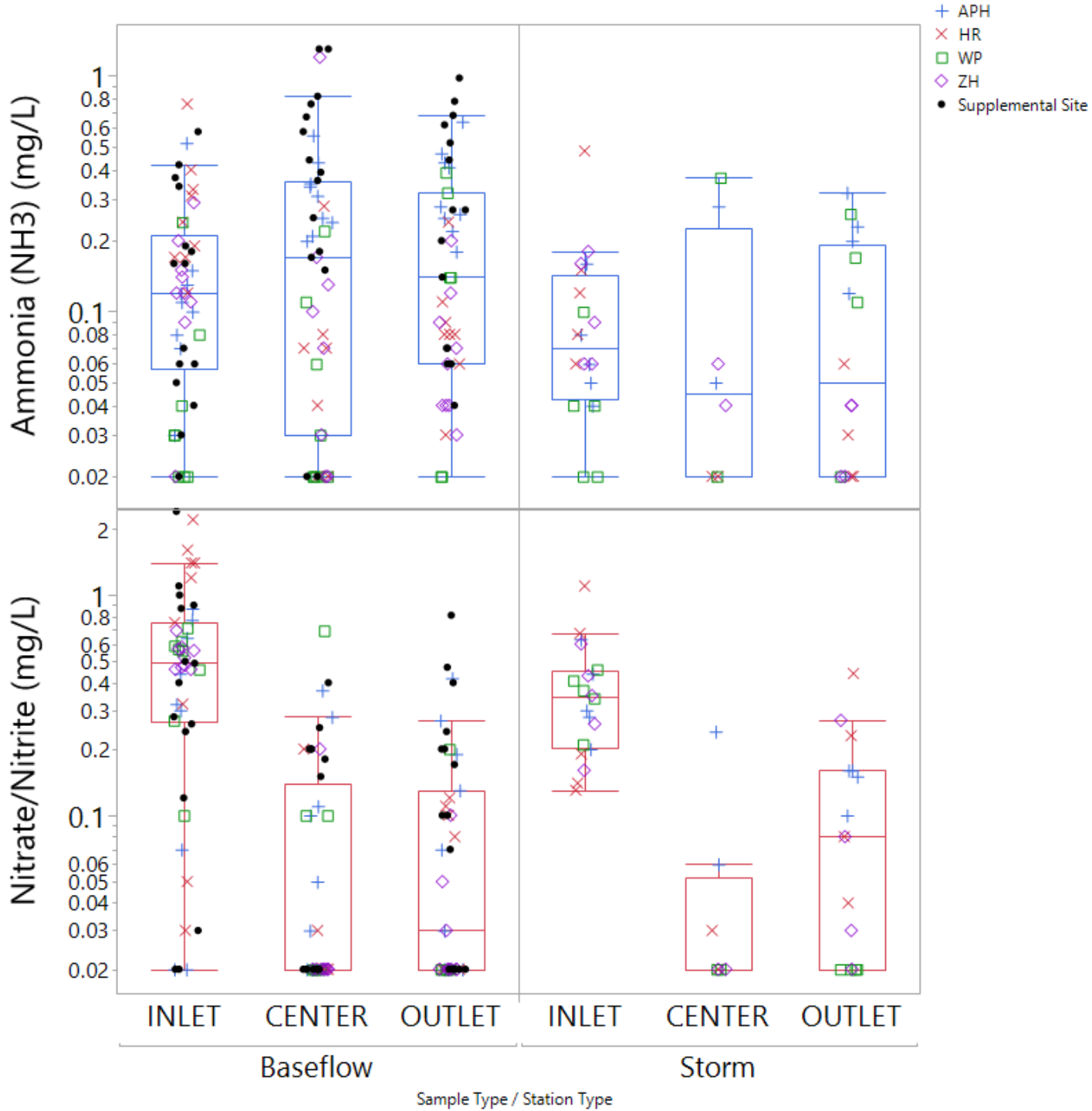
Station	Sample Type (N)	Median Oil and Grease (mg/L)	Median Copper (Cu) (ug/L)	Median Lead (Pb) (ug/L)	Median Zinc (Zn) (ug/L)
INLET	Growing Season (27)	10/ND	3.40	2.00*	16.0
CENTER	Growing Season (22)	10/ND	3.80	4.45	17.5
OUTLET	Growing Season (26)	10/ND	4.75	3.80*	17.5
INLET	Non-growing Season (28)	10/ND	2.50	2.00	16.0
CENTER	Non-growing Season (20)	10/ND	2.90	5.75	22.0
OUTLET	Non-growing Season (23)	10/ND	2.60	3.00	18.0

