

**THE CITY OF KNOXVILLE
TENNESSEE
NPDES Permit Annual Report**



National Pollutant Discharge Elimination System
Stormwater Discharge Permit TNS068055
July 1, 2022 - June 30, 2023



Phase I Medium Municipal Separate Storm Drain System (MS4) Annual Report



Tennessee Department of
Environment and Conservation
Division of Water Resources
William R. Snodgrass Tennessee Tower,
312 Rosa L. Parks Avenue, Nashville,
Tennessee 37243, 888-891-8332

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1. MS4 Information

Name of MS4: City of Knoxville	MS4 Permit Number: TNS068055	
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What is the current population of your MS4? **From 2022 Census: 195,889**

What is the reporting period for this annual report? **July 1, 2022 to June 30, 2023**

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2. Discharges to Water Bodies with Unavailable Parameters or Exceptional Tennessee Waters

- A. Does your MS4 discharge into waters with unavailable parameters (previously referred to as impaired) for pathogens, nutrients, siltation or other parameters related to stormwater runoff from urbanized areas as listed on TN's most current 303(d) list and/or according to the on-line state GIS mapping tool (tdeconline.tn.gov/dwr/)? If yes, attach a list. Yes No

See attached Table 2A.

- B. Are there established and approved TMDLs (<https://www.tn.gov/environment/program-areas/wr-water-resources/watershed-stewardship/tennessee-s-total-maximum-daily-load-tmdl-program.html>) with waste load allocations for MS4 discharges in your jurisdiction? If yes, attach a list. Yes No

When the current permit was issued, the following TMDLs had been approved:

- Fecal Coliform in First, Second, Third, and Goose Creek (Fort Loudoun Lake Watershed - HUC 06010201), and;
- Fecal Coliform in Baker, Fourth, and Williams Creek (Fort Loudoun Lake Watershed HUC 06010201).

The following TMDLs have been approved since the current permit was issued or added to City limits due to annexation:

- Siltation and Habitat Alteration in the Ft. Loudon Lake Watershed (HUC 06010201), approved in 2006;
- E. Coli in the Fort Loudon Lake Watershed (HUC 06010201), approved in 2017;
- Pathogens in the Lower Clinch Watershed (HUC 06010207), approved in 2005;
- Siltation and Habitat Alteration in the Lower Clinch Watershed (HUC 06010207), approved in 2006, and;
- E. coli in the Lower Clinch River Watershed (HUC 06010207), approved in 2017.

Additionally, in 2010 a proposed TMDL was approved and titled *Proposed Total Maximum Daily Loads (TMDLs) for Polychlorinated Biphenyls (PCBs) in the Fort Loudon Lake Reservoir, Fort Loudon Lake Watershed (HUC 06010201)*.

- C. Does your MS4 discharge to any Exceptional TN Waters (ETWs - http://environmentonline.tn.gov:8080/pls/enf_reports/f?p=9034:34304:4880790061142)? If yes, attach a list.
 Yes No

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- D. Are you implementing a specific Stormwater Management Plan (SWMP) to control pollutant discharges to waterbodies with unavailable parameters or ETWs? If yes, describe the specific practices: Yes No

The City of Knoxville continues to implement and comply with the SWMP as issued in the 2004 NPDES permit (TNS068055), including the Comprehensive Monitoring Program (MN) as modified and approved by TDEC (Tennessee Department of Environment and Conservation). The SWMP and modified MN program and included as Table 2D and Table 2E, respectively.

3. Public Education/Outreach and Involvement/Participation

- A. Have you developed a Public Information and Education plan (PIE)? Yes No

- B. Is your public education program targeting specific pollutants and sources, such as Hot Spots? If yes, describe the specific pollutants and/or sources targeted by your public education program: Yes No

- The Special Pollution Abatement Permit (SPAP) program targets specific hot spots known to produce pollutants not covered by first flush requirements, such as floatable debris, oil/grease, and detergents/solvents. The program educates business on management and structural controls that can be used to prevent pollution.
- Signs have been installed at strategic locations throughout the City that are designed to educate the public on the water quality concerns, specifically E. coli and total Coliform bacteria, that can result from pet waste, feeding wild birds and sanitary sewer leakages.
- Educational programs for pesticides, herbicides, fertilizer, automotive fluids, etc., use have been implemented in conjunction with City's public education programs for collection and recycling of household hazardous waste (HHW).
- The 311 call center is advertised to increase the public's awareness of the City's role in water quality issues and to create a quick and anonymous method for citizens to report water quality concerns, like illicit dumping or industrial discharges.

- C. Do you have a webpage dedicated to your stormwater program? If yes, provide a link/URL: Yes No: <http://www.knoxvilletn.gov/stormwater>

- D. Summarize how you advertise and publicize your public education, outreach, involvement and participation opportunities:
- The City advertises the 311 call center through stormwater pollution prevention educational handouts (e.g. magnets, pet waste bag dispensers, koozies, and brochures), as well as through school presentations, neighborhood meetings, development conferences, business cards, vehicles, and signage.

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- The City advertises volunteer opportunities on the volunteer opportunities website (<https://volunteeretn.galaxydigital.com>) and on a shared website with other agencies.
 - The City manned an educational booth at the Knoxville 2023 Neighborhood Resource Fair. Information regarding water quality and stormwater pollution prevention for homeowners was presented to the public.
 - The City published a water quality related article titled, *Wetlands and Blue Water: Fountain City Lake's Water Quality Reflects Years of Careful Stewardship* on the City's blog and social media sites. The blog can be found at: knoxvilletn.gov/blog. Additionally, water quality projects can often be found on the Public Improvement Projects webpage at: knoxvilletn.gov/projects.
 - The City mailed 650 letters as part of the National Flood Insurance Programs (NFIP) Community Rating System (CRS). The letters included text encouraging public involvement with water quality through reporting concerns to 311.
 - The City developed and maintains the Best Management Practices (BMP) Manual and the Land Development Manual (LDM). Both are updated on an as needed basis and are available on the stormwater engineering website. The BMP Manual explains requirements for stormwater pollution prevention and erosion control for homeowners and both commercial and industrial sites. The LDM was created to assist developers with meeting all design and construction requirements.
 - The City has a standard that requires a "No Dumping, Drains to River" message to be cast in all new curb irons, solid stormwater manhole/junction box covers, and manhole lids for stormwater treatment devices.
- E. *Summarize the public education, outreach, involvement and participation activities you completed during this reporting period:*
- The City's Adopt-a-Stream program hosted 7 cleanup events through ongoing adoptions and one time group volunteer activities resulting in the removal of blockages and gross pollutants from approximately 3 miles of stream and the riparian buffer zone.
 - Both City staff and volunteers continued to educate the public on the negative effects on water quality that result from feeding wild birds at Fountain City Lake and other waterbodies. Educational efforts include permanent signage and updates on the City blog and Facebook page about the progress and struggles at Fountain City Lake. Updated signage is expected to be installed during the current permit year.
 - City staff provided education and outreach to those receptive at vagrant encampments and encouraged them not to use stream water to bathe, perform other hygiene practices, or eliminate waste.

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F. Summarize any specific successful outcome(s) (e.g., citizen involvement, pollutant reduction, water quality improvement, etc.) fully or partially attributable to your public education and participation program during this reporting period:

- Water quality related blog and social media post educated many citizens on wetland vegetation and controlling algae growth to enhance water quality.
- Adopt-A-Stream events removed gross pollutants from over three miles of stream and riparian buffer zones. A trailer equipped with creek cleaning supplies and wrapped with educational message is now available to the public to assist with adoption efforts. The trailer stays parked at Ned Mcwherter Park near a public boat ramp and is highly visible by all visiting the park
- The City's Solid Waste Facility collected 85,230 pounds of household hazardous waste.
- Approximately 220,000 pet waste bags were dispensed from the City's pet waste bag stations located throughout the City.
- Purchased a StormX trash net for secondary treatment of an outfall into Third Creek. The net was purchased partly in response to university student's interest in keeping trash out of Third Creek and what they could do to help. The City will monitor and maintain the net and effectiveness will be evaluated. Based on performance, other trash nets may be added to other City outfalls in the future.

4. Illicit Discharge Detection and Elimination, CFR 122.26 (d)(2)(iv)(B)

A. Have you developed and do you continue to update a storm drain system map that shows the location of system outfalls where the municipal storm drain system discharges into waters of the state? Yes No

See attached NPDES Permit Program Inventory Map.

B. If yes, does the map include inputs into the storm drain collection system, such as the inlets, catch basins, drop structures or other defined contributing points to the drainage area of that outfall, and general direction of stormwater flow? Yes No

The detailed inventory is maintained by City staff and managed by the Knoxville Geographic Information System (KGIS), which is funded by the City of Knoxville in partnership with Knox County and the Knoxville Utilities Board. The individual structures are not provided on the printed NPDES Permit Program Inventory Map due to scale. A City-wide assessment and inventory of the stormwater system is currently underway. The assessment will include invert data, flow direction, provide a current condition of the infrastructure, and include the ability to digitally attach inspection data to the assets. Additionally, as the surveyors encounter assets that require maintenance for access, the City maintains or repairs the asset quickly to allow the project to proceed.

C. How many outfalls have you identified in your storm drain system? 1,394

D. Do you have an ordinance, or other regulatory mechanism, that prohibits non-stormwater discharges into your storm sewer system? Yes No

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- E. *Have you implemented a plan to detect, identify and eliminate non-stormwater discharges, including illegal disposal, throughout the storm sewer system? If yes, provide a summary:*
 Yes No

In 1996, the City of Knoxville began implementation of the Illicit Discharge and Improper Disposal Program as a part of the SWMP. The program has been designed to detect and remove illicit and improper discharges to the Municipal Storm Drain System (MS4) as required by 40 CFR 122.26(d)(2)(iv)(B). The program includes the following sections:

- **The Stormwater and Street Ordinance (effective June 20, 1997)**

Specifically prohibits non-stormwater discharges and authorizes penalties up to \$5000 per day and provides water quality regulations for new development.

- **Field Screening**

Since 1996, the Dry Weather Screening Program has been used to evaluate both randomly selected outfalls and high-risk outfalls. At least 150 outfalls are screened annually. Screening consists of four site visits per outfall over a 1 year period. If flow is present the water is tested for indicator pollutants using a field test kit. A summary table of the results of outfalls that had flow at the time of screening is included as Table 4E. A map showing the location of all screened outfalls is included as the NPDES Permit Program Inventory Map. This program has successfully located and removed many illicit discharges and illegal cross connections.

- **Investigation of the Storm Drain Mapping System**

The procedure for mapping, field surveys, and upstream source identification were developed and included in the Part 2 Application in Section 5.3.5. The City continues to utilize and continually update the procedure to maintain the effectiveness of the Illicit Discharge and Improper Disposal Program. During this reporting year, The City made over 144 mapping corrections and revisions to the storm drain mapping system.

- **Spill Response Program**

The City's Stormwater Division coordinates with the Knoxville Emergency Management Agency (KEMA), Knoxville Fire Department (KFD) Hazmat, and TDEC during emergency situations, including after hours and weekends. Each agency has specific roles to play during an emergency event. When discharges enter the MS4, the Stormwater Division assists with information gathering, investigations, GIS support, containment, remediation, follow-up monitoring, documentation, and enforcement when necessary.

- **Reporting of Illicit Discharges**

The City actively encourages citizens to report water quality concerns to the 311 call center. In March of 2021, the 311 call center debuted the My Knoxville App, which allows citizens to report water quality concerns through a smart phone app. The app allows users to easily add a location using Google Maps and has the ability to attach pictures or videos. A direct link to report water quality concerns to 311 was also added to the Stormwater Engineering website. The City advertises the 311 call center through stormwater pollution prevention educational handouts (e.g. pet waste bag dispensers, koozies, and brochures), as well as presentations, business cards, vehicles, signage, and routine correspondence with residents. The City also promotes public involvement through several educational programs, such as, the River Rescue, Adopt-A-Stream, an educational booth at the Neighborhood Resource Fair, and routine training of Public Service, Engineering, and City Fleet departments.

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● **Used Oil and Toxic Materials Program**

The City operates multiple recycling centers as well as the Household Hazardous Waste Facility, which serves to divert reusable products, collect and reuse or solidify paints, collect car batteries and fluids, divert selected acids and bases to wastewater treatment, bulk flammable materials, and pack miscellaneous materials for safe shipment and disposal.

F. How many illicit discharge related complaints were received this reporting period?

223 illicit discharge complaints were received during the reporting year. 70 were received as an illicit discharge complaint and 153 were received as a new construction erosion control complaint.

G. How many illicit discharge investigations were performed this reporting period? **All illicit discharge complaints that were received resulted in an investigation and 220 outfalls were systematically screened through the Dry Weather Screening Program.**

H. Of those investigations performed, how many resulted in valid illicit discharges that were addressed and/or eliminated? **All valid complaints were addressed and eliminated as part of the initial field investigation. Of the 220 outfalls that were screened through the Dry Weather Screening Program, 12 illicit discharges were detected and addressed.**

5. Construction Site Stormwater Runoff Pollutant Control, CFR 122.26 (D)(2)(IV)(D)

A. Do you have an ordinance or other regulatory mechanism requiring:

Construction site operators to implement appropriate erosion prevention and sediment control BMPs consistent with those described in the TDEC EPSC Handbook? Yes No

Construction site operators to control wastes such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste? Yes No

Design storm and special conditions for unavailable parameters waters or exceptional Tennessee waters consistent with those of the current Tennessee Construction General Permit (TNR100000)? Yes No

B. Do you have specific procedures for construction site plan (including erosion prevention and sediment BMPs) review and approval? Yes No

C. Do you have sanctions to enforce compliance? Yes No

D. Do you hold pre-construction meetings with operators of priority construction activities and inspect priority construction sites at least monthly? Yes No

E. How many permits were issued for construction sites disturbing at least one acre or greater in your jurisdiction this reporting period? **27**

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F. *How many permits were issued for construction sites disturbing less than one acre or greater in your jurisdiction this reporting period?* **2,706**

G. *How many construction inspections were inspected this reporting period?* **11,812**

H. *How many construction related complaints were received this reporting period?* **153**

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6. Permanent Stormwater Management of Source Controls, CFR 122.26 (d)(2)(iv)(a)

- A. Do you have a regulatory mechanism (e.g. ordinance) requiring permanent stormwater pollutant removal for development and redevelopment projects? If no, have you submitted an Implementation Plan to the Division? Yes No

The 1997 Stormwater and Street Ordinance, updated November 2020, and the accompanying Land Development Manual (LDM).

- B. Does the ordinance or other regulatory mechanism require:

Site plan review and approval of new and re-development projects? Yes No

A process to ensure stormwater control measures (SCMs) are properly installed and maintained? Yes No

Permanent water quality riparian buffer zones? If yes, specify requirements: Yes No

The Stormwater and Street Ordinance requires a riparian buffer zone (RBZ) of 60 ft for drainage areas of greater than 1 square mile. A RBZ of 30 ft is allowed for drainage areas that are less than 1 square mile. The RBZ is measured from the top of the bank and extends perpendicularly for the length of the water body and is illustrated on KGIS. If a plat is required, the natural streamside buffer zone must be shown. The Ordinance does not allow any actively eroding creek banks to remain after development is complete. This may require the stream bank to be stabilized as part of the construction project. If stabilization is necessary, hard armor may only be used when bioengineering alternatives are not technologically feasible. The RBZ must be preserved post development.

- C. What is the threshold for development and redevelopment project plans plan review (e.g., all projects, projects disturbing greater than one acre, etc.)?

All disturbed areas greater than 10,000 ft² must submit an Erosion and Sediment Control Plan (ESC) that has been stamped by a design professional and calculations must be stamped by a registered professional engineer.

- D. How many development and redevelopment project plans were reviewed for this reporting period? **2,453**

- E. How many development and redevelopment project plans were issued permits? **2,733**

- F. How many enforcement actions were taken to address improper installation or maintenance?

402 Notices of Violation (NOVs) were issued for active construction site BMPs, 4 for active SPAP site BMPs, and 12 for illicit discharges. Verbal notifications are a routine part of our inspection process and are not included in this total.

- G. How many permanent, post-construction stormwater quality related inspections were performed during this reporting period? **172 SPAP inspections and 241 stormwater pond inspections were performed during the reporting year.**

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- H. Do you have a system to inventory and track the status of all public and private SCMs installed on development and redevelopment projects? Yes No

Both public and private SCMs that were installed before 1997 are mapped using the KGIS database. Private SCMs that are installed after 1997 are mapped using the KGIS database, recorded using permanent maintenance agreements and/or covenants, and tracked using the SPAP program (used for Hot Spots only) and the Accela database. All Public SCMs installed after 1997 are mapped using KGIS and tracked using the Accela database.

