Water Quality Assessment of Jacks Creek, an Urbanized Watershed in Coastal North Carolina

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ABSTRACT

Jacks Creek is an urban catchment in the City of Washington in Eastern North Carolina. Drainage from Jacks Creek discharges to the nutrient-sensitive Pamlico Estuary, where excess nutrients and bacteria have led to the impairment of water resources. Stormwater runoff from Jacks Creek was an expected source of excess nutrients and bacteria to the Estuary, but monitoring data were needed for an accurate assessment of the watershed. The goal of this project was to analyze nutrient and microbial concentration discharges from different segments of Jacks Creek. Water samples were collected from 5 locations within the Jacks Creek watershed during baseflow and stormflow conditions over a one-year period. Samples were analyzed for nitrogen, phosphorus, and *E. coli* concentrations. Stream flow and temperature were also measured during sampling events. This poster presentation will provide preliminary findings regarding the nutrient and bacteria contributions to the Pamlico Estuary from Jacks Creek.

INTRODUCTION

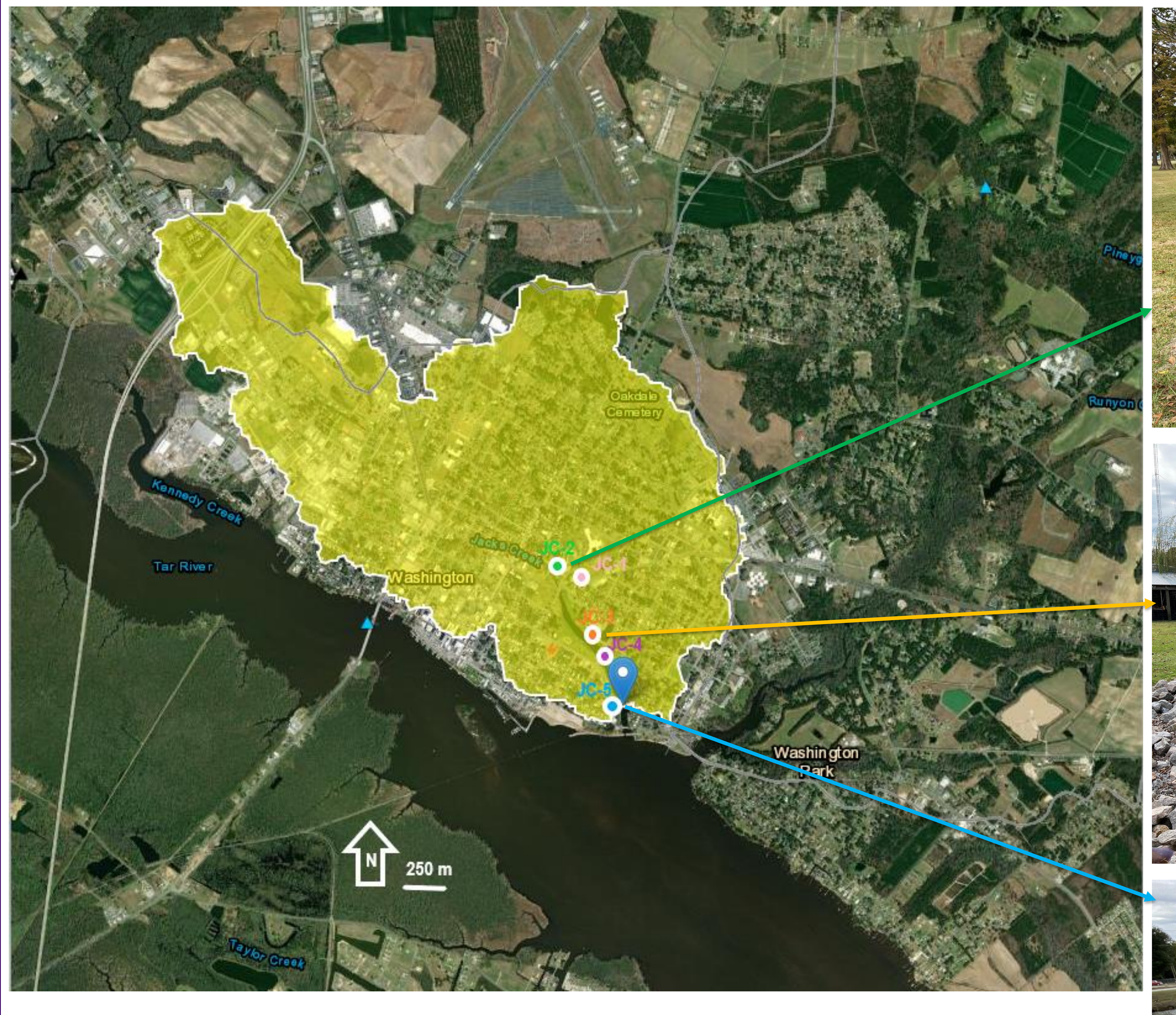
- Impervious surfaces such as roads, rooftops, and parking lots do not allow infiltration of rainwater and thus cause increases in runoff and flash flooding.
- Runoff transports pollutants such as pet and wildlife waste, trash, and sediment that collect on impervious surfaces between rain events.
- Urban runoff is commonly cited as a source of water use impairment.
- Stormwater control measures such as rain gardens, wetlands, and wet detention basins have been shown effective at reducing the rate of stormflow discharge and nutrient and bacteria loading leaving urban areas.
- Control measures must be placed in locations where they will have the greatest influence.
- Jacks Creek is an urban, coastal watershed that drains to the nutrient-sensitive Tar-Pamlico River.
- Based on land-use characteristics, it was suspected that urban runoff was a contributing factor to poor water quality in the Tar-Pamlico estuary.
- Field-based data were needed to characterize the nutrient and fecal indicator bacteria content of drainage discharging from different segments of the Jacks Creek watershed to help focus mitigation efforts.