Station	Sample Type (N)	Median pH	Median Dissolved Oxygen (DO) (%)	Median Dissolved Oxygen (DO) (mg/L)	Median Specific Conductivity (S/m)	Median Water temperature (deg C)
INLET	Growing Season (27)	7.02*	63.5*	5.72*	200.70	23.1
CENTER	Growing Season (22)	6.64	23.9	2.18	186.85	24.3
OUTLET	Growing Season (26)	6.63*	36.9*	3.43*	192.60	22.5
INLET	Non-growing Season (28)	7.02	82.1*	9.55*	251.15*	9.3
CENTER	Non-growing Season (20)	6.75	35.8	4.08	226.9	6.9
OUTLET	Non-growing Season (23)	6.81	50.7*	6.52*	156.80*	7.0

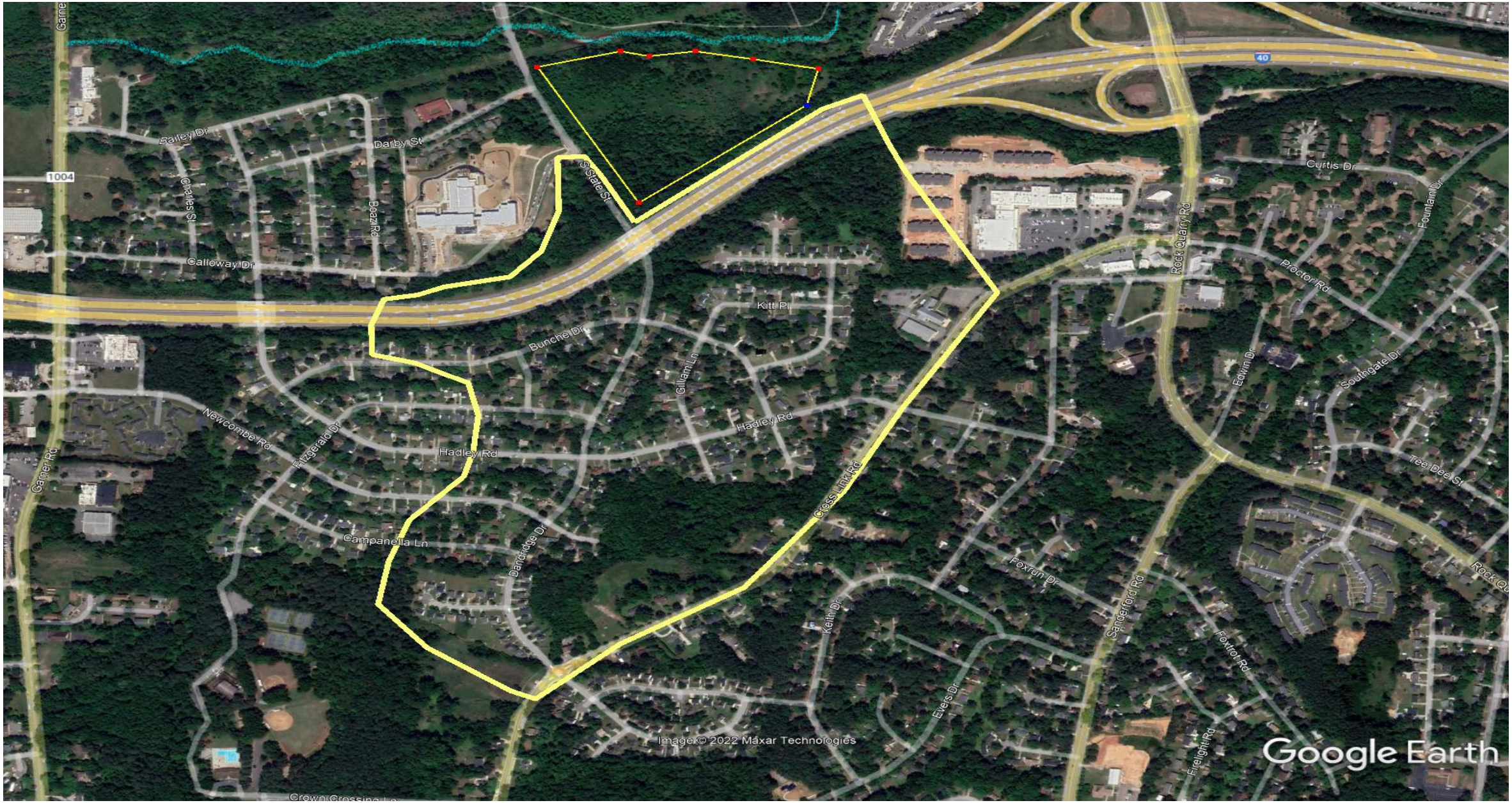
Where's the contamination?