- I. Does your program include an off-site stormwater mitigation or payment into public stormwater fund? If yes, specify. Yes No

7. Stormwater Management for Municipal Operations, CFR 122.26(d)(2)(iv)(C)

- A. As applicable, have annual visual inspections been performed at least once a year on each of the municipal industrial facilities (MIFs) listed below:

Solid Waste Management Facility (SWMF) on Elm Street?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
The Fleet Truck and Heavy Equipment garage on Loraine Street?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
The Fleet and Police Garage at Prosser Road?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
The Knoxville Area Transit (KAT) bus station on Magnolia Avenue?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
The KAT Transfer Station on Church Street?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No

- B. Do you have a training program for employees responsible for municipal operations at facilities within the jurisdiction that handle, generate and/or store materials which constitute a potential pollutant of concern for MS4s? Yes No

Employees responsible for handling potential pollutants of concern are OSHA 24 Hour Hazardous Materials Technician trained and take a refresher course annually.

If yes, are new applicable employees trained within six months, and existing applicable employees trained and/or retrained within the permit term? Yes No

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8. Reviewing and Updating Stormwater Management Programs

- A. Describe any revisions to your program implemented during this reporting period including but not limited to: Modifications or replacement of an ineffective activity/control measure.

The City completed the third full year of the revised MN program approved by TDEC during 2020/2021 reporting year. The program continues to be refined as employees have utilized the previous two monitoring years to become more familiar with the Hydrolab equipment, Hydrolab software, more proficient at invertebrate sampling and identification, and bacteria testing. Dry weather screening continues to be streamlined using additional quick result test strips for certain field indicator parameters. Over the previous reporting year test strips were utilized in comparison to the more expensive and time consuming Chemetrics tests. Utilizing test strips for initial screening has been a time saving update. The more sensitive Chemetrics field tests are still used as needed given the initial results and/or specific site needs.

Changes to the program as required by the division to satisfy permit requirements. None

Information (e.g. additional acreage, outfalls, BMPs) on newly annexed areas and any resulting updates to your program. 21 previously unknown outfalls were identified on existing City property and added to the current inventory.

- B. In preparation for this annual report, have you performed an overall assessment of your stormwater management program effectiveness? If yes, summarize the assessment results, and any modifications and improvements scheduled to be implemented in the next reporting period.
 Yes No

The City of Knoxville proposed many changes in both the 2008 and the 2016 reapplication for permit TNS068055 to modify the current SWMP.

Enforcement Response Plan

- A. Have you implemented an enforcement response plan that includes progressive enforcement actions to address non-compliance, and allows the maximum penalties specified in TCA 68-221-1106? If no, explain. Yes No

The written Enforcement Response plan was developed by the City and reviewed by TDEC as part of the Tennessee Qualifying Local Program (QLP) approval process and can be found in the LDM as the “Qualified Local Program Construction General Permit”.

- B. As applicable, identify which of the following types of enforcement actions (or their equivalent) were used during this reporting period; indicate the number of actions, the minimum measure (e.g., construction, illicit discharge, permanent stormwater management), and note those for which you do not have authority:

<u>Action</u>	<u>Construction</u>	<u>Permanent Stormwater</u>	<u>Illicit Discharge</u>	<u>In Your ERP?</u>			
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NOVs	# 402	# 4	# 12	X	Yes	<input type="checkbox"/>	No
Administrative Penalties	# 21	#	#	X	Yes	<input type="checkbox"/>	No
Stop Work Orders	# 90	#	#	X	Yes	<input type="checkbox"/>	No

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- C. Do you track instances of non-compliance and related enforcement documentation?
 Yes No
- D. What were the most common types of non-compliance instances documented during this reporting period?

Erosion prevention and sediment control at new construction sites were the most common type of violation.

9. Monitoring, Recordkeeping, and Reporting

- A. Summarize any analytical monitoring activities (e.g., planning, collection, evaluation of results) performed during this reporting period.

Findings and Conclusions from the Comprehensive Monitoring Program:

Fourth Creek was selected for evaluation during the 2022/2023 reporting year. Eight strategic sampling/monitoring locations were selected. During the last part of the first quarter an additional location was added based on field investigation that found a small spring fed lake with an excessive population of ducks. Beginning with the September monitoring a ninth location was included. Fourth Creek analysis included, but was not limited to; ten defined reaches consisting of approximately 7.5 miles of creek, which were walked and evaluated by city staff. Invertebrate surveys conducted at eight sites within the watershed, included habitat assessment. See Appendix A for maps, Appendix C for invertebrate sampling and habitat assessments.

Water Quality Monitoring Summary:

The water quality monitoring was completed using Hydrolab Sondes and bacteria testing initially at seven strategic locations. This allowed for a comprehensive overview of the water quality in Fourth Creek. This monitoring in tandem with the creek walk survey revealed a problem area, which expanded sampling to include that location, named "Duck Poo". Elevated levels of bacteriological pollution were found along this tributary, as well as elevated levels of turbidity. The excess bacteria and turbidity levels decreased to low / normal levels after the ducks flew south for the winter. The excess levels of bacteria and turbidity never returned during the sampling period.

The sonde data collected at Fourth Creek revealed only elevated levels of Chloride after road salts were used for possible de-icing, at select locations. All other parameters sampled via Hydrolab Sonde were within accepted healthy limits, however, the creek does test above fishable/swimmable bacteria levels. See Tables 10A.1a through 10A.1j for Hydrolab Sonde results and Tables 10A.2a through 10A.2j for bacteria results. See table below for sonde parameters, ranges, and explanations.

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Sonde Parameter	Units	Acceptable Range
Specific Conductivity	mS/cm	.15 - .50 (Conductivity @ 25°C)
Raw Conductivity	μS/cm	This is used to get Specific Conductivity (Conductivity @ measured temp)
DO	%SAT	>60
DO	mg/L	>5
TDS	g/L	<.5
Density kg/m3	kg/m3	Weight of water
Salinity	psu	<.5
Turbidity #	NTU	<100 Lower is better
NH4+	mg/L-N	<1
NO3-	mg/L-N	>0, <1
NH3 Total	mg/L-N	<1
Cl- mg/L	mg/L	<230
NH3	mg/L-N	<1

Conductivity - Indicator of water quality, can determine concentration of solutions, detect contaminants and determine the purity of water (mS/cm x1000 = μS/cm)

Density - Weight of the water in Kg per cubic meter

Salinity - Concentration of salts in the water

Turbidity - Water clarity, can be higher after rain events

NH3 + NH4 = NH3 Total - Lower is better

Cl - Measure of chloride in the water, mostly comes from road salts, less is better.

TDS – Total Dissolved Solids, Measured in the field.

TSS – Total Suspended Solids, TSS = TDS + filtered solids

Stream Survey Summary:

Lower reaches 1 through 3, and 8 are majority residential zones, while 4 is primarily mixed commercial with a golf course at the head of the reach, which results in an intact decent quality riparian buffer. Slightly eroded banks and manicured lawns occupy much of this section of the creek. Reaches 5 through 7, and 10 are mixed commercial along major roads and travel corridors resulting in less of the creek being protected by a quality riparian buffer zone. Reach 9 is located along a surface street, but is mostly urban forest and unimproved land, giving it a wide and healthy riparian zone. Most of the creek has a good mix of riffles/runs/pools with a varied substrate consisting of a majority of gravel, boulder, and bedrock. Overall, Fourth Creek water quality parameters are good, but has the expected high bacteriological counts after rain events. See Appendix A for maps. See Appendix B for stream survey field sheets and representative photos. Additional photos of all reaches surveyed available upon request.

Invertebrate and Habitat Summary:

Eight different invertebrate surveys were performed at seven different locations. The samples at all locations contained a variety of obligate and tolerant species, from most orders, varied family species. Mayflies, Caddisflies, and True flies (mostly midges) were abundant throughout. Beetles, Damselflies, and Dragon flies were present throughout. Megaloptera (Adler fly, Dobson fly, Fish fly), and Stone flies, were not identified by City staff in Fourth Creek at the sampling locations. Less desirable insects such as scuds, flat worms, and water mites were also present in most locations, but not common. Salamanders and crayfish were common in the stream segments sampled. See Appendix A for maps. See Appendix C for habitat assessment field forms and representative invertebrate photos. Additional photos and completed biorecon data sheets for all sampling events available upon request.

This type of fluid and reactive monitoring/sampling allows tailoring to each creek's specific needs to better locate pollutant sources, identify impacted segments, and plan improvements. The overall goal is to identify and remediate unavailable parameters of 303(d) listed streams to the point portions and/or parameters listed will be delisted.

Municipal Industrial Facility Screening Summary:

The City collected wet weather grab samples from MIF outfalls that have pretreatment structures installed. In order to evaluate the effectiveness of the treatment units located at the Fleet Truck and Heavy Equipment garage and the SWMF, both pretreated and post treated grab samples were collected. Analytical laboratory data summaries for each of the sampling locations are included as Table 10A.3.

During the July 1, 2022 to June 30, 2023 monitoring period, a total average of 52.2 inches of rainfall was recorded. The City's five ISCO monitoring stations, two ISCO rain gauges, and one Weatherlink weather station recorded daily rainfall. Data is available on the City's Stormwater website:

https://knoxvilletn.gov/government/city_departments_offices/engineering/stormwater_engineering_division/rainfall_data

The NPDES permit requires an estimate of the total urban runoff volume discharged by the City of Knoxville annually. The volume estimate is based on total average annual rainfall and the estimated imperviousness of different land uses. To estimate the imperviousness the City utilizes GIS to determine the approximate area of each land use within a watershed. The total average rainfall was determined by averaging the rainfall recorded during the year from the City's stormwater monitoring stations, rain gauge

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stations, and the National Weather Service data recorded at McGhee Tyson airport. The analysis for each watershed and the entire City is included as Table 10A.4.

B. *Summarize any non-analytical monitoring and remedial activities (e.g., planning, collection, evaluation of results) performed during this reporting period.*

- **Hot Spots**

The City has identified many common discharges from facilities that are not required to be permitted under the TDEC multi-sector general stormwater permit or individual NPDES permit programs. Rather than spend limited resources attempting to duplicate the efforts of TDEC and Environmental Protection Agency (EPA) by monitoring existing permitted facilities, the City added the SPAP program for those specific land-uses that have proven to have the potential to discharge polluted runoff. Section 22.5-37 of the Stormwater and Street Ordinance requires a SPAP on new development and redevelopment of projects for certain land uses, targeting the pollutants of concern for each land use. This program is used to eliminate gaps in the existing State and Federal permit programs through a local inspection program for otherwise non-permitted facilities.

Each of the SPAP facilities is required to have some type of structural stormwater treatment device (e.g., oil/water separator, catch basin inset, grass swale) and/or pollution prevention management controls. During the SPAP inspection, the City typically reviews the facilities maintenance records, provides technical advice on proper maintenance scheduling, and updates the City's industrial and commercial facilities database. Inspection of the SPAP facilities occurs systematically to ensure that the structural controls are maintained and the management controls are being followed.

Stormwater Quality compliance inspections for non-SPAP sites are conducted in response to specific complaints from citizens or tips from 311 calls. The City decides on a case-by-case basis whether this group of inspections will use education or enforcement to correct any problems found. In some cases, an existing facility that is not "new development" or undergoing "redevelopment" may be required to apply for a SPAP to correct violations.

Hot spots are also identified through the water quality monitoring program, as discovered through field investigation, sampling, and complaint response. Monitoring hot spots included Mead Quarry, Papermill Place, Lonas/Weigles, Lorraine Street seep, Fountain City Lake, Broadway McDonalds, and Davis Street Spring. Summary of investigation below.

Mead Quarry was tested in May 2023 in response to suspected contamination due to algae bloom. Bacteria results were very low and within recreational limits. The event was determined to be a natural occurrence due to the lake flipping, and not associated with additional bacteria pollution.

The Davis Street spring investigation is ongoing, however the spring continues to be contaminated with bacteria from an unknown source despite multiple projects by KUB to eliminate inflow and infiltration that is contaminating groundwater. Laterals and fixtures of homes in the zone of influence were systematically tested to identify leaks and verify connectivity to the sanitary. Several properties were found to be in non-compliance. Multiple NOVs and plumbing enforcement orders have been served, with several properties already completing repairs. Bacteria levels have been found to not be impacted by wet and/or dry conditions. Currently, repairs to date have not resulted in a noticeable reduction in bacteria contamination. E. Coli continues to be extremely high in the effluent, and the spring discharge is capped and plumbed into the sanitary sewer.

Phase I Medium Municipal Separate Storm Drain System (MS4) Annual Report

Papermill Place was part of an investigation into a spike in bacteria levels identified during scheduled monitoring. A point source was not identified, and bacteria levels dropped back to previous levels. The source was either eliminated or possibly caused by vagrant camp activity. Lonas/Weigles was sampled to determine the downstream impact of a significant sanitary sewer main overflow, which occurred at 1225 East Weisgarber Rd, on March 28th 2023. Bacteria levels had returned to base level at time of sampling. Fountain City Lake experienced a fish kill and was sampled as a response. The fish kill was later identified to be caused by the stocking agent releasing sick/diseased fish into the body of water.

TMDL Implementation

Dilapidated metal stormwater pipes are continually identified and remediated using cured in place pipe (CIPP) lining technology. This technology allows the City to repair the dilapidated metal pipes without the need to dig and replace. This results in eliminating the risk of sediment discharge during construction, as well as eliminating sediment discharges from the rusted pipe that occur during storms. During this reporting period, the City designed and awarded a contract to line 1,485 feet of dilapidated pipe.

Vagrant encampments continue to severely impact the health of urban creeks. Impacts include, but are not limited to, high bacteria levels, loss of substrate habitat due to unnatural debris coverage, riparian buffer damage, creek bank instability due to loss of vegetation, biological hazards, needles, nutrients from food waste, chemicals, detergents, garbage dams, methamphetamine manufacturing, and increased flood potential. Due to the attempted management and evacuation of camps this pollution source has been diffused into smaller areas of watersheds and may have a reduced impact of the creeks. The most significantly impacted creeks continue to be First Creek, Second Creek, Goose Creek, and Ten Mile Creek. Further monitoring, coordination with other agencies/departments, and remediation efforts will continue and hopefully expand in the future.

The City continues to remediate the pollutant hazard with removal of trash and other materials. Contractors were hired on an emergency remediation basis to remove trash, bulky items (creating flooding and habitat damage), and biohazards (needles and drug paraphernalia) from the creek and riparian buffer. Approximately \$163,000 worth of contractor remediations efforts were completed utilizing emergency funds.

In the First Creek Watershed, Fountain City Lake has historically been a source of fecal coliform due to wildlife. The City's efforts to educate the public on the negative impacts of feeding wildlife, as well as the physical removal of invasive aquatic plants, has resulted in water quality improvements that allowed TWRA to stock the lake with trout and catfish.

TWRA's stocking schedule can be found here:

<https://www.tn.gov/content/dam/tn/twra/documents/fishing/trout/winter-trout-schedule.pdf>

• Municipal Industrial Facility Inspection Program

The City has developed an inspection and pollution prevention program for municipal industrial facilities. Currently only five MIFs are operated by the City. These facilities include:

- The Solid Waste Management Facility (SWMF) on Elm Street,
- The Fleet Truck and Heavy Equipment garage on Loraine Street,
- The Fleet and Police Garage at Prosser Road,
- The Knoxville Area Transit (KAT) bus station on Magnolia Avenue, and
- The KAT Transfer Station on Church Street.

Phase I Medium Municipal Separate Storm Drain System (MS4) Annual Report

Each facility is currently evaluated and inspected regularly by Stormwater staff and will continue to be inspected at least annually in the future. The KAT Station is the newest of the MIFs and was built using LEED standards including stormwater quality treatment devices for the runoff.

The inspection and monitoring program has been productive at all of the MIFs in the past. Structural and management BMPs have been installed to control pollution and improve the water quality of runoff from each facility. The SWMF has been retrofitted with structural controls to reduce the solids, sediment, hydrocarbons, and bacteria in the runoff from the paved areas. Additional water quality improvements have been constructed at the SWMF that include new grit/sediment sumps, floatables skimmers, grass swale, and low flow modifications to the detention pond.