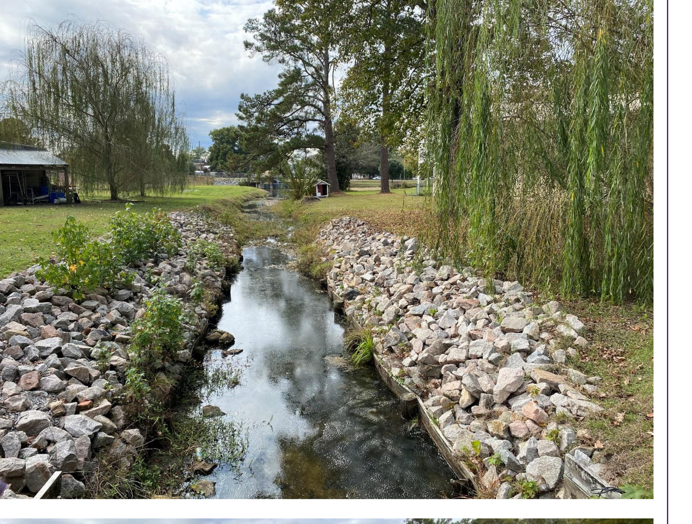
MATERIALS & METHODS

- Surface water samples were collected during baseflow (n = 5) and stormflow conditions (n = 5) at 4 main tributaries of Jacks Creek and the main stem of Jacks Creek.

A handheld multi-probe meter was used to measure pH, oxidation reduction potential, temperature, and specific conductance. A flow-probe was used to measure stream velocity and along with the active stream channel dimensions, discharge was calculated. The physicochemical properties of water during stormflow and baseflow were compared. Also compared were the physicochemical properties of water at each location.