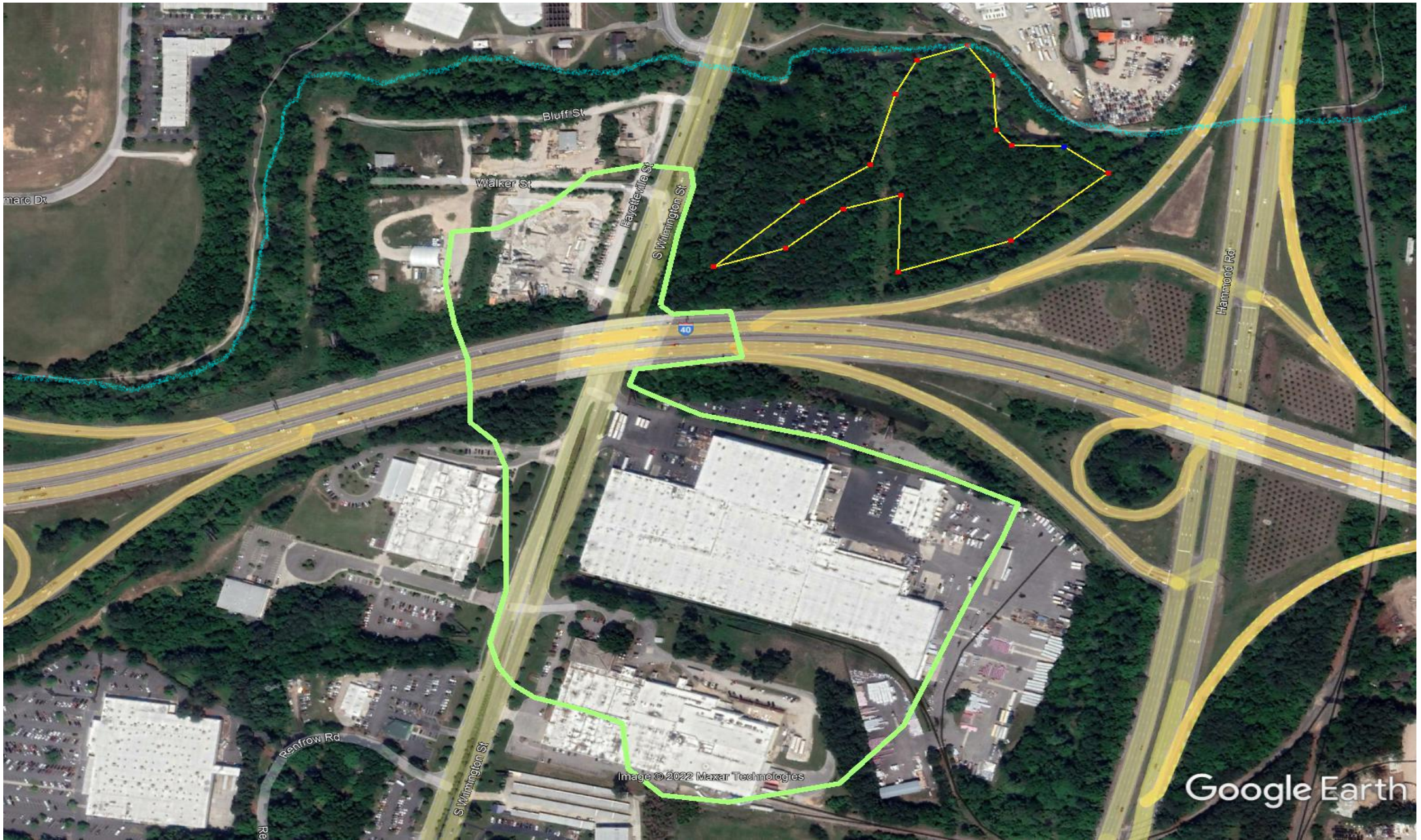

APH
HR
WP
ZH
Supplemental Site
Total Suspended Solids (mg/L)
20000
10000
5000
3000
2000
1000
500
300
200
100
50
30
20
10
5
3
2
Total Phosphorus (mg/L)
50
30
20
10
5
3
2
1
0.5
0.3
0.2
0.1
0.05
0.03
0.02
0.01
INLET
CENTER
OUTLET
INLET
CENTER
OUTLET
Baseflow
Storm
Sample Type / Station Type


APH
HR
WP
ZH
Supplemental Site
Ammonia (NH3) (mg/L)
1
0.8
0.6
0.5
0.4
0.3
0.2
0.1
0.08
0.06
0.05
0.04
0.03
0.02
Nitrate/Nitrite (mg/L)
2
1
0.8
0.6
0.5
0.4
0.3
0.2
0.1
0.06
0.05
0.04
0.03
0.02
INLET
CENTER
OUTLET
INLET
CENTER
OUTLET
Baseflow
Storm
Sample Type / Station Type

Well-buffered neighborhoods make up ZH Wetland Catchment



HR Wetland: lots of impervious and heavy vehicle usage in catchment



Benefits provided by these wetlands? Metals, sediment, and trash trapping

flood attenuation

Lack of maintenance after initial constructed wetland success

Upcoming: **Urban Wetland Flooding Quantification Project**

The Question: How much water is held back by these wetlands during overbank events and for how long?

Thank you, EPA for funding

Thank you, Amanda Mueller

NC DEQ
Gregory.Rubino@ncdenr.gov
919-743-8450

Your Questions?