- **Industrial Facility Inspection Program**

As part of the NPDES Permit for stormwater discharges associated with industrial activity, applicants are required to monitor, at least bi-annually, representative stormwater outfalls identified in the facilities' SWPPPs. Applicants must monitor in accordance with TDEC Rule 1200-4-10-.04. The Stormwater and Street Ordinance authorizes the City to require additional monitoring from industries not covered under the TDEC programs whenever necessary and requires all permit holders to submit a copy of their permit within 60 days of issuance. The City maintains this information and assess the impact of the monitored discharges on the water quality in the MS4.

If the City determines that additional data needs to be provided in the monitoring program for an industry (e.g., reports on additional parameters), requirements for an expanded program for subsequent monitoring events is coordinated with TDEC and/or the industrial discharger.

- **Permanent Maintenance Agreement Inspection Program**

Since 1997, permanent maintenance agreements and/or covenants have been required for all new stormwater detention facilities and special pollution abatement devices (e.g., oil/water separators and catch basin inserts). A covenant is defined in Section 22.5-34 of the Ordinance as a legal document entitled "Covenant for Permanent Maintenance of Stormwater Facilities," which replaced the original "agreement" referred to in the Part II application and Part IV of the permit. A covenant does not require the Mayor's signature or Council approval, and the end result for water quality protection and flood control is the same. Covenants are recorded in the office of the Knox County Register of Deeds. The City has also begun logging all non-SPAP facility SCMs with covenants into the Accela database for better tracking of inspections and maintenance.

The City retains the right to inspect the stormwater facilities to insure they are properly maintained; however, the responsibility for the maintenance of stormwater facilities remains with the property owner unless legally transferred to another person or entity by a properly recorded legal agreement. If the property owner does not maintain the facility properly, the City may perform the maintenance at the property owner's expense. If the owner does not reimburse the City, the City may place a lien against the property for double the cost. To ensure access to the facility, a traversable access easement is required.

C. *If applicable, are monitoring records for activities performed during this reporting period submitted with this report.* Yes No

Phase I Medium Municipal Separate Storm Drain System (MS4) Annual Report

10. Fiscal Analysis

The Fiscal Analysis for this annual report lists the permit year budget sources and amounts along with estimates for the following permit year. Due to complexity, all of the support activities such as purchasing, payroll, legal support, information systems, fleet management, and human resources are not reflected. The below table presents the primary sources of funding for the City’s stormwater related activities.

Capital Funds	FY23 Actual	Proposed Funding FY24
Stormwater Engineering and Development Services	\$2,517,877	\$24,782,196**
Civil Engineering*	\$22,942,606	\$50,551,270**
Operating Funds	FY23 Actual	FY24 Budget
Stormwater Engineering and Development Services	\$3,061,993	\$3,319,700
PSD – Stormwater Related	\$4,605,371	\$4,722,311***
Household Hazardous Waste Facility and Recycling	\$3,067,609	\$3,164,978

* - Civil Engineering capital funded projects include stormwater quality and quantity components but also have unrelated expenses.

** - Includes FY23 ending balances, FY24 funding, and American Rescue Plan (ARP) funds.

*** - Estimated amount of stormwater related activities which are paid out of PSD general fund account.

Phase I Medium Municipal Separate Storm Drain System (MS4) Annual Report

11. Certification

This report must be signed by a ranking elected official or by a duly authorized representative of that person. See signatory requirements in sub-part VII (K) of the permit.

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Indya Kincannon, Mayor City of Knoxville

Printed Name and Title

Indya Kincannon

Signature

12/14/2023

Date

Annual reports must be submitted within 6 months after the end of the permit year to the Environmental Field Office (EFO) located at 3711 Middlebrook Pike, Knoxville TN 37921.

APPROVED AS TO FORM:

Charles W. Swanson

CHARLES W. SWANSON
LAW DIRECTOR

Table 2A

City of Knoxville Waters with Unavailable Parameters

Waterbody ID	Impacted Waterbody	County	Miles/Acres Impaired	Reason for Impairment/TMDL Priority	Pollutant Source
TN06010104 001_0100	LOVE CREEK	Knox	9.7 Miles	Nitrate+Nitrite Sediment/Siltation Other Anthropogenic Habitat Alterations Escherichia coli	L L L NA Urbanized High Density Area
TN06010104 001_1400	SWANPOND CREEK	Knox	16.3 Miles	Escherichia coli	NA Urbanized High Density Area
TN06010201 020_1000	FORT LOUDOUN RESERVOIR	Knox Loudon	14066 acres	PCBs	L Contaminated Sediment
TN06010201 020_2000	FORT LOUDOUN RESERVOIR	Knox	534 acres	Mercury PCBs	L NA Atmospheric Deposition Contaminated Sediment
TN06010201 066_0500	MCCALL BRANCH	Knox	1.73 Miles	Sediment/Siltation	L Urbanized High Density Area
TN060102010 20T_0100	TOLL CREEK	Knox	2.05 Miles	Alteration in Stream-Side or Littoral Vegetative Covers Sediment/Siltation	L L Urbanized High Density Area
TN060102010 89_0110	UNNAMED TRIB TO FLENNIKEN BRANCH	Knox	1.87 Miles	Chloride Sedimentation/Siltation	L L Landfills Urbanized High Density Areas
TN06010201 067_0100	EAST FORK THIRD CREEK	Knox	2.78 Miles	Sediment/Siltation Other Anthropogenic Habitat Alterations Escherichia coli	NA NA NA Urbanized High Density Area Collection System Failure
TN06010201 067_1000	THIRD CREEK	Knox	17.86 Miles	Nitrate+Nitrite Sediment/Siltation Other Anthropogenic Habitat Alterations Escherichia coli	L NA NA NA Land Development or Redevelopment Urbanized High Density Area Collection System Failure
TN06010201 080_0100	WHITES CREEK	Knox	10.2 Miles	Other Anthropogenic Habitat Alterations Escherichia coli Sediment/Siltation	NA NA L Urbanized High Density Area Streambank Modification
TN06010201 080_1000	FIRST CREEK	Knox	16.1 Miles	Nitrate+Nitrite Sediment/Siltation Other Anthropogenic Habitat Alterations Escherichia coli	L NA NA NA Urbanized High Density Area Collection System Failure
TN06010201 097_1000	SECOND CREEK	Knox	12.8 Miles	Other Anthropogenic Habitat Alterations Nitrate+Nitrite Sediment/Siltation Escherichia coli	NA L NA NA Urbanized High Density Area Collection System Failure
TN06010201 1330_1000	SINKING CREEK	Knox	4.1 Miles	Escherichia coli	NA Urbanized High Density Area
TN06010201 1334_0100	TEN MILE CREEK	Knox	12.74 Miles	Alteration in Stream-Side or Littoral Vegetative Covers Sediment/Siltation Escherichia coli	L L NA Urbanized High Density Area
TN06010201 340_1000	TURKEY CREEK	Knox	15.8 Miles	Sediment/Siltation Escherichia coli	NA NA Urbanized High Density Area
TN06010201 697_1000	FOURTH CREEK	Knox	14.9 Miles	Physical Substrate Habitat Alterations Escherichia coli	NA NA Urbanized High Density Area Channelization

Table 2A

City of Knoxville Waters with Unavailable Parameters

Waterbody ID	Impacted Waterbody	County	Miles/Acres Impaired	CAUSE / TMDL Priority	Pollutant Source
TN06010201 719_1000	WILLIAMS CREEK	Knox	2.8 Miles	Nitrate+Nitrite Other Anthropogenic Habitat Alterations Escherichia coli	L NA NA Urbanized High Density Area Collection System Failure
TN06010201 721_1000	BAKER CREEK	Knox	3.3 Miles	Nitrate+Nitrite Other Anthropogenic Habitat Alterations Escherichia coli	L NA NA Urbanized High Density Area Collection System Failure
TN06010201 723_1000	GOOSE CREEK	Knox	4.9 Miles	Sediment/Siltation Other Anthropogenic Habitat Alterations PCBs Escherichia coli	NA NA L NA Collection System Failure Urbanized High Density Area RCRA Hazardous Waste
TN06010207 011_0600	KNOB FORK	Knox	8.1 Miles	Nitrate+Nitrite Sediment/Siltation Other Anthropogenic Substrate Alterations Alteration in Stream-Side or Littoral Vegetative Cover Escherichia coli	L NA L L NA Urbanized High Density Area
TN06010207 011_0700	GRASSY CREEK	Knox	8.2 Miles	Sediment/Siltation Escherichia coli Alteration in Stream-Side or Littoral	NA NA L Urbanized High Density Area
TN06010207 011_2000	BEAVER CREEK	Knox	13.7 Miles	Escherichia coli Sediment/Siltation Physical Substrate Habitat Alteration in Stream-Side or littoral	NA NA L L Pasture Grazing Urbanized High Density Area Collection System Failure

Notes:

L - Low Priority

M - Medium Priority

H - High Priority

NA - Not Applicable

Table 2D

City of Knoxville SWMP

**SCHEDULE FOR MAINTENANCE AND IMPLEMENTATION OF
SWMP ELEMENTS AND PROGRAMS**

PROGRAM OF STRUCTURAL AND SOURCE CONTROLS FOR REDUCING
POLLUTANTS TO THE MUNICIPAL SEPARATE STORM SEWER SYSTEM

122.26 (d)(2)(iv)(A)

The Residential and Commercial Program (RC)

Code	Activity	Schedule
	<u><i>Maintenance Activities for Structural Controls</i></u>	
RC-1	-Continue existing maintenance programs from Part 2 application, pp.5-5 thru 5-8.	Ongoing
	-Develop improved stream restoration and channel maintenance program.	12 Months
	-Implement improved stream restoration and channel maintenance program.	24 Months
	-Require Standard Maintenance Agreement for on-site facilities.	Ongoing
	-Continue to coordinate with other agencies/organizations to develop, install, and maintain structural controls that prevent floating pollution (litter/oils/foam/etc) from entering the TN River	Ongoing
	-Require routine / major maintenance of BMP facilities.	Ongoing
	<u><i>Planning for New Development</i></u>	
RC-2	-Review original Stormwater & Streets Ordinance to evaluate possible improvements to existing water quality and quantity requirements for new development.	Immediately
	-Require "No Dumping" message cast into all curb irons and solid stormwater catch basin covers installed on new developments.	Immediately
	-Plan and site location for regional BMP facilities for area of new development.	Ongoing
	-Continue to review, update, and maintain guidance criteria for BMP's on City web page (http://www.ci.knoxville.tn.us/engineering/)	Ongoing
	<u><i>Maintenance for Public Streets, Roads, and Highways</i></u>	
RC-3	-Continue street maintenance activities outlined in Part 2 application, p.5-8	Ongoing
	-Evaluate current deicing program and study alternatives and improvements.	Ongoing
	<u><i>Evaluation of Flood Management Projects</i></u>	
RC-4	-Continue to evaluate regional BMP facilities for water quality retrofits.	Ongoing
	-Maintain existing GIS inventory of on-site BMP facilities, including newly constructed facilities.	Ongoing
	<u><i>Monitoring of Solid Waste Facilities</i></u>	
RC-5	-See City's management program for industrial areas.	See Code IN-3
	<u><i>Management of Pesticides, Herbicides, and Fertilizer</i></u>	
RC-6	- Evaluate possible improvements to existing public education program as part of illicit connection and improper disposal program. Educate City staff, public, etc.	12 Months
	- Reevaluate effect of fertilizers as part of the City's ongoing monitoring program.	60 Months
	<u><i>Annual Reporting</i></u>	
RC-7	- Annual reporting to TDEC concerning the progress of this program.	Within 6 months after the end of each year.

Table 2D

City of Knoxville SWMP

**SCHEDULE FOR MAINTENANCE AND IMPLEMENTATION OF
SWMP ELEMENTS AND PROGRAMS**

PROGRAM TO DETECT AND REMOVE ILLICIT AND
IMPROPER DISCHARGES TO THE MUNICIPAL STORM SEWER SYSTEM
122.26 (d)(2)(iv)(B)

The Illicit Discharges and Improper Disposal Program (ILL)

Code	Activity	Schedule
ILL-1	<u>Ordinances</u>	
	-Evaluate the prohibitions and exemptions of non-stormwater discharges in the original Stormwater & Streets Ordinance. Maintain authority for \$5000 penalty.	Immediately
	-Implement any new revisions to the Stormwater & Streets Ordinance.	6 Months
ILL-2	<u>Field Screening</u>	
	-Perform follow-up analysis at all high risk screening sites.	Ongoing
	-Investigate 150 field sites four times per year . (Including the repeat high parameter sites above.)	Ongoing
ILL-3	<u>Investigation of Storm Drain System</u>	
	- Implement procedures for mapping, field surveys and upstream source identification.	Ongoing
	-Evaluate and update enforcement procedures, policies, monitoring and inspections.	Ongoing
	- Inspect stormdrain system and update features on GIS.	Ongoing
ILL-4	<u>Spill Response Program</u>	
	- Coordinate with Knoxville Emergency Response Team (KERT) and Tennessee Department of Environment and Conservation (TDEC).	Ongoing
ILL-5	<u>Reporting of Illicit Discharges and Public Education Program</u>	
	- Continue to maintain and monitor the "Water Quality Hotline" for public reporting.	Ongoing
	- Maintain public education program.	Ongoing
ILL-6	<u>Used Oil & Toxic Materials Program</u>	
	- Continue coordination of recycling program (managed by Solid Waste Division (SWD)).	Ongoing
	- Maintain and Operate household hazardous waste facility (managed by SWD).	Ongoing
ILL-7	<u>Annual Reporting</u>	
	- Annual reporting to TDEC concerning the progress of this program.	Within 6 months after the end of each year.

Table 2D

City of Knoxville SWMP

SCHEDULE FOR MAINTENANCE AND IMPLEMENTATION OF SWMP ELEMENTS AND PROGRAMS

PROGRAM TO MONITOR AND CONTROL RUNOFF FROM TSD AND INDUSTRIAL FACILITIES SUBJECT TO SARA III, SECTION 313 122.26(d)(2)(iv)(C)

The Industrial and Related Facilities Program (IN)

Code	Activity	Schedule
<u>Ordinances</u>		
IN-1	<ul style="list-style-type: none"> - Evaluate possible revisions to the prohibitions and exemptions of non-stormwater discharges in the existing Stormwater & Streets Ordinance - Implement any new revisions to the Stormwater & Streets Ordinance. 	Immediately
		6 Months
<u>Inspection Element</u>		
IN-2	<ul style="list-style-type: none"> - Develop inspection program for non-permitted commercial facilities (i.e. restaurants, services stations, grocery stores, car lots, etc.) - Collect and analyze NOI's from Industrial Permit applicants. - Identify potential industrial discharges through Illicit Connection and Improper Disposal Program. (Both SW and non-SW discharges) - Review and update inspection program as part of Pollution Prevention Plans for Municipal Industrial Facilities. Conduct annual inspections at municipal industrial facilities. 	12 Months
		Ongoing
		Ongoing
		12 Months
<u>Monitoring Element</u>		
IN-3	<ul style="list-style-type: none"> - Collect monitoring data from industrial stormwater dischargers and/or from TDEC. Assess impacts to storm sewer system. - Develop an ongoing monitoring program at non-permitted commercial facilities using guidelines pursuant to 40 CFR 122.26(d)(2)(iv)(c)(2). Identify industrial pollutants & sources as applicable. - Implement the ongoing monitoring program at non-permitted commercial facilities and analyze the results from ongoing commercial monitoring program. - Maintain adequate legal authority to require monitoring and reports from TSDs and Industrial facilities subject to SARA Title III, Section 313. Request monitoring reports as necessary. - Evaluate and update the monitoring program for Municipal Industrial Facilities (MIFs) in each annual report. - Manage and conduct monitoring program at Municipal Industrial Facilities. 	Ongoing
		12 Months
		Begin after 12 Months
		Ongoing
		Annually
		12 Months
<u>Annual Reporting</u>		
IN-4	<ul style="list-style-type: none"> - Annual reporting to TDEC concerning the progress of this program. 	Within 6 months after the end of each year

Table 2D

City of Knoxville SWMP

SCHEDULE FOR MAINTENANCE AND IMPLEMENTATION OF SWMP ELEMENTS AND PROGRAMS

PROGRAM TO IMPLEMENT AND MAINTAIN BMP PLANS TO REDUCE CONSTRUCTION SITE RUNOFF TO THE MUNICIPAL STORM SEWER 122.26(d)(2)(iv)(D)

The Construction Site Runoff Program (CS)