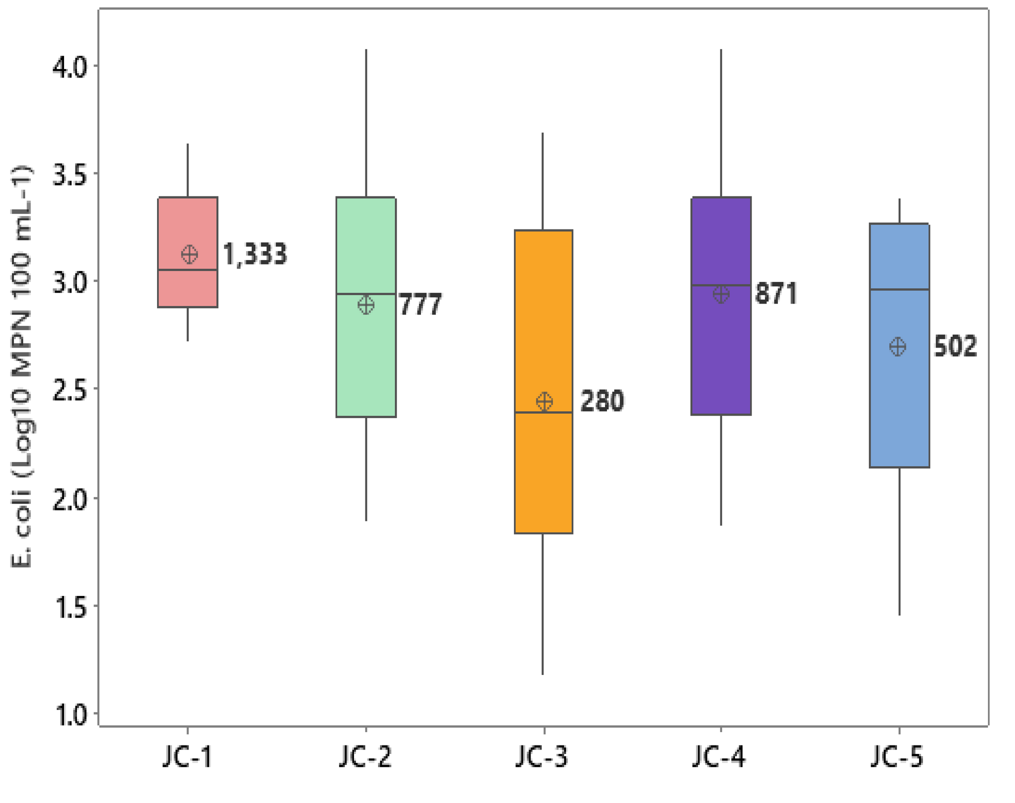
MATERIALS & METHODS

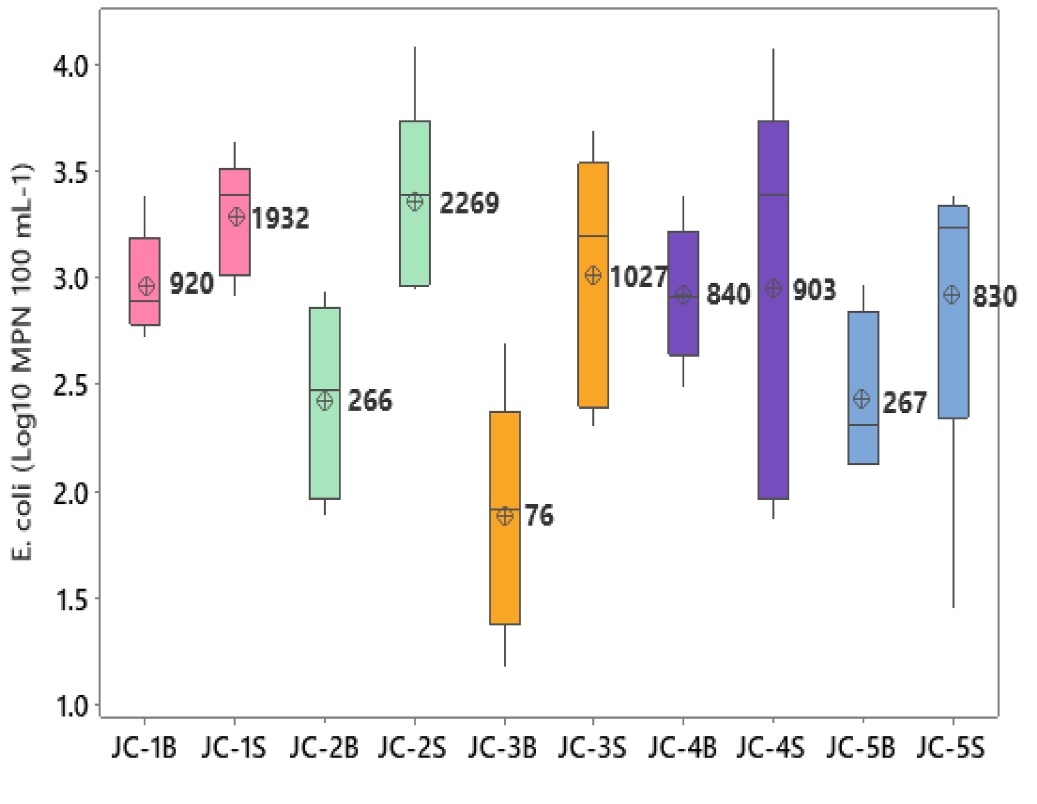




- The Jacks Creek watershed encompasses approximately 622 hectares
- An estimated 93% of the watershed has been developed
- There is approximately 37% impervious coverage
- A watershed management plan is not currently available for Jacks Creek
- Drainage from Jacks Creek discharges to the Tar-Pamlico estuary
- The estuary has experienced problems associated with excess nutrients and bacteria for several decades
- More information is needed regarding the nutrient and bacteria contributions from Jacks Creek to the estuary
- Assessment of the water quality characteristics of drainage from the main tributaries of Jacks Creek is needed to determine where mitigation efforts should be focused