Code	Activity	Schedule
<u>Site Planning</u>		
CS-1	<ul style="list-style-type: none"> - Review and update the original Stormwater & Streets Ordinance which requires construction sites greater than 10,000 sq.ft. to submit Erosion & Sediment (E&S) control plans. - Require site plans submittals per the City of Knoxville BMP manual. - Review & update minimum criteria for plan review and inspection checklist. - Continue Preconstruction Assistance Meetings with developer/contractors. 	Immediately
		Immediately
		Immediately
		Immediately
<u>BMP Requirements</u>		
CS-2	<ul style="list-style-type: none"> - Require Construction BMP's from the City of Knoxville BMP manual or equivalent. - Evaluate additional BMP requirements and design modifications. Maintain the updated BMP requirements on the City's web page. - Continue to require construction site "good housekeeping" practices. 	Immediately
		2nd half of each year
		Immediately
<u>Inspection / Enforcement</u>		
CS-3	<ul style="list-style-type: none"> - Continue expanded inspections to include smaller construction sites (single family); where feasible. - Implement routine site inspections on commercial and subdivision developments (e.g. rough grading, E&S control installation, final grading, and final stabilization. - Continue to require post-construction Development Certifications from licensed professional Engineers, and/or the appropriate design professional before bond release to insure the stormwater facilities were built as planned. - Maintain enforcement procedures, policies, and follow-up monitoring/inspections. 	Ongoing
		Ongoing
		Ongoing
		Ongoing
<u>Training Programs</u>		
CS-4	<ul style="list-style-type: none"> - Co-sponsor E & S Control Practice Seminars for all participants. - Continue to provide training for City plan review staff and inspectors. 	Annually
		Annually
<u>Annual Reporting</u>		
CS-5	<ul style="list-style-type: none"> - Annual reporting to TDEC concerning the progress of this program. 	Within 6 months after the end of each year

Table 2D

City of Knoxville SWMP

SCHEDULE FOR MAINTENANCE AND IMPLEMENTATION OF SWMP ELEMENTS AND PROGRAMS

**PROGRAM TO COLLECT QUANTITATIVE DATA TO DETERMINE THE IMPACTS OF URBAN STORMWATER ON THE NATURAL ENVIRONMENT
122.26(d)(2)(iii)(A)**

The Comprehensive Monitoring Program (MN)

Code	Activity	Schedule
	<u>Seasonal Storm Event Monitoring</u>	
MN-1	- Maintain the Standard Operating Procedures (SOP) for the seasonal sampling program.	Annually
	- Maintain at least five (5) automatic monitoring stations at locations approved by TDEC.	Ongoing
	- Collect and analyze a minimum of twenty (20) flow weighted composite samples as listed below in accordance with 40 CFR 136 for all parameters except pH, which will be determined in the field at the time of sample collection. Parameters include: BOD5, COD5, suspended residue, dissolved residue, nitrate + nitrite N, ammonia, total kjeldahl N, total organic N, total phosphate, lead, zinc, and ph (field).	Minimum of one per quarter per station annually.
	- Collect and analyze five (5) wet weather bacteria samples (fecal coliform and <i>E.coli</i>).	One sample/year/station
	- Collect and analyze five (5) full-suite grab samples of: oil & grease, the pollutants listed in Tables II & III of 40 CFR Part 122 Appendix D (Volatiles, Pesticides, Acids, Base/Neutrals, Toxic Metals, Cyanide, and Total Phenols).	One station per year.
	<u>Dry Weather Screening & Industrial/Commercial Site Monitoring</u>	
MN-2	- Dry weather screening as described in ILL-2.	Annually
	- Implement Commercial/Industrial Monitoring Programs as described in IN-3.	Varies
	<u>Ambient & Biological Monitoring</u>	
MN-3	- Continue Ambient sampling program at the five designated monitoring stations. All routine parameters shall be tested once per quarter per station.	Quarterly
	- Maintain the Biological Monitoring program that supplements the program administered by TVA. This program focuses on habitat assessments, bioassessments, etc.	Ongoing
	<u>Training Programs</u>	
MN-4	- Maintain the Training Program for Staff and/or Volunteers.	Ongoing
	<u>Annual Reporting</u>	
MN-5	- Annual reporting to TDEC concerning the progress of this program.	Within 6 months after the end of each year

Table 2E

City of Knoxville SWMP - Modified MN

SCHEDULE FOR MAINTENANCE AND IMPLEMENTATION OF SWMP ELEMENTS AND PROGRAMS

PROGRAM TO COLLECT QUANTITATIVE DATA TO DERMINE THE IMPACTS OF U RBAN STORMWATER ON THE NATURAL ENVIRONMENT
122.26(D)(2)(iii)(A)

The Comprehensive Monitoring Program (MN)

Code	Activity	Schedule
MN-1	<u>Ambient and Wet Weather Monitoring</u>	
	Revise and maintain the Standard Operating Procedures (SOP) for the sampling program.	Annually
	Maintain at least five automatic monitoring stations to collect rainfall data, including at creek flow/depth measurements.	Ongoing
	Select "designated" creek/watersheds for in depth watershed monitoring. Watersheds will be rotated annually.	Annually
	Analyze samples with a hand held sonde (Hydrolab HL4 and HL7) within designated watershed for parameters including pH, temperature, dissolved oxygen, specific conductivity, raw conductivity, TDS, density, salinity, turbidity, ammonium, nitrate, total ammonia, ammonia, and chloride. A minimum of four (4) strategically located sampling locations selected along the designated creek segment. Sample collection will be targeted the same week of the given month and year.	Monthly
	Collect and analyze a bacteria samples (total coliform and E.coli) within designated watershed. One sample per designated sampling location per sampling event.	Monthly
	Creek and Hot Spot sampling and monitoring locations to be identified and investigated as determined necessary for point source pollutants.	Ongoing
	Collect and analyze full suite grab samples of: oil and grease, volatiles, pesticides, acids, base/neutrals, toxic metals, cyanide, and total phenols.	One Creek Annually
MN-2	<u>Dry Weather Screening & Industrial/Commercial Site Monitoring</u>	
	Dry weather screening as described in ILL-2	Annually
	Implement Commercial/Industrial Monitoring Program as described in IN-3.	Varies
MN-3	<u>Biological Monitoring</u>	
	Creek walk and stream surveys will be completed for the designated creek.	Annually
	Biological sampling and habitat assessment will be performed for designated stream. Identifications to be made by City staff. Macroinvertebrate sampling will occur monthly in combination with sonde/bacteria sampling at and/or near monitoring locations, spring thru fall. No sampling in winter.	Seasonally
MN-4	<u>Training Program & Analysis</u>	
	Maintain the Training Program for Staff and/or Volunteers.	Ongoing
MN-5	<u>Annual Reporting</u>	
	Annual reporting to TDEC concerning the progress of this program.	Annually

Table 4E

Dry Weather Screening Outfalls with Flow
July 1, 2022 through June 30, 2023

Outfall/Permit Year	Visit Date	Visit #	Flow Yes/No	Flow Rate	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Color	Odor Yes/No	Surface Scum Yes/No	Oil Sheen Yes/No
00-400-0265														
22/23	02/08/2023 11:15	1	Yes	7gpm	7	1	0	0	0	0	Clear	Yes	No	No
22/23	02/08/2023 15:15	2	Yes	7gpm	7	1	0	0	0	0	Clear	Yes	No	No
22/23	05/24/2023 08:45	3	Yes	7gpm	7	T	0	0	0	0	Clear	No	No	No
22/23	05/24/2023 13:05	4	Yes	7gpm	7	T	0	0	0	0	Clear	No	No	No
01-100-0230														
22/23	09/20/2022 10:30	1	Yes	3gpm	8.5	0	0	0	0	T	Clear	No	Yes	No
22/23	09/20/2022 14:45	2	Yes	3gpm	8.5	0	0	0	0	0	Clear	No	Yes	No
22/23	03/29/2023 09:15	3	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	03/29/2023 13:20	4	Yes	5gpm	7	0	0	0	T	0	Clear	No	No	No
01-100-0550														
22/23	09/01/2022 11:10	1	Yes	10gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	09/01/2022 15:10	2	Yes	10gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	03/29/2023 11:30	3	Yes	10gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	03/29/2023 15:35	4	Yes	10gpm	7	0	0	0	0	0	Clear	No	No	No
01-100-0830														
22/23	08/25/2022 09:30	1	Yes	3gpm	7.0	0	0	0	0.5	1	Clear	Yes	Yes	No
22/23	08/25/2022 13:40	2	Yes	3gpm	7.5	0	0	0	0.5	1	Clear	Yes	Yes	No
22/23	03/21/2023 09:45	3	Yes	5gpm	6.5	0	0	0	T	0	Clear	No	No	No
22/23	03/21/2023 13:45	4	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
01-200-0400														
22/23	09/15/2022 09:15	1	Yes	3gpm	7.0	0	0	0	0	0	Clear	No	No	No
22/23	09/15/2022 13:45	2	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	03/21/2023 11:20	3	Yes	3gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	03/21/2023 15:20	4	Yes	3gpm	7	0	0	0	0	0	Clear	No	No	No
01-200-0695														
22/23	09/01/2022 09:50	1	Yes	3gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	09/01/2022 13:55	2	Yes	3gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	03/21/2023 11:00	3	Yes	3gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	03/21/2023 15:00	4	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No

Table 4E

Dry Weather Screening Outfalls with Flow
July 1, 2022 through June 30, 2023

Outfall/Permit Year	Visit Date	Visit #	Flow Yes/No	Flow Rate	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Color	Odor Yes/No	Surface Scum Yes/No	Oil Sheen Yes/No
01-300-0144														
22/23	09/19/2022 09:15	1	Yes	10gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	09/19/2022 13:25	2	Yes	10gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	03/29/2023 12:15	3	Yes	10gpm	6.5	0	0	0	0	0	Clear	No	No	No
22/23	03/30/2023 09:45	4	Yes	10gpm	7	0	0	0	0	0	Clear	No	No	No
01-300-0150														
22/23	09/19/2022 08:50	1	Yes	10+gpm	8.5	0	0	0	T	T	Clear	No	No	No
22/23	09/19/2022 13:00	2	Yes	10+gpm	8.5	0	0	0	0	.25	Clear	No	No	No
22/23	03/29/2023 11:50	3	Yes	10+gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	03/29/2023 16:05	4	Yes	10+gpm	7.5	0	0	0	0	0	Clear	No	No	No
01-300-0395														
22/23	09/15/2022 10:00	1	Yes	Low flow	7.0	0	0	0	0	0	Clear	No	No	No
22/23	09/15/2022 14:05	2	Yes	Low flow	7.0	0	0	0	0	0	Clear	No	No	No
22/23	03/21/2023 11:45	3	Yes	Low flow	7.5	0	0	0	0	0	Clear	No	No	No
22/23	03/21/2023 15:50	4	Yes	Low flow	7.5	0	0	0	0	T	Clear	No	No	No
01-400-0335														
22/23	09/15/2022 11:25	1	Yes	5+ gpm	6	1+	0	0	0	0	Clear	No	No	No
22/23	09/15/2022 15:25	2	Yes	5+ gpm	6.5	1+	0	0	0	0	Clear	No	No	No
22/23	03/29/2023 10:25	3	Yes	Low flow	6.5	T	0	0	0	1+	Clear	No	No	No
22/23	03/29/2023 14:40	4	Yes	Low flow	6.5	T	0	0	0	1+	Clear	No	No	No
01-400-0355														
22/23	09/15/2022 10:00	1	Yes	Low flow	7.0	0	0	0	0	0	Clear	No	No	No
22/23	09/15/2022 14:05	2	Yes	Low flow	7.0	0	0	0	0	0	Clear	No	No	No
22/23	03/16/2023 09:35	3	No											
22/23	03/16/2023 13:40	4	No											
01-400-0470														
22/23	09/15/2022 08:45	1	Yes	Low flow	7.5	0	0	0	0	0	Clear	No	No	No
22/23	09/15/2022 13:30	2	Yes	Low flow	7.5	0	0	0	0	0	Clear	No	No	No
22/23	03/29/2023 09:35	3	No											
22/23	03/29/2023 15:50	4	No											

Table 4E

Dry Weather Screening Outfalls with Flow
July 1, 2022 through June 30, 2023

Outfall/Permit Year	Visit Date	Visit #	Flow Yes/No	Flow Rate	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Color	Odor Yes/No	Surface Scum Yes/No	Oil Sheen Yes/No
01-400-0725														
22/23	09/01/2022 08:55	1	Yes	10gpm	7.0	0	0	0	0	0	Clear	No	No	No
22/23	09/01/2022 13:05	2	Yes	10gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	03/29/2023 10:45	3	Yes	10gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	03/29/2023 15:00	4	Yes	10gpm	7	0	0	0	0	0	Clear	No	No	No
01-400-0812														
22/23	08/25/2022 10:10	1	Yes	3gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	08/25/2022 14:15	2	Yes	3gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	03/21/2023 10:40	3	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	03/21/2023 14:40	4	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
01-400-0820														
22/23	08/25/2022 10:00	1	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	08/25/2022 14:00	2	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	03/21/2023 10:15	3	Yes	3gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	03/21/2023 14:15	4	Yes	3gpm	7	0	0	0	0	0	Clear	No	No	No
01-500-0710														
22/23	09/01/2022 09:30	1	Yes	3gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	09/01/2022 13:40	2	Yes	3gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	03/29/2023 11:10	3	Yes	3gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	03/29/2023 15:15	4	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
02-100-0480														
22/23	09/21/2022 10:00	1	Yes	5gpm	8.5	0	0	0	0	0	Clear	No	No	No
22/23	09/21/2022 14:25	2	Yes	5gpm	8.5	0	0	0	0	0	Clear	No	No	No
22/23	05/24/2023 11:05	3	Yes	5gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	05/24/2023 15:15	4	Yes	5gpm	8.5	0	0	0	0	0	Clear	No	No	No
02-300-0165														
22/23	09/30/2022 09:50	1	Yes	3gpm	7.5	0	0	0	T	T	Clear	No	No	No
22/23	09/30/2022 13:50	2	Yes	3gpm	7.5	0	0	0	0	T	Clear	No	No	No
22/23	06/01/2023 11:35	3	Yes	3gpm	7	0	0	0	0	T	Clear	No	No	No
22/23	06/02/2023 09:45	4	Yes	3gpm	7.5	0	0	0	0	T	Clear	No	No	No

Table 4E

Dry Weather Screening Outfalls with Flow
July 1, 2022 through June 30, 2023

Outfall/Permit Year	Visit Date	Visit #	Flow Yes/No	Flow Rate	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Color	Odor Yes/No	Surface Scum Yes/No	Oil Sheen Yes/No
02-300-0230														
22/23	09/29/2022 11:10	1	Yes	10gpm	7.0	0	0	0	0	0	Clear	No	No	No
22/23	09/29/2022 15:30	2	Yes	10gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	06/01/2023 11:00	3	Yes	10gpm	7.5	0	0	0	T	0	Clear	No	No	No
22/23	06/02/2023 10:15	4	Yes	10gpm	7.5	0	0	0	0	0	Clear	No	No	No
02-400-0150														
22/23	09/30/2022 09:30	1	Yes	5gpm	7.5	T	0	0	0	0.25	Clear	No	No	No
22/23	09/30/2022 13:30	2	Yes	5gpm	7.5	T	0	0	0	T	Clear	No	No	No
22/23	06/01/2023 11:55	3	Yes	5gpm	7.5	T	0	0	T	T	Clear	No	No	No
22/23	06/02/2023 11:00	4	Yes	5gpm	7.5	0	0	0	0	T	Clear	No	No	No
03-100-0380														
22/23	10/06/2022 11:00	1	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	10/06/2022 15:15	2	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	06/06/2023 10:15	3	Yes	3gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	06/06/2023 14:30	4	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
03-100-0620														
22/23	10/04/2022 13:30	1	No											
22/23	10/05/2022 08:50	2	No											
22/23	03/21/2023 10:45	3	Yes	Trickle	6.8	0.2	0	0	T	T	Clear	No	Yes	No
22/23	03/21/2023 16:05	4	Yes	Trickle	6.8	0.4	0	0	T	T	Clear	No	Yes	No
03-200-0409														
22/23	10/06/2022 09:45	1	Yes	5gpm	7.0	0	0	0	0	0	Clear	No	No	No
22/23	10/06/2022 14:00	2	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	06/06/2023 09:50	3	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	06/06/2023 14:05	4	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No
03-200-0436														
22/23	10/05/2022 10:30	1	Yes	3gpm	7.0	0	0	0	0	0	Clear	No	No	No
22/23	10/05/2022 14:30	2	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	06/06/2023 10:40	3	Yes	5gpm	7.5	0	0	0	T	0	Clear	No	No	No
22/23	06/06/2023 14:50	4	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No

Table 4E

Dry Weather Screening Outfalls with Flow
July 1, 2022 through June 30, 2023

Outfall/Permit Year	Visit Date	Visit #	Flow Yes/No	Flow Rate	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Color	Odor Yes/No	Surface Scum Yes/No	Oil Sheen Yes/No
03-200-0905														
22/23	09/01/2022 10:30	1	Yes	Low Creek Flow	7.5	0	0	0	0	0	Clear	No	No	No
22/23	09/01/2022 14:30	2	Yes	Low Creek Flow	7.5	0	0	0	0	0	Clear	No	No	No
22/23	02/06/2023 09:20	3	Yes	Low Creek Flow	7.5	0	0	0	0	0	Clear	No	No	No
22/23	02/06/2023 14:00	4	Yes	Low Creek Flow	7.5	0	0	0	0	0	Clear	No	No	No
03-200-0990														
22/23	10/03/2022 09:15	1	Yes	Low flow	7.5	0	0	0	0	0	Sediment	No	No	No
22/23	10/03/2022 13:20	2	Yes	Low flow	7.5	0	0	0	0	0	Sediment	No	No	No
22/23	02/21/2023 09:30	3	Yes	*creek										
22/23	02/21/2023 14:35	4	Yes	*creek										
03-300-0675														
22/23	10/04/2022 12:30	1	Yes	Drip	8.5	0	0	0	0	0	Clear	No	Yes	No
22/23	10/05/2022 10:15	2	Yes	Drip	7.5	0	0	0	0	0	Clear	No	Yes	No
22/23	03/21/2023 11:30	3	Yes	5gpm	7.2	0	0	0	0	T	Clear	Yes	Yes	No
22/23	03/21/2023 16:20	4	Yes	*creek										
04-500-0160														
22/23	09/15/2022 09:50	1	No											
22/23	09/15/2022 14:15	2	No											
22/23	02/06/2023 13:30	3	Yes	10+	7	0	0	N/A	t	0	Clear	No	No	No
22/23	02/07/2023 13:30	4	Yes	10+	7.5	0	0	0	0	0	Clear	No	No	No
04-500-0238														
22/23	09/01/2022 08:45	1	No											
22/23	09/01/2022 15:25	2	No											
22/23	02/06/2023 10:05	3	Yes	5+gpm	7	0.1	0	N/A	T	0.1	Clear	No	No	No
22/23	02/07/2023 09:50	4	Yes	5+gpm	7	0	0	0	0	0	Clear	No	No	No
05-300-0035														
22/23	08/15/2022 10:50	1	Yes	5gpm	9	0	0	0	0	0	Clear	No	No	No
22/23	08/15/2022 14:55	2	Yes	5gpm	9	0	0	0	0	0	Clear	No	No	No
22/23	03/28/2023 09:15	3	Yes	5gpm	7.5	0	0	0	0	T	Clear	No	No	No
22/23	03/28/2023 13:15	4	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No

Table 4E

Dry Weather Screening Outfalls with Flow
July 1, 2022 through June 30, 2023

Outfall/Permit Year	Visit Date	Visit #	Flow Yes/No	Flow Rate	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Color	Odor Yes/No	Surface Scum Yes/No	Oil Sheen Yes/No
06-100-0200														
22/23	08/18/2022 09:30	1	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	08/18/2022 13:50	2	Yes	5gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	02/21/2023 10:25	3	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	02/21/2023 14:30	4	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
06-400-0080														
22/23	08/18/2022 10:20	1	Yes	5gpm	7.0	0	0	0	0	0	Clear	No	No	No
22/23	08/18/2022 14:30	2	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	02/21/2023 11:00	3	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	02/21/2023 15:00	4	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No
07-100-0055														
22/23	08/15/2022 10:15	1	Yes	Low Creek Flow	7	0	0	0	0	0	Clear	No	No	No
22/23	08/15/2022 14:15	2	Yes	Low Creek Flow	7	0	0	0	0	0	Clear	No	No	No
22/23	02/06/2023 10:45	3	Yes	Low Creek Flow	7	0	0	0	0	0	Clear	No	No	No
22/23	02/06/2023 14:50	4	Yes	Low Creek Flow	7.5	0	0	0	0	0	Clear	No	No	No
07-100-0130														
22/23	08/15/2022 10:35	1	Yes	2gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	08/15/2022 14:35	2	Yes	2gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	02/07/2023 10:20	3	No											
22/23	02/07/2023 14:20	4	No											
07-200-0015														
22/23	08/15/2022 09:55	1	Yes	Low Creek Flow	7	0	0	0	0	0	Clear	No	No	No
22/23	08/15/2022 13:55	2	Yes	Low Creek Flow	7.5	0	0	0	0	0	Clear	No	No	No
22/23	02/06/2023 10:15	3	Yes	Low Creek Flow	7.5	0	0	0	0	0	Clear	No	No	No
22/23	02/06/2023 15:40	4	Yes	Low Creek Flow	7.6	0	0	0	0	0	Clear	No	No	No
11-200-0600														
22/23	09/15/2022 11:30	1	Yes	5gpm	8.5	0	0	0	0	T	Sediment	No	Yes	No
22/23	09/16/2022 09:50	2	Yes	5gpm	8	0	0	0	0	T	Sediment	No	Yes	No
22/23	05/02/2023 09:30	3	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	05/02/2023 13:40	4	Yes	5gpm	8	0	0	0	0	0	Clear	No	No	No

Table 4E

Dry Weather Screening Outfalls with Flow
July 1, 2022 through June 30, 2023

Outfall/Permit Year	Visit Date	Visit #	Flow Yes/No	Flow Rate	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Color	Odor Yes/No	Surface Scum Yes/No	Oil Sheen Yes/No
12-100-0748														
22/23	02/07/2023 10:45	1	Yes	10gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	02/07/2023 14:45	2	Yes	10gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	04/13/2023 10:50	3	Yes	10gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	04/13/2023 15:00	4	Yes	10gpm	7.5	0	0	0	0	0	Clear	No	No	No
12-200-0745														
22/23	02/07/2023 10:10	1	Yes	1gpm	6	0	0	0	0	0	Clear	No	No	No
22/23	02/07/2023 14:10	2	Yes	1gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	04/13/2023 10:20	3	Yes	Low flow	7.5	0	0	0	0	0	Clear	No	No	No
22/23	04/13/2023 14:30	4	Yes	Low flow	7.5	0	0	0	0	0	Clear	No	No	No
12-300-0749														
22/23	02/07/2023 11:10	1	Yes	Drip	9	0	0	0	0	0	Clear	No	No	No
22/23	02/07/2023 15:10	2	Yes	Drip	9	0	0	0	0	0	Clear	No	No	No
22/23	04/13/2023 11:25	3	Yes	Drip	8.5	0	0	0	0	0	Clear	No	No	No
22/23	04/13/2023 15:30	4	Yes	Drip	9	0	0	0	0	0	Clear	No	No	No
12-500-0740														
22/23	02/07/2023 09:30	1	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	02/07/2023 13:35	2	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	04/13/2023 09:50	3	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	04/13/2023 13:55	4	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
13-300-0135														
22/23	10/11/2022 10:45	1	No											
22/23	10/11/2022 15:05	2	No											
22/23	05/04/2023 11:00	3	Yes	1gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	05/04/2023 15:30	4	Yes	1gpm	7.5	0	0	0	0	0	Clear	No	No	No
13-300-0150														
22/23	10/11/2022 10:20	1	No											
22/23	10/11/2022 14:35	2	No											
22/23	05/04/2023 10:30	3	Yes	5gpm	7.5	0	0	0	0	T	Clear	No	No	No
22/23	05/04/2023 14:45	4	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No

Table 4E

Dry Weather Screening Outfalls with Flow
July 1, 2022 through June 30, 2023

Outfall/Permit Year	Visit Date	Visit #	Flow Yes/No	Flow Rate	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Color	Odor Yes/No	Surface Scum Yes/No	Oil Sheen Yes/No
13-300-0305														
22/23	10/10/2022 10:00	1	Yes	10gpm	8	T	0	0	T	0	Clear	No	No	No
22/23	10/10/2022 14:15	2	Yes	10gpm	8.5	0	0	0	T	0	Clear	No	No	No
22/23	06/06/2023 09:25	3	Yes	10gpm	8	T	0	0	0	0	Clear	No	No	No
22/23	06/06/2023 13:35	4	Yes	10gpm	8	T	0	0	T	0	Clear	No	No	No
31-100-0500														
22/23	08/19/2022 10:30	1	Yes	10gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	08/19/2022 14:30	2	Yes	10gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	02/21/2023 09:15	3	Yes	10gpm	6	0	0	0	0	0	Clear	No	No	No
22/23	02/21/2023 13:20	4	Yes	10gpm	6.5	0	0	0	0	0	Clear	No	No	No
31-500-0510														
22/23	08/19/2022 09:40	1	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	08/19/2022 13:55	2	Yes	3gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	02/21/2023 09:40	3	Yes	5gpm	6	0	0	0	0	0	Clear	No	No	No
22/23	02/21/2023 13:50	4	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
53-100-0065														
22/23	08/31/2022 11:05	1	Yes	3gpm	8.5	0	0	0	0	0	Clear	No	No	No
22/23	08/31/2022 15:15	2	Yes	3gpm	8.5	0	0	0	0	0	Clear	No	No	No
22/23	02/07/2023 11:00	3	No											
22/23	02/07/2023 15:00	4	No											
53-100-0075														
22/23	08/31/2022 10:55	1	Yes	5gpm	8.5	0	0	0	0	0	Clear	No	No	No
22/23	08/31/2022 15:00	2	Yes	5gpm	8.5	0	0	0	0	0	Clear	No	No	No
22/23	02/07/2023 11:30	3	Yes	5gpm	8	0	0	0	0	0	Clear	No	No	No
22/23	02/07/2023 15:30	4	Yes	5gpm	8	0	0	0	0	0	Clear	No	No	No
53-100-0085														
22/23	08/31/2022 10:30	1	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	08/31/2022 14:30	2	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	02/07/2023 11:50	3	Yes	Low Creek Flow	7	0	0	0	0	0	Clear	No	No	No
22/23	02/07/2023 15:50	4	Yes	Low Creek Flow	7	0	0	0	0	0	Clear	No	No	No

Table 4E

Dry Weather Screening Outfalls with Flow
July 1, 2022 through June 30, 2023

Outfall/Permit Year	Visit Date	Visit #	Flow Yes/No	Flow Rate	pH (su)	Chlorine (ppm)	Copper (ppm)	Phenol (ppm)	Detergents (ppm)	Ammonia (ppm)	Color	Odor Yes/No	Surface Scum Yes/No	Oil Sheen Yes/No
53-100-0128														
22/23	08/31/2022 09:35	1	Yes	Low Creek Flow	7.0	0	0	0	0	0	Clear	No	No	No
22/23	08/31/2022 13:45	2	Yes	Low Creek Flow	7.5	0	0	0	0	0	Clear	No	No	No
22/23	02/20/2023 09:55	3	Yes	Low Creek Flow	7	0	0	0	0	0	Hazy	No	No	No
22/23	02/20/2023 14:15	4	Yes	Low Creek Flow	7	0	0	0	0	0	Hazy	No	No	No
53-200-0170														
22/23	08/31/2022 08:30	1	Yes	2gpm	7.0	0	0	0	0	0	Clear	No	No	No
22/23	08/31/2022 13:10	2	Yes	2gpm	7.0	0	0	0	0	0	Clear	No	No	No
22/23	02/20/2023 10:55	3	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	02/20/2023 15:25	4	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
53-200-0240														
22/23	08/29/2022 09:50	1	Yes	5gpm	7.0	0	0	0	0	.25	Clear	No	No	No
22/23	08/29/2022 13:50	2	Yes	5gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	02/20/2023 11:45	3	Yes	5gpm	7	0	0	0	0	0	Clear		No	No
22/23	02/20/2023 15:55	4	Yes	5gpm	7	0	0	0	0	0	Clear	No	No	No
53-500-0185														
22/23	08/29/2022 10:30	1	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	08/29/2022 14:35	2	Yes	3gpm	7.5	0	0	0	0	0	Clear	No	No	No
22/23	05/25/2023 09:15	3	Yes	3gpm	7	0	0	0	0	0	Clear	No	No	No
22/23	05/25/2023 13:20	4	Yes	3gpm	7	0	0	0	0	0	Clear	No	No	No

Notes:

gpm - gallons per minute

su - standard unit

ppm - parts per million

mpn - most probable number

ml - mililiter

Table 10A.1a

Water Quality Monitoring Program (HL4 & HL7 Sonde) Analysis Summary - Fourth Creek

July 1, 2022 through June 30, 2023

Agnes																		
Site	Date	Last Rain	72 Hour Precip**	Temp	pH	Specific Conductivity	Raw Conductivity	DO	DO	TDS	Density kg/m3	Salinity	Turbidity #	NH4+ *	NO3- *	NH3 Total *	Cl- mg/L *	NH3 *
Units			in	°F		mS/cm	µS/cm	%SAT	mg/L	g/L	kg/m3	psu	NTU	mg/L-N	mg/L-N	mg/L-N	mg/L	mg/L-N
Q1	7/27/22	7/26/22	Wet	77.0	7.96	0.32	319.4	104.2	8.4	0.205	997.178	0.150	0.829	0.29000	0.4699	0.310	22.6196	0.020
	8/24/22	8/22/22	Wet	69.3	7.94	0.39	359.3	79.0	6.9	0.250	998.199	0.190	32.452	0.35016	0.9836	0.361	28.7052	0.010
	9/28/22	9/25/22	Dry	57.9	7.98	0.48	383.6	79.9	8.0	0.307	999.380	0.230	0.722	0.22956	1.1219	0.235	42.0579	0.010
Average:				68.1	7.96	0.40	354.1	87.7	7.8	0.254	998.252	0.190	11.334	0.28991	0.8585	0.302	31.1276	0.013
Q2	10/26/22	10/26/22	Wet	59.0	7.75	0.22	179.2	64.4	6.3	0.141	999.193	0.111	8.437	0.27051	0.9399	0.279	14.8871	0.000
	11/22/22	11/15/22	Dry	42.4	7.97	0.49	315.4	87.8	10.8	0.312	1000.150	0.240	0.326	0.26892	2.8598	0.272	55.8552	0.000
	12/28/22	12/27/22	Wet	43.5	8.05	0.52	339.2	103.0	12.5	0.331	1000.142	0.250	0.757	0.19015	4.0292	0.191	179.2223	0.000
Average:				48.3	7.92	0.41	277.9	85.1	9.9	0.261	999.828	0.200	3.174	0.24320	2.6096	0.247	83.3215	ND
Q3	1/25/23	1/25/23	Wet	46.2	7.88	0.15	102.1	99.3	11.3	0.096	999.920	0.070	65.541	0.31070	2.2080	0.313	21.2166	0.000
	2/22/23	2/17/23	Dry	59.2	8.21	0.44	358.9	117.3	11.4	0.282	999.258	0.210	1.293	0.15148	2.4238	0.160	32.2921	0.010
	3/29/23	3/26/23	Dry	51.4	8.12	0.46	334.8	97.9	10.6	0.291	999.810	0.220	1.322	0.12000	1.7108	0.120	26.0321	0.000
Average:				52.3	8.07	0.35	265.3	104.8	11.1	0.223	999.663	0.167	22.718	0.19406	2.1142	0.198	26.5136	0.003
Q4	4/26/23	4/23/23	Dry	54.7	7.91	0.46	353.8	84.7	8.8	0.295	999.610	0.220	1.347	0.25231	1.4829	0.260	29.5266	0.010
	5/24/23	5/20/23	Dry	68.8	8.01	0.39	352.2	133.3	11.7	0.247	998.261	0.190	1.690	0.20000	0.4844	0.216	15.6511	0.010
	6/28/23	6/25/23	Dry	74.5	8.07	0.45	433.3	141.5	11.6	0.285	997.561	0.220	0.983	0.25032	0.4792	0.266	12.8458	0.015
Average:				66.0	8.00	0.43	379.7	119.8	10.7	0.276	998.477	0.210	1.340	0.23421	0.8155	0.248	19.3412	0.012

- ND: Analyte was not detected, or no data available

- #: HL4 parameter only

- *: HL7 parameter only

- Mapped sampling locations available in Appendix A

- **: Rain= Rain during sampling, Wet= Rain in previous 72 hours, Dry= No rain in previous 72 hours

Table 10A.1b

Water Quality Monitoring Program (HL4 & HL7 Sonde) Analysis Summary - Fourth Creek