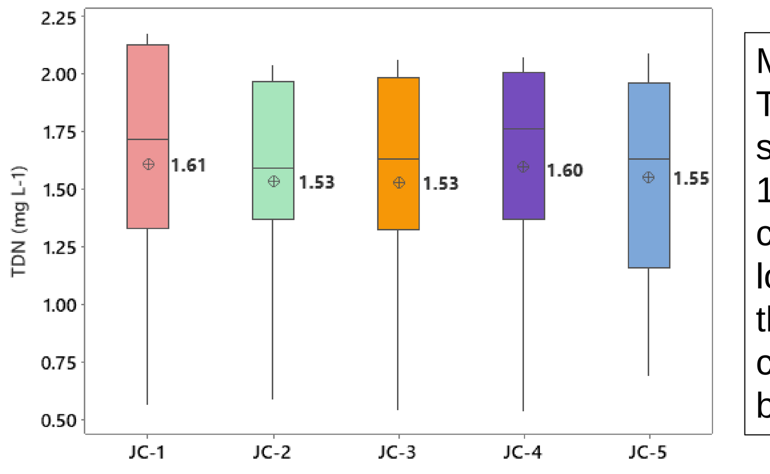
RESULTS & DISCUSSION



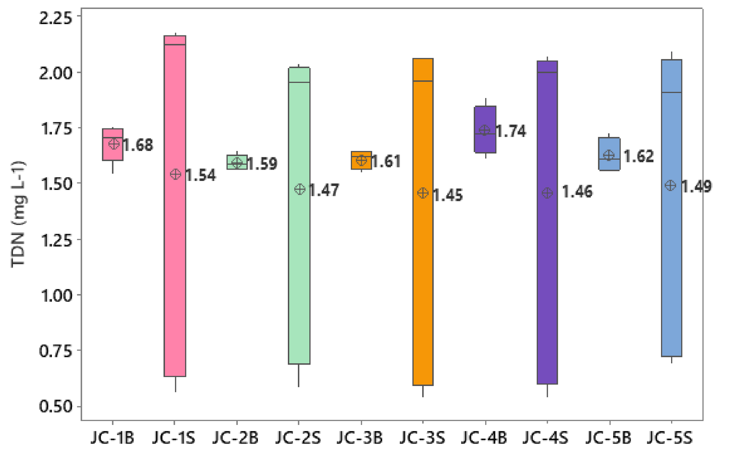


Water samples collected from the main stem of Jacks Creek (JC-5) and some of its tributaries (JC-1 to JC-4) had geometric mean concentrations of *E. coli* that exceeded the EPA recommendations for freshwater (geometric mean of 126 cfu/100 mL). The geometric mean concentration of *E. coli* was higher for stormflow relative to baseflow for each sampling location. Sampling location JC-3 had the lowest overall concentration of *E. coli*. These results suggest that additional retention and treatment of stormwater may help reduce microbial loading to the estuary.