July 1, 2022 through June 30, 2023

Aquarium																		
Site	Date	Last Rain	72 Hour Precip**	Temp	pH	Specific Conductivity	Raw Conductivity	DO	DO	TDS	Density kg/m3	Salinity	Turbidity #	NH4+ *	NO3- *	NH3 Total *	Cl- mg/L *	NH3 *
Units			in	°F		mS/cm	µS/cm	%SAT	mg/L	g/L	kg/m3	psu	NTU	mg/L-N	mg/L-N	mg/L-N	mg/L	mg/L-N
Q1	7/27/22	7/26/22	Wet	66.4	7.35	0.42	373.1	67.6	6.1	0.269	998.554	0.200	1.516	0.28806	1.5721	0.292	67.9581	0.000
	8/24/22	8/22/22	Wet	64.0	7.56	0.44	381.6	63.0	5.8	0.283	998.812	0.210	1.868	0.21098	1.6746	0.212	27.2625	0.000
	9/28/22	9/25/22	Dry	61.1	7.53	0.45	376.8	67.6	6.5	0.289	999.098	0.220	1.300	0.20569	1.9914	0.209	36.6855	0.000
Average:				63.8	7.48	0.44	377.1	66.1	6.2	0.280	998.821	0.210	1.562	0.23491	1.7460	0.238	43.9687	ND
Q2	10/26/22	10/26/22	Wet	60.3	7.49	0.42	348.4	59.8	5.8	0.270	999.155	0.207	3.513	0.20000	1.9629	0.200	38.5105	0.000
	11/22/22	11/15/22	Dry	54.8	7.58	0.45	347.1	70.5	7.4	0.289	999.604	0.220	2.508	0.28246	2.0723	0.286	41.0609	0.000
	12/28/22	12/27/22	Wet	56.3	7.72	0.48	379.3	84.5	8.7	0.310	999.508	0.240	1.539	0.19369	2.6938	0.196	61.4552	0.000
Average:				57.1	7.60	0.45	358.3	71.6	7.3	0.290	999.422	0.222	2.520	0.22538	2.2430	0.228	47.0089	ND
Q3	1/25/23	1/25/23	Wet	48.8	7.85	0.19	131.3	93.7	10.3	0.119	999.840	0.090	24.154	0.17957	1.7722	0.182	42.3513	0.000
	2/22/23	2/17/23	Dry	62.0	7.85	0.44	368.4	83.1	7.8	0.280	999.002	0.210	2.046	0.18985	2.8351	0.191	40.5919	0.000
	3/29/23	3/26/23	Dry	56.0	7.50	0.46	361.5	78.2	8.0	0.296	999.521	0.230	1.947	0.18000	1.9732	0.180	31.0354	0.000
Average:				55.6	7.73	0.36	287.1	85.0	8.7	0.232	999.454	0.177	9.382	0.18314	2.1935	0.184	37.9929	ND
Q4	4/26/23	4/23/23	Dry	58.2	7.83	0.45	364.5	70.5	7.0	0.290	999.346	0.220	4.635	0.18735	2.2096	0.190	33.4471	0.000
	5/24/23	5/20/23	Dry	62.7	7.54	0.44	370.2	73.0	6.9	0.279	998.938	0.210	1.502	0.19016	1.5580	0.194	28.0492	0.000
	6/28/23	6/25/23	Dry	64.6	7.52	0.40	351.0	71.0	6.5	0.258	998.733	0.200	2.637	0.18359	1.3016	0.185	27.7080	0.000
Average:				61.8	7.63	0.43	361.9	71.5	6.8	0.276	999.006	0.210	2.925	0.18703	1.6897	0.190	29.7347	ND

- ND: Analyte was not detected, or no data available

- #: HL4 parameter only

- *: HL7 parameter only

- Mapped sampling locations available in Appendix A

- **: Rain= Rain during sampling, Wet= Rain in previous 72 hours, Dry= No rain in previous 72 hours

Table 10A.1c

Water Quality Monitoring Program (HL4 & HL7 Sonde) Analysis Summary - Fourth Creek

July 1, 2022 through June 30, 2023

Aubreys																		
Site	Date	Last Rain	72 Hour Precip**	Temp	pH	Specific Conductivity	Raw Conductivity	DO	DO	TDS	Density kg/m3	Salinity	Turbidity #	NH4+ *	NO3- *	NH3 Total *	Cl- mg/L *	NH3 *
Units			in	°F		mS/cm	µS/cm	%SAT	mg/L	g/L	kg/m3	psu	NTU	mg/L-N	mg/L-N	mg/L-N	mg/L	mg/L-N
Q1	7/27/22	7/26/22	Wet	67.1	7.77	0.50	444.5	85.5	7.6	0.318	998.494	0.240	0.805	0.34061	1.6062	0.350	54.5327	0.010
	8/24/22	8/22/22	Wet	65.4	7.94	0.37	325.7	84.1	7.7	0.238	998.637	0.179	8.398	0.23000	1.7020	0.240	29.3551	0.010
	9/28/22	9/25/22	Dry	60.7	8.00	0.48	401.2	84.2	8.2	0.310	999.147	0.239	2.986	0.24406	2.0236	0.252	31.8141	0.010
Average:				64.4	7.90	0.45	390.5	84.6	7.8	0.288	998.759	0.219	4.063	0.27156	1.7773	0.280	38.5673	0.010
Q2	10/26/22	10/26/22	Wet	61.7	7.83	0.46	385.9	61.2	5.8	0.294	999.043	0.220	3.494	0.23492	2.0892	0.240	29.1010	0.000
	11/22/22	11/15/22	Dry	53.9	8.02	0.48	360.9	77.3	8.2	0.304	999.670	0.230	1.981	0.32269	2.6401	0.331	40.5024	0.010
	12/28/22	12/27/22	Wet	55.5	7.99	0.65	501.5	92.1	9.5	0.414	999.630	0.320	2.447	0.30422	3.3145	0.310	151.3506	0.010
Average:				57.0	7.95	0.53	416.1	76.9	7.8	0.337	999.448	0.257	2.641	0.28727	2.6813	0.294	73.6513	0.007
Q3	1/25/23	1/25/23	Wet	54.1	7.69	0.51	387.3	82.8	8.5	0.325	999.668	0.250	16.616	0.30571	3.1611	0.309	112.7404	0.000
	2/22/23	2/17/23	Dry	61.8	7.88	0.52	434.5	87.4	8.2	0.331	999.053	0.250	3.759	0.22954	2.8463	0.233	47.6788	0.010
	3/29/23	3/26/23	Dry	58.4	7.82	0.51	412.4	88.2	8.8	0.328	999.353	0.250	27.299	0.20815	2.0885	0.210	37.9440	0.000
Average:				58.1	7.80	0.51	411.4	86.1	8.5	0.328	999.358	0.250	15.891	0.24780	2.6986	0.251	66.1211	0.003
Q4	4/26/23	4/23/23	Dry	59.0	7.89	0.50	409.3	86.0	8.5	0.323	999.297	0.250	2.852	0.19143	2.3068	0.200	34.4081	0.010
	5/24/23	5/20/23	Dry	63.4	7.71	0.50	424.7	87.3	8.1	0.317	998.888	0.240	7.217	0.19000	1.7571	0.200	26.8018	0.010
	6/28/23	6/25/23	Dry	65.7	7.96	0.47	417.2	89.2	8.1	0.303	998.639	0.231	1.531	0.23506	1.3553	0.243	22.2481	0.010
Average:				62.7	7.85	0.49	417.1	87.5	8.2	0.314	998.941	0.240	3.867	0.20550	1.8064	0.214	27.8193	0.010

- ND: Anlyate was not detected, or no data available

- #: HL4 parameter only

- *: HL7 parameter only

- Mapped sampling locations available in Appendix A

- **: Rain= Rain during sampling, Wet= Rain in previous 72 hours, Dry= No rain in previous 72 hours

Table 10A.1d

Water Quality Monitoring Program (HL4 & HL7 Sonde) Analysis Summary - Fourth Creek

July 1, 2022 through June 30, 2023

Lakeshore																		
Site	Date	Last Rain	72 Hour Precip**	Temp	pH	Specific Conductivity	Raw Conductivity	DO	DO	TDS	Density kg/m3	Salinity	Turbidity #	NH4+ *	NO3- *	NH3 Total *	Cl- mg/L *	NH3 *
Units			in	°F		mS/cm	µS/cm	%SAT	mg/L	g/L	kg/m3	psu	NTU	mg/L-N	mg/L-N	mg/L-N	mg/L	mg/L-N
Q1	7/27/22	7/26/22	Wet	68.8	8.01	0.44	399.5	100.9	8.9	0.280	998.280	0.210	0.746	0.28926	1.2475	0.301	31.0174	0.010
	8/24/22	8/22/22	Wet	66.2	8.10	0.44	391.8	97.9	8.9	0.283	998.582	0.215	3.230	0.19042	1.4732	0.200	26.5696	0.010
	9/28/22	9/25/22	Dry	57.8	8.04	0.45	358.2	91.1	9.1	0.287	999.380	0.220	0.997	0.23108	1.8528	0.240	38.5646	0.010
Average:				64.3	8.05	0.44	383.2	96.6	9.0	0.283	998.747	0.215	1.658	0.23692	1.5245	0.247	32.0505	0.010
Q2	10/26/22	10/26/22	Wet	60.5	7.82	0.25	208.1	80.6	7.7	0.161	999.079	0.120	11.947	0.24898	1.8452	0.250	20.7710	0.000
	11/22/22	11/15/22	Dry	48.5	8.15	0.44	307.2	102.7	11.7	0.279	999.950	0.210	1.136	0.26349	2.4262	0.270	43.6705	0.010
	12/28/22	12/27/22	Wet	50.3	8.20	0.47	342.0	108.5	12.0	0.302	999.874	0.230	3.013	0.55523	3.3415	0.570	69.9757	0.010
Average:				53.1	8.06	0.39	285.8	97.3	10.5	0.247	999.634	0.187	5.365	0.35590	2.5377	0.363	44.8057	0.007
Q3	1/25/23	1/25/23	Wet	48.4	7.94	0.19	132.7	102.6	11.4	0.120	999.850	0.090	55.960	0.21029	2.3479	0.211	32.8163	0.000
	2/22/23	2/17/23	Dry	61.7	8.26	0.44	366.8	110.5	10.4	0.280	999.040	0.210	1.604	0.19000	2.7092	0.201	33.7197	0.010
	3/29/23	3/26/23	Dry	56.7	8.02	0.45	351.4	117.9	12.0	0.285	999.460	0.220	2.483	0.17672	1.9513	0.180	28.0666	0.010
Average:				55.6	8.07	0.36	283.6	110.3	11.3	0.228	999.450	0.173	20.016	0.19234	2.3362	0.198	31.5342	0.007
Q4	4/26/23	4/23/23	Dry	56.3	8.03	0.45	354.1	96.6	9.8	0.289	999.490	0.220	2.147	*	*	*	*	*
	5/24/23	5/20/23	Dry	64.2	7.78	0.44	384.6	104.5	9.7	0.284	998.790	0.220	2.744	0.17000	1.3970	0.180	21.8983	0.010
	6/28/23	6/25/23	Dry	68.4	8.13	0.44	395.3	106.6	9.4	0.278	998.330	0.210	2.148	0.19016	1.1483	0.201	17.4597	0.010
Average:				63.0	7.98	0.44	378.0	102.5	9.6	0.284	998.870	0.217	2.346	0.18008	1.2726	0.191	19.6790	0.010

- ND: Analyte was not detected, or no data available

- #: HL4 parameter only

- *: HL7 parameter only

- Mapped sampling locations available in Appendix A

- **: Rain= Rain during sampling, Wet= Rain in previous 72 hours, Dry= No rain in previous 72 hours

Table 10A.1e

Water Quality Monitoring Program (HL4 & HL7 Sonde) Analysis Summary - Fourth Creek

July 1, 2022 through June 30, 2023

Nutting																		
Site	Date	Last Rain	72 Hour Precip**	Temp	pH	Specific Conductivity	Raw Conductivity	DO	DO	TDS	Density kg/m3	Salinity	Turbidity #	NH4+ *	NO3- *	NH3 Total *	Cl- mg/L *	NH3 *
Units			in	°F		mS/cm	µS/cm	%SAT	mg/L	g/L	kg/m3	psu	NTU	mg/L-N	mg/L-N	mg/L-N	mg/L	mg/L-N
Q1	7/27/22	7/26/22	Wet	65.7	7.79	0.46	400.9	90.1	8.2	0.292	998.644	0.220	0.304	0.28985	1.1544	0.293	42.8389	0.010
	8/24/22	8/22/22	Wet	64.2	7.87	0.46	401.1	81.1	7.5	0.297	998.797	0.230	1.787	0.22000	1.2763	0.229	25.8008	0.010
	9/28/22	9/25/22	Dry	57.9	7.97	0.46	370.7	81.1	8.1	0.296	999.380	0.230	1.715	0.26446	1.5219	0.271	35.6297	0.010
Average:				62.6	7.88	0.46	390.9	84.1	7.9	0.295	998.940	0.227	1.269	0.25810	1.3175	0.265	34.7565	0.010
Q2	10/26/22	10/26/22	Wet	59.6	7.73	0.31	255.1	65.3	6.3	0.200	999.177	0.150	9.292	0.25000	1.1436	0.251	24.1584	0.000
	11/22/22	11/15/22	Dry	49.8	7.96	0.45	323.1	84.5	9.4	0.288	999.890	0.220	1.434	0.28714	1.9625	0.292	41.6641	0.001
	12/28/22	12/27/22	Wet	50.7	7.98	0.48	349.4	95.3	10.5	0.307	999.860	0.234	0.980	0.21308	2.7037	0.219	58.4025	0.000
Average:				53.4	7.89	0.41	309.2	81.7	8.7	0.265	999.642	0.201	3.902	0.25007	1.9366	0.254	41.4083	0.000
Q3	1/25/23	1/25/23	Wet	47.6	7.86	0.18	123.6	97.1	10.9	0.113	999.880	0.082	61.410	0.18029	1.6726	0.182	26.9979	0.000
	2/22/23	2/17/23	Dry	60.7	8.03	0.38	317.9	101.9	9.8	0.245	999.106	0.184	1.851	0.19581	2.2661	0.201	29.8384	0.010
	3/29/23	3/26/23	Dry	55.0	7.72	0.46	351.2	87.2	9.1	0.292	999.590	0.220	2.147	0.20000	1.5232	0.200	22.9789	0.000
Average:				54.4	7.87	0.34	264.2	95.4	9.9	0.217	999.525	0.162	21.803	0.19203	1.8207	0.194	26.6051	0.003
Q4	4/26/23	4/23/23	Dry	56.6	7.81	0.46	363.5	83.9	8.5	0.295	999.470	0.230	2.358	0.19723	1.7155	0.200	26.0737	0.000
	5/24/23	5/20/23	Dry	62.4	7.73	0.45	384.5	89.7	8.5	0.291	998.975	0.220	2.334	0.19975	1.2221	0.209	23.2977	0.010
	6/28/23	6/25/23	Dry	65.1	7.81	0.44	382.5	92.9	8.5	0.280	998.691	0.217	1.832	0.20844	1.0042	0.211	19.6275	0.010
Average:				61.4	7.78	0.45	376.9	88.8	8.5	0.289	999.045	0.222	2.175	0.20181	1.3140	0.207	22.9996	0.007

- ND: Anlyate was not detected, or no data available

- #: HL4 parameter only

- *: HL7 parameter only

- Mapped sampling locations available in Appendix A

- **: Rain= Rain during sampling, Wet= Rain in previous 72 hours, Dry= No rain in previous 72 hours

Table 10A.1f

Water Quality Monitoring Program (HL4 & HL7 Sonde) Analysis Summary - Fourth Creek

July 1, 2022 through June 30, 2023

Old Weisgarber																		
Site	Date	Last Rain	72 Hour Precip**	Temp	pH	Specific Conductivity	Raw Conductivity	DO	DO	TDS	Density kg/m3	Salinity	Turbidity #	NH4+ *	NO3- *	NH3 Total *	Cl- mg/L *	NH3 *
Units			in	°F		mS/cm	µS/cm	%SAT	mg/L	g/L	kg/m3	psu	NTU	mg/L-N	mg/L-N	mg/L-N	mg/L	mg/L-N
Q1	7/27/22	7/26/22	Wet	63.1	7.56	0.45	382.9	81.7	7.6	0.287	998.900	0.220	1.026	0.31215	0.9675	0.317	55.3734	0.000
	8/24/22	8/22/22	Wet	62.6	7.67	0.45	381.8	82.6	7.7	0.288	998.954	0.220	1.085	0.28417	0.8627	0.289	17.0513	0.000
	9/28/22	9/25/22	Dry	58.8	7.91	0.45	367.3	85.2	8.4	0.290	999.292	0.220	1.357	0.25677	1.0977	0.261	24.6937	0.010
Average:				61.5	7.71	0.45	377.3	83.2	7.9	0.288	999.049	0.220	1.156	0.28436	0.9760	0.289	32.3728	0.003
Q2	10/26/22	10/26/22	Wet	59.4	7.75	0.41	337.3	69.0	6.7	0.265	999.230	0.200	2.038	0.26889	1.0160	0.271	22.8838	0.000
	11/22/22	11/15/22	Dry	51.8	7.85	0.45	329.8	85.4	9.3	0.286	999.789	0.220	1.477	0.29311	1.4827	0.300	32.6631	0.000
	12/28/22	12/27/22	Wet	54.3	7.80	0.47	356.0	89.3	9.4	0.298	999.640	0.230	1.643	0.22672	2.0695	0.230	46.3748	0.000
Average:				55.2	7.80	0.44	341.0	81.3	8.4	0.283	999.553	0.217	1.719	0.26291	1.5228	0.267	33.9739	ND
Q3	1/25/23	1/25/23	Wet	47.6	7.88	0.18	122.5	92.5	10.4	0.113	999.884	0.080	70.190	0.19022	1.6775	0.193	28.0228	0.000
	2/22/23	2/17/23	Dry	61.1	7.92	0.43	357.7	87.2	8.3	0.275	999.087	0.210	1.617	0.21426	1.8575	0.218	24.6318	0.000
	3/29/23	3/26/23	Dry	56.8	7.35	0.44	350.1	83.1	8.4	0.284	999.450	0.220	1.723	0.23953	1.3956	0.240	22.2727	0.000
Average:				55.2	7.72	0.35	276.8	87.6	9.0	0.224	999.473	0.170	24.510	0.21467	1.6436	0.217	24.9758	ND
Q4	4/26/23	4/23/23	Dry	58.2	7.93	0.45	364.2	81.2	8.0	0.290	999.341	0.220	1.956	0.24924	1.3559	0.254	21.2570	0.000
	5/24/23	5/20/23	Dry	60.9	7.66	0.45	372.6	79.8	7.7	0.287	999.113	0.220	1.067	0.21769	0.9554	0.220	18.4169	0.000
	6/28/23	6/25/23	Dry	63.0	7.73	0.44	378.7	79.4	7.4	0.284	998.908	0.220	1.447	0.22484	0.8534	0.230	19.4431	0.000
Average:				60.7	7.77	0.45	371.8	80.1	7.7	0.287	999.121	0.220	1.490	0.23059	1.0549	0.235	19.7057	ND

- ND: Analyte was not detected, or no data available

- #: HL4 parameter only

- *: HL7 parameter only

- Mapped sampling locations available in Appendix A

- **: Rain= Rain during sampling, Wet= Rain in previous 72 hours, Dry= No rain in previous 72 hours

Table 10A.1g

Water Quality Monitoring Program (HL4 & HL7 Sonde) Analysis Summary - Fourth Creek

July 1, 2022 through June 30, 2023

Duck Poo Pond

Site	Date	Last Rain	72 Hour Precip**	Temp	pH	Specific Conductivity	Raw Conductivity	DO	DO	TDS	Density kg/m3	Salinity	Turbidity #	NH4+ *	NO3- *	NH3 Total *	Cl- mg/L *	NH3 *	
Units			in	°F		mS/cm	µS/cm	%SAT	mg/L	g/L	kg/m3	psu	NTU	mg/L-N	mg/L-N	mg/L-N	mg/L	mg/L-N	
Q1																			
	9/28/22	9/25/22	Dry	59.0	7.37	0.43	347.8	61.9	6.1	0.274	999.266	0.210	32.159	0.54062	2.7748	0.545	36.9966	0.000	
Average:				59.0	7.37	0.43	347.8	61.9	6.1	0.274	999.266	0.210	32.159	0.54062	2.7748	0.545	36.9966	ND	
Q2	10/26/22	10/26/22	Wet	58.8	7.37	0.43	344.8	45.4	4.4	0.273	999.290	0.210	7.339	0.23632	2.2011	0.238	29.2283	0.000	
	11/22/22	11/15/22	Dry	55.2	7.57	0.42	324.9	77.5	8.1	0.269	999.562	0.200	8.881	0.28403	3.0305	0.286	32.8587	0.000	
	12/28/22	12/27/22	Wet	58.8	7.45	0.40	326.2	80.3	8.0	0.258	999.274	0.200	11.152	0.26071	3.1754	0.262	30.7341	0.000	
Average:				57.6	7.46	0.42	332.0	67.7	6.8	0.267	999.375	0.203	9.124	0.26035	2.8023	0.262	30.9404	0.000	
Q3	1/25/23	1/25/23	Wet	59.9	7.40	0.39	323.1	81.1	7.8	0.252	999.182	0.190	9.590	0.23013	3.8312	0.230	25.1538	0.000	
	2/22/23	2/17/23	Dry	60.7	7.57	0.37	309.5	75.1	7.2	0.239	999.100	0.180	6.173	0.18908	3.9437	0.190	28.2462	0.000	
	3/29/23	3/26/23	Dry	59.4	7.12	0.39	318.9	79.6	7.8	0.250	999.222	0.190	5.805	0.17985	2.7326	0.180	20.3473	0.000	
Average:				60.0	7.37	0.39	317.2	78.6	7.6	0.247	999.168	0.187	7.190	0.19969	3.5025	0.200	24.5824	ND	
Q4	4/26/23	4/23/23	Dry	58.8	7.62	0.40	326.3	74.5	7.4	0.258	999.276	0.200	4.292	0.18778	2.9898	0.189	30.0130	0.000	
	5/24/23	5/20/23	Dry	63.5	7.39	0.41	354.8	66.5	6.2	0.265	998.852	0.200	8.512	0.22000	2.2530	0.220	23.0383	0.000	
	6/28/23	6/25/23	Dry	62.5	7.46	0.40	337.5	67.3	6.3	0.255	998.945	0.190	6.315	0.23015	2.2421	0.231	24.2818	0.000	
Average:				61.6	7.49	0.40	339.5	69.4	6.6	0.259	999.025	0.197	6.373	0.21264	2.4950	0.213	25.7777	ND	

- ND: Analyte was not detected, or no data available

- #: HL4 parameter only

- *: HL7 parameter only

- Mapped sampling locations available in Appendix A

- **: Rain= Rain during sampling, Wet= Rain in previous 72 hours, Dry= No rain in previous 72 hours

Table 10A.1h

Water Quality Monitoring Program (HL4 & HL7 Sonde) Analysis Summary - Fourth Creek

July 1, 2022 through June 30, 2023

Walden																		
Site	Date	Last Rain	72 Hour Precip**	Temp	pH	Specific Conductivity	Raw Conductivity	DO	DO	TDS	Density kg/m3	Salinity	Turbidity #	NH4+ *	NO3- *	NH3 Total *	Cl- mg/L *	NH3 *
Units			in	°F		mS/cm	µS/cm	%SAT	mg/L	g/L	kg/m3	psu	NTU	mg/L-N	mg/L-N	mg/L-N	mg/L	mg/L-N
Q1	7/27/22	7/26/22	Wet	69.4	7.83	0.46	419.3	97.0	8.5	0.292	998.222	0.220	0.571	0.30523	1.1718	0.314	36.7246	0.010
	8/24/22	8/22/22	Wet	66.4	7.90	0.46	404.1	89.0	8.0	0.291	998.563	0.220	3.488	0.20017	1.3477	0.208	27.9592	0.010
	9/28/22	9/25/22	Dry	59.9	7.91	0.46	375.1	88.5	8.7	0.292	999.206	0.220	1.382	0.22446	1.6162	0.230	36.2808	0.010
Average:				65.2	7.88	0.46	399.5	91.5	8.4	0.292	998.664	0.220	1.814	0.24329	1.3786	0.251	33.6549	0.010
Q2	10/26/22	10/26/22	Wet	60.4	7.74	0.31	258.1	69.7	6.7	0.200	999.102	0.150	7.228	0.25119	1.5449	0.257	21.4427	0.000
	11/22/22	11/15/22	Dry	50.6	8.02	0.45	327.2	94.2	10.4	0.288	999.855	0.220	1.429	0.26603	2.0913	0.271	43.0110	0.010
	12/28/22	12/27/22	Wet	51.3	8.09	0.49	357.3	103.5	11.3	0.311	999.829	0.240	1.624	0.64738	2.8306	0.660	71.9723	0.010
Average:				54.1	7.95	0.42	314.2	89.1	9.5	0.267	999.595	0.203	3.427	0.38820	2.1556	0.396	45.4753	0.007
Q3	1/25/23	1/25/23	Wet	48.1	8.08	0.20	137.4	97.0	10.8	0.125	999.870	0.090	57.614	0.29000	2.0009	0.290	37.6578	0.000
	2/22/23	2/17/23	Dry	61.1	8.08	0.46	380.0	102.2	9.7	0.292	999.100	0.220	2.172	0.25313	2.4552	0.262	35.2837	0.010
	3/29/23	3/26/23	Dry	54.0	7.87	0.47	356.5	103.3	10.9	0.300	999.661	0.230	2.230	0.19935	1.6936	0.200	27.1351	0.000
Average:				54.4	8.01	0.37	291.3	100.9	10.5	0.239	999.544	0.180	20.672	0.24749	2.0499	0.251	33.3589	0.003
Q4	4/26/23	4/23/23	Dry	56.8	7.95	0.46	365.2	87.6	8.9	0.296	999.460	0.230	2.789	0.18172	1.8697	0.190	28.0409	0.001
	5/24/23	5/20/23	Dry	62.9	7.86	0.46	392.9	92.7	8.7	0.295	998.922	0.220	2.624	0.19299	1.2275	0.200	20.1237	0.010
	6/28/23	6/25/23	Dry	66.7	7.92	0.45	400.4	98.5	8.8	0.287	998.524	0.220	2.318	0.20306	1.0929	0.210	20.8834	0.010
Average:				62.2	7.91	0.46	386.1	92.9	8.8	0.293	998.969	0.223	2.577	0.19259	1.3967	0.200	23.0160	0.007

- ND: Analyte was not detected, or no data available

- #: HL4 parameter only

- *: HL7 parameter only

- Mapped sampling locations available in Appendix A

- **: Rain= Rain during sampling, Wet= Rain in previous 72 hours, Dry= No rain in previous 72 hours

Table 10A.1i

Water Quality Monitoring Program (HL4 & HL7 Sonde) Analysis Summary - Fourth Creek

July 1, 2022 through June 30, 2023

Westland																		
Site	Date	Last Rain	72 Hour Precip**	Temp	pH	Specific Conductivity	Raw Conductivity	DO	DO	TDS	Density kg/m3	Salinity	Turbidity #	NH4+ *	NO3- *	NH3 Total *	Cl- mg/L *	NH3 *
Units			in	°F		mS/cm	µS/cm	%SAT	mg/L	g/L	kg/m3	psu	NTU	mg/L-N	mg/L-N	mg/L-N	mg/L	mg/L-N
Q1	7/27/22	7/26/22	Wet	72.1	7.92	0.33	317.0	95.7	8.1	0.214	997.840	0.160	1.458	0.23147	1.0744	0.241	21.5072	0.010
	8/24/22	8/22/22	Wet	66.5	8.08	0.39	345.4	95.7	8.6	0.249	998.528	0.190	0.338	0.16000	1.5876	0.170	18.4093	0.010
	9/28/22	9/25/22	Dry	56.1	8.09	0.39	305.3	89.7	9.2	0.250	999.488	0.190	1.403	0.18521	2.0852	0.191	29.6086	0.009
Average:				64.9	8.03	0.37	322.6	93.7	8.6	0.238	998.619	0.180	1.066	0.19223	1.5824	0.201	23.1750	0.010
Q2	10/26/22	10/26/22	Wet	57.7	7.82	0.28	222.5	75.3	7.5	0.178	999.320	0.130	4.355	0.25808	1.1062	0.260	18.9926	0.000
	11/22/22	11/15/22	Dry	44.8	7.96	0.36	242.6	92.5	11.0	0.232	1000.045	0.180	0.401	0.23723	2.6789	0.241	33.8326	0.000
	12/28/22	12/27/22	Wet	45.8	8.09	0.44	299.2	99.0	11.6	0.282	1000.049	0.215	1.133	0.24477	4.4025	0.248	111.2682	0.000
Average:				49.5	7.95	0.36	254.8	88.9	10.0	0.231	999.805	0.175	1.963	0.24669	2.7292	0.250	54.6978	ND
Q3	1/25/23	1/25/23	Wet	46.3	7.88	0.14	96.3	101.0	11.5	0.090	999.913	0.070	54.145	0.19928	2.1768	0.200	18.7594	0.000
	2/22/23	2/17/23	Dry	58.8	8.19	0.37	301.9	107.0	10.5	0.239	999.270	0.180	2.944	0.14984	3.0816	0.151	30.8766	0.010
	3/29/23	3/26/23	Dry	54.5	7.96	0.41	313.7	104.7	11.0	0.262	999.607	0.200	5.546	0.13971	2.4818	0.140	25.7769	0.000
Average:				53.2	8.01	0.31	237.3	104.2	11.0	0.197	999.597	0.150	20.878	0.16294	2.5801	0.164	25.1376	0.003
Q4	4/26/23	4/23/23	Dry	54.6	7.95	0.40	307.5	94.2	9.8	0.257	999.590	0.190	2.372	0.14000	2.6077	0.145	26.9980	0.000
	5/24/23	5/20/23	Dry	62.9	7.83	0.39	334.7	92.4	8.7	0.252	998.903	0.190	1.621	0.15149	1.5972	0.160	17.2504	0.010
	6/28/23	6/25/23	Dry	67.9	7.88	0.36	327.8	94.2	8.3	0.232	998.360	0.180	1.916	0.17359	1.2519	0.180	16.2102	0.010
Average:				61.8	7.89	0.39	323.3	93.6	8.9	0.247	998.951	0.187	1.970	0.15503	1.8189	0.162	20.1529	0.007

- ND: Anlyate was not detected, or no data available

- #: HL4 parameter only

- *: HL7 parameter only

- Mapped sampling locations available in Appendix A

- **: Rain= Rain during sampling, Wet= Rain in previous 72 hours, Dry= No rain in previous 72 hours

Table 10A.2a

Water Quality Monitoring Program Bacteria Analysis Summary Fourth Creek

June 1, 2022 through July 30, 2023

Old Weisgarber							
	Date	Last Rain	72 Hour Precip	Temp	pH	E. Coli	Total Coliform
Units			inches	°F		mpn/ 100mL	mpn/ 100mL
Q1	7/27/22	7/21/22	DRY	63.0	7.50	200.00	8130.0
	8/24/22	8/21/22	WET	63.0	7.70	300.00	19350.0
	9/28/22	9/25/22	DRY	59.0	7.90	200.00	3230.0
Q2	10/26/22	10/26/22	WET	59.0	7.70	1730.00	29090.0
	11/22/22	11/15/22	DRY	52.0	7.80	<100	3690.0
	12/28/22	12/27/22	WET	54.2	7.80	200.00	1480.0
Q3	1/25/23	1/25/23	WET	48.0	7.90	3150.00	86640.0
	2/22/23	2/17/23	DRY	61.0	7.80	100.00	2160.0
	3/29/23	3/26/23	DRY	57.0	7.40	<100	1830.0
Q4	4/26/23	4/23/23	DRY	58.0	7.90	<100	2620.0
	5/24/23	5/20/23	DRY	61.0	7.70	100.00	3930.0
	6/28/23	6/26/23	WET	63.0	7.70	200.00	5940.0

- ND: Analyte was not detected, or no data available

- *: Laboratory error prevented accurate count

Table 10A.2b

Water Quality Monitoring Program Bacteria Analysis Summary Fourth Creek

June 1, 2022 through July 30, 2023

Aquarium							
	Date	Last Rain	72 Hour Precip	Temp	pH	E. Coli	Total Coliform
Units			inches	°F		mpn/ 100mL	mpn/ 100mL
Q1	7/27/22	7/21/22	DRY	65.5	7.40	310.00	21870.0
	8/24/22	8/21/22	WET	63.0	7.40	520.00	57940.0
	9/28/22	9/25/22	DRY	61.0	8.00	3590.00	45690.0
Q2	10/26/22	10/26/22	WET	60.0	7.50	860.00	38730.0
	11/22/22	11/15/22	DRY	56.0	7.60	4100.00	6770.0
	12/28/22	12/27/22	WET	57.0	7.60	<100	1830.0
Q3	1/25/23	1/25/23	WET	48.8	7.90	2260.00	38730.0
	2/22/23	2/17/23	DRY	61.5	7.80	<100	1830.0
	3/29/23	3/26/23	DRY	56.0	7.50	<100	18600.0
Q4	4/26/23	4/23/23	DRY	60.0	7.70	<100	3590.0
	5/24/23	5/20/23	DRY	67.7	7.60	630.00	3180.0
	6/28/23	6/26/23	WET	65.0	7.50	200.00	38730.0