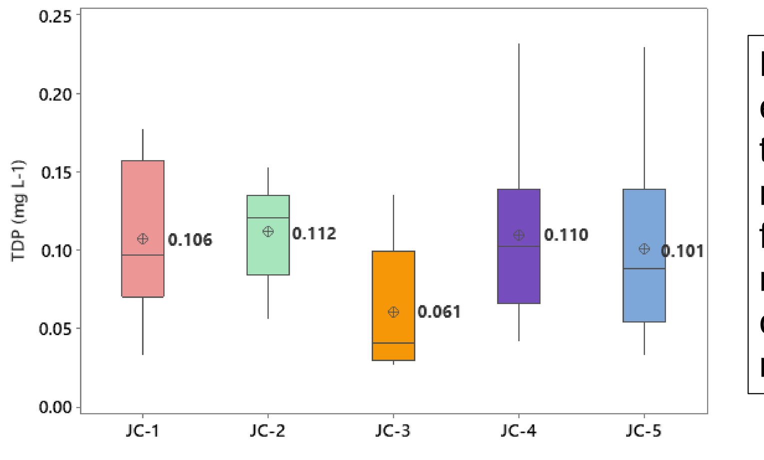
RESULTS & DISCUSSION



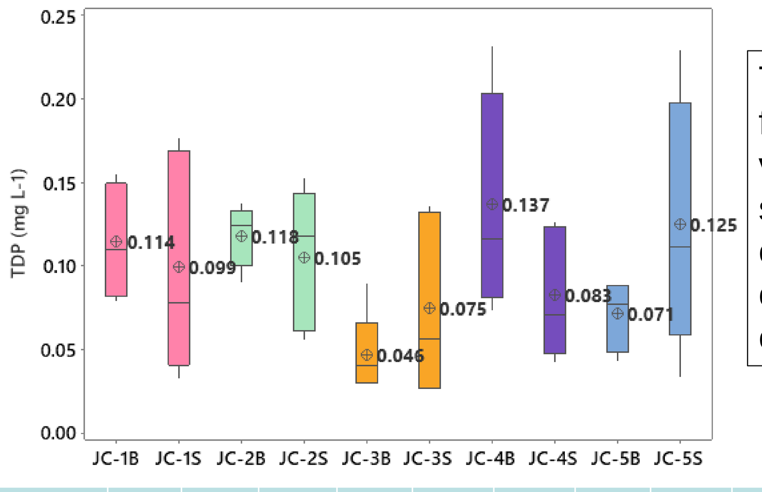
Mean overall concentrations of TDN were similar for each location sampled and ranged from 1.53 to 1.61 mg L^{-1}. The mean concentration of TDN at each location was elevated relative to the 25th percentile reference condition (0.69 mg L^{-1}) published by the EPA for Ecoregion IX.



Stormflow concentrations (S) of TDN were more variable in comparison to baseflow (B) concentrations for each sampling location. The highest TDN concentrations for each sampling location were observed during stormflow and median TDN concentrations were higher relative to baseflow for each site.



Mean concentrations of TDP for each sampling location exceeded the US EPA's 25th percentile reference standard (0.0366 mg/L) for Ecoregion IX. Therefore, both nitrogen and phosphorus concentrations were elevated relative to natural conditions.



TDP concentrations during storm flow were also much more variable than base flow for each sampling location. The highest concentration of TDP was observed during stormflow for each sampling location.

SC (µS cm-1)	JC-1 B	JC-1 S	JC-1 O	JC-2 B	JC-2 S	JC-2 O	JC-3 B	JC-3 S	JC-3 O	JC-4 B	JC-4 S	JC-4 O	JC-5 B	JC-5 S	JC-5 O
Mean	356	193	275	422	190	306	301	148	225	389	161	275	577	190	362
Stdev	59	108	119	100	90	151	72	137	131	98	116	157	359	80	305
ORP	JC-1 B	JC-1 S	JC-1 O	JC-2 B	JC-2 S	JC-2 O	JC-3 B	JC-3 S	JC-3 O	JC-4 B	JC-4 S	JC-4 O	JC-5 B	JC-5 S	JC-5 O
Mean	46	95	71	32	86	59	39	94	66	22	95	58	-1	81	45
Stdev	95	75	85	84	82	83	92	81	87	87	85	90	81	82	88
pH	JC-1 B	JC-1 S	JC-1 O	JC-2 B	JC-2 S	JC-2 O	JC-3 B	JC-3 S	JC-3 O	JC-4 B	JC-4 S	JC-4 O	JC-5 B	JC-5 S	JC-5 O
Mean	7.6	6.1	6.9	7.5	5.7	6.6	7.2	5.7	6.5	7.4	5.6	6.5	7.9	5.4	6.5
Stdev	0.5	1.2	1.2	0.4	1.8	1.6	0.4	2.1	1.6	0.5	2.0	1.7	0.5	2.2	2.1
Temp (C°)	JC-1 B	JC-1 S	JC-1 O	JC-2 B	JC-2 S	JC-2 O	JC-3 B	JC-3 S	JC-3 O	JC-4 B	JC-4 S	JC-4 O	JC-5 B	JC-5 S	JC-5 O
Mean	20.4	17.8	19.1	19.6	17.3	18.5	18.1	17.1	17.6	20.6	18.0	19.3	17.2	17.7	17.5
Stdev	7.4	8.0	7.4	8.8	8.1	8.1	8.1	7.9	7.6	6.0	6.8	6.2	7.7	8.8	7.8

The specific conductance and pH of stormflow was lower relative to baseflow for each sampling location while the oxidation reduction potential for stormflow was higher than baseflow. Rainwater is typically acidic and has less ions than groundwater. Groundwater discharge to streams makes up baseflow.

Overall, data suggest that better controlling stormwater runoff may reduce the nutrient and bacteria loadings to the estuary and thus improve water quality.

ACKNOWLEDGEMENTS

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