- ND: Analyte was not detected, or no data available

- *: Laboratory error prevented accurate count

Table 10A.2c

Water Quality Monitoring Program Bacteria Analysis Summary Fourth Creek

June 1, 2022 through July 30, 2023

Nutting							
	Date	Last Rain	72 Hour Precip	Temp	pH	E. Coli	Total Coliform
Units			inches	°F		mpn/ 100mL	mpn/ 100mL
Q1	7/27/22	7/21/22	DRY	65.5	7.80	410	22820
	8/24/22	8/21/22	WET	64.0	7.90	310.00	14140.0
	9/28/22	9/25/22	DRY	58.0	8.00	1340.00	21870.0
Q2	10/26/22	10/26/22	WET	60.0	7.80	2530.00	111990.0
	11/22/22	11/15/22	DRY	50.0	8.00	100.00	6570.0
	12/28/22	12/27/22	WET	50.8	8.00	<100	1870.0
Q3	1/25/23	1/25/23	WET	47.7	7.90	3170.00	86640.0
	2/22/23	2/17/23	DRY	60.6	8.00	100.00	3640.0
	3/29/23	3/26/23	DRY	55.0	7.70	200.00	5710.0
Q4	4/26/23	4/23/23	DRY	57.0	8.00	<100	4960.0
	5/24/23	5/20/23	DRY	62.2	7.90	<100	6770.0
	6/28/23	6/26/23	WET	65.0	7.80	200.00	10430.0

- ND: Analyte was not detected, or no data available

- *: Laboratory error prevented accurate count

Table 10A.2d

Water Quality Monitoring Program Bacteria Analysis Summary Fourth Creek

June 1, 2022 through July 30, 2023

Aubrey							
	Date	Last Rain	72 Hour Precip	Temp	pH	E. Coli	Total Coliform
Units			inches	°F		mpn/ 100mL	mpn/ 100mL
Q1	7/27/22	7/21/22	DRY	67.0	7.80	<100	14140.0
	8/24/22	8/21/22	WET	65.0	8.00	200.00	12960.0
	9/28/22	9/25/22	DRY	62.0	8.00	<100	7980.0
Q2	10/26/22	10/26/22	WET	62.0	7.80	630.00	36540.0
	11/22/22	11/15/22	DRY	54.0	8.00	310.00	30760.0
	12/28/22	12/27/22	WET	55.4	8.00	100.00	7030.0
Q3	1/25/23	1/25/23	WET	54.0	7.70	310.00	27230.0
	2/22/23	2/17/23	DRY	61.8	7.80	<100	1990.0
	3/29/23	3/26/23	DRY	58.0	7.80	100.00	10460.0
Q4	4/26/23	4/23/23	DRY	60.0	8.00	100.00	13540.0
	5/24/23	5/20/23	DRY	63.4	8.00	310.00	11870.0
	6/28/23	6/26/23	WET	66.0	8.00	310.00	27230.0

- ND: Analyte was not detected, or no data available

- *: Laboratory error prevented accurate count

Table 10A.2e

Water Quality Monitoring Program Bacteria Analysis Summary Fourth Creek

June 1, 2022 through July 30, 2023

Agnes							
	Date	Last Rain	72 Hour Precip	Temp	pH	E. Coli	Total Coliform
Units			inches	°F		mpn/ 100mL	mpn/ 100mL
Q1	7/27/22	7/21/22	DRY	77.0	8.00	<100	20980.0
	8/24/22	8/21/22	WET	69.0	8.00	630.00	48840.0
	9/28/22	9/25/22	DRY	57.0	8.00	<100	8860.0
Q2	10/26/22	10/26/22	WET	59.0	7.80	3500.00	198630.0
	11/22/22	11/15/22	DRY	42.0	8.00	<100	3110.0
	12/28/22	12/27/22	WET	41.5	8.00	200.00	1560.0
Q3	1/25/23	1/25/23	WET	46.0	7.90	2090.00	77010.0
	2/22/23	2/17/23	DRY	61.0	8.10	200.00	2110.0
	3/29/23	3/26/23	DRY	51.0	8.00	200.00	3410.0
Q4	4/26/23	4/23/23	DRY	54.0	8.00	1580.00	13960.0
	5/24/23	5/20/23	DRY	68.8	8.10	100.00	7280.0
	6/28/23	6/26/23	WET	75.0	8.00	100.00	14390.0

- ND: Analyte was not detected, or no data available

- *: Laboratory error prevented accurate count

Table 10A.2f

Water Quality Monitoring Program Bacteria Analysis Summary Fourth Creek

June 1, 2022 through July 30, 2023

Walden							
	Date	Last Rain	72 Hour Precip	Temp	pH	E. Coli	Total Coliform
Units			inches	°F		mpn/ 100mL	mpn/ 100mL
Q1	7/27/22	7/21/22	DRY	69.0	7.85	410.00	29090.0
	8/24/22	8/21/22	WET	65.0	7.90	310.00	30760.0
	9/28/22	9/25/22	DRY	60.0	8.00	410.00	7760.0
Q2	10/26/22	10/26/22	WET	61.0	7.70	2620.00	129970.0
	11/22/22	11/15/22	DRY	51.0	8.00	<100	1450.0
	12/28/22	12/27/22	WET	52.0	8.00	<100	1950.0
Q3	1/25/23	1/25/23	WET	48.0	8.00	2180.00	57940.0
	2/22/23	2/17/23	DRY	59.2	8.20	<100	3410.0
	3/29/23	3/26/23	DRY	55.0	7.90	100.00	5380.0
Q4	4/26/23	4/23/23	DRY	57.0	8.00	200.00	6440.0
	5/24/23	5/20/23	DRY	63.5	8.00	850.00	7080.0
	6/28/23	6/26/23	WET	67.0	8.00	200.00	14670.0

- ND: Analyte was not detected, or no data available

- *: Laboratory error prevented accurate count

Table 10A.2g

Water Quality Monitoring Program Bacteria Analysis Summary Fourth Creek

June 1, 2022 through July 30, 2023

Westland							
	Date	Last Rain	72 Hour Precip	Temp	pH	E. Coli	Total Coliform
Units			inches	°F		mpn/ 100mL	mpn/ 100mL
Q1	7/27/22	7/21/22	DRY	75.0	8.00	300.00	21050.0
	8/24/22	8/21/22	WET	66.0	8.00	100.00	14670.0
	9/28/22	9/25/22	DRY	56.0	8.00	200.00	6050.0
Q2	10/26/22	10/26/22	WET	57.8	7.80	620.00	61310.0
	11/22/22	11/15/22	DRY	45.0	8.00	200.00	2180.0
	12/28/22	12/27/22	WET	46.0	8.10	100.00	1090.0
Q3	1/25/23	1/25/23	WET	46.0	7.80	1340.00	46110.0
	2/22/23	2/17/23	DRY	58.8	8.20	200.00	2380.0
	3/29/23	3/26/23	DRY	54.0	8.00	200.00	9320.0
Q4	4/26/23	4/23/23	DRY	55.0	8.00	410.00	3790.0
	5/24/23	5/20/23	DRY	62.0	8.00	200.00	6830.0
	6/28/23	6/26/23	WET	68.0	7.90	310.00	10860.0

- ND: Analyte was not detected, or no data available

- *: Laboratory error prevented accurate count

Table 10A.2h

Water Quality Monitoring Program Bacteria Analysis Summary Fourth Creek

June 1, 2022 through July 30, 2023

Duck Poo Pond							
	Date	Last Rain	72 Hour Precip	Temp	pH	E. Coli	Total Coliform
Units			inches	°F		mpn/ 100mL	mpn/ 100mL
Q1							
	9/28/22	9/25/22	DRY	59.0	7.40	1710.00	16640.0
Q2	10/26/22	10/26/22	WET	59.0	7.30	200.00	6330.0
	11/22/22	11/15/22	DRY	55.0	7.60	<100	17890.0
	12/28/22	12/27/22	WET	59.0	7.50	<100	6240.0
Q3	1/25/23	1/25/23	WET	59.5	7.40	<100	3320.0
	2/22/23	2/17/23	DRY	60.0	7.50	<100	2590.0
	3/29/23	3/26/23	DRY	58.0	7.20	<100	3590.0
Q4	4/26/23	4/23/23	DRY	55.0	7.50	<100	2620.0
	5/24/23	5/20/23	DRY	63.4	7.40	100.00	4790.0
	6/28/23	6/26/23	WET	63.0	7.50	310.00	8600.0

- ND: Analyte was not detected, or no data available

- *: Laboratory error prevented accurate count

Table 10A.2i

Water Quality Monitoring Program Bacteria Analysis Summary Fourth Creek

June 1, 2022 through July 30, 2023

Lakeshore							
	Date	Last Rain	72 Hour Precip	Temp	pH	E. Coli	Total Coliform
Units			inches	°F		mpn/ 100mL	mpn/ 100mL
Q1	7/27/22	7/21/22	DRY	69.0	8.00	100.00	19350.0
	8/24/22	8/21/22	WET	66.0	8.00	310.00	14210.0
	9/28/22	9/25/22	DRY	58.0	8.00	100.00	9590.0
Q2	10/26/22	10/26/22	WET	60.5	7.8	2940.00	198630.0
	11/22/22	11/15/22	DRY	48.5	8.10	100.00	1910.0
	12/28/22	12/27/22	WET	50.5	8.20	<100	1730.0
Q3	1/25/23	1/25/23	WET	48.3	7.90	980.00	37840.0
	2/22/23	2/17/23	DRY	62.0	8.30	100.00	1990.0
	3/29/23	3/26/23	DRY	56.5	8.00	200.00	5290.0
Q4	4/26/23	4/23/23	DRY	56.0	8.00	200.00	4100.0
	5/24/23	5/20/23	DRY	64.2	8.00	300.00	7380.0
	6/28/23	6/26/23	WET	68.0	8.00	100.00	12460.0

- ND: Analyte was not detected, or no data available

- *: Laboratory error prevented accurate count

Table 10A.3

Laboratory Analysis Summary - Municipal Industrial Facility Wet Weather Program

July 1, 2022 through June 30, 2023

Point Source Sample Site	Period/Unit	Date	Type	pH	BOD	COD	Suspended Solids (TSS)	Dissolved Solids (TDS)	Nitrate + Nitrite Nitrogen	Ammonia Nitrogen	Total Kjeldahl Nitrogen	Total Organic Nitrogen	Lead	Zinc	Total Phosphorus	Ortho Phosphate	Oil/ Grease	E. Coli	Total Colif.
Units					mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mpn/ 100mL	cfu/ 100mL
	<i>ANNUAL</i>																		
KAT	Treated Outfall	11/11/22	Grab	7.0	42.50	43.00	10.3	113	0.197	0.666	2.300	1.630	ND	0.0866	0.457	0.2870	ND	**	**
	E. Fifth	11/11/22	Grab	6.0	20.60	35.90	9.8	52	ND	ND	1.220	1.010	ND	0.0517	0.387	0.2620	ND	**	**
	Church (Bus)	11/11/22	Grab	5.5	15.20	ND	7.2	30	ND	ND	0.596	0.290	ND	ND	ND	ND	ND	**	**
Loraine Street Treatment Units	Pretreated	11/11/22	Grab	6.0	33.50	275.0	115.0	138	0.157	ND	3.330	3.330	0.0100	0.2710	0.852	0.2680	11.6	**	**
	East Suntime	11/11/22	Grab	6.0	7.99	37.6	12.0	78	ND	0.260	0.792	0.532	ND	0.0503	0.143	0.0920	ND	**	**
	West Baysaver	11/11/22	Grab	6.5	10.10	41.9	10.8	95	ND	0.349	1.870	1.520	ND	0.0618	0.459	0.1090	ND	**	**
	Yard East	11/11/22	Grab	7.0	9.06	62.3	18.0	298	0.352	ND	0.897	0.897	0.0054	0.1820	0.294	0.3050	ND	**	**
	CDS	03/17/23	Grab	6.0	4.48	21.9	8.5	82	0.353	0.296	1.260	0.964	ND	ND	0.113	0.0470	ND	**	**
Transfer Station	Pretreated	02/23/23	Grab	6.5	23.40	181.0	223.0	344	0.174	ND	1.460	1.300	0.0801	0.3540	0.355	0.0960	ND	2,330	24,810
	Treated	02/23/23	Grab	6.5	35.00	181	206	358	0.210	ND	1.430	1.210	0.0777	0.2780	0.357	0.2050	ND	2,490	64,880
	Catch Basin	02/23/23	Grab	7.0	107.00	238.0	112.0	601	0.186	ND	2.570	2.390	0.0612	0.1960	0.500	0.0570	ND	13,740	>241,960
Prosser Rd	Treated Outfall	11/11/22	Grab	6.0	10.30	25.7	5.7	73	0.204	ND	0.670	0.670	ND	0.4510	0.118	0.0630	ND	**	**
Average:				6.3	26.59	103.9	61.5	189	0.229	0.393	1.533	1.312	0.0469	0.1982	0.367	0.1628	11.6	6186.7	44845.0
*National NURP Study Average					11.9	90.8	N/A	N/A	N/A	N/A	2.350	3.310	0.18	0.176	0.16	N/A	N/A	N/A	N/A
*Characteristics of Urban Stormwater Range					1 - 700	5 - 3,100	2 - 11,300	200 - 14,600	N/A	0.1 - 2.5	0.01 - 4.5	N/A	0.0 - 1.9	N/A	0.1 - 125	N/A	N/A	N/A	N/A

* Data was taken from tables 4-1 and 4-2 of the Stormwater Management for Maine: BMPS.

** Microbiological testing not needed at these locations.

-N/A: Not applicable.

-ND: Analyte was not detected.

Table 10A.4

Estimated Runoff From Major Watersheds Within the MS4
July 1, 2022 Through June 30, 2023

Watershed	Agricul./ Forest/ Vacant, Public Parks	Vacant (>10)	Rural Res.	Single Family Res.	Private Rec., Public Land	Multi-Family Res., Church	Institutional	Mining, Office/ Service	Manufacturing/ Wholesale	Commer., Trans./ Utility/ Commun.	Major Roads/ Hwys/ ROWs	Under Const	Not Loaded	Total Acres in Watershed	Acres in the City Limits	Est. % Impervious	C Value	Total Rainfall during 22/23 (in./yr)	Total Runoff for 22/23 (Mgal/yr)
Baker Cr.	412	2	107	640	90	77	32	1	1	3	269	13	27	1,674	1,674	32	0.41	52.2	968
East Fork	313	0	10	475	302	78	73	31	195	235	584	33	180	2,509	2,509	53	0.57	52.2	2,037
First Cr.	724	0	300	3,152	544	501	110	157	127	556	1,412	51	116	7,750	7,750	44	0.50	52.2	5,483
Fourth Cr.	965	57	423	2,026	468	406	93	206	201	568	881	61	414	6,769	5,920	41	0.48	52.2	4,006
Goose Cr.	639	40	126	669	213	67	8	21	77	131	327	34	29	2,381	1,755	35	0.43	52.2	1,064
Grassy Cr.	2,230	176	561	610	215	24	0	14	31	95	211	39	95	4,301	433	17	0.29	52.2	176
Holston R.	2,362	69	371	1,222	417	45	5	2	219	33	805	32	50	5,632	2,455	28	0.37	52.2	1,292
Inman Br.	563	33	214	138	4	12	0	0	0	0	145	0	34	1,143	99	21	0.31	52.2	44
Knob Cr.	1,719	195	481	843	125	84	1	19	1	29	296	4	169	3,966	989	19	0.30	52.2	427
Knob Fork	1,659	26	398	675	182	56	5	93	6	124	257	19	252	3,752	823	22	0.33	52.2	382
Love Cr.	1,735	102	505	1,625	311	212	51	94	178	408	1,038	46	103	6,408	5,090	36	0.44	52.2	3,182
Second Cr.	443	0	90	1,281	346	247	29	107	140	542	1,161	35	82	4,503	4,498	53	0.57	52.2	3,641
Sinking Cr.	1,614	146	459	1,266	284	90	17	33	31	267	881	12	347	5,447	2,434	33	0.41	52.2	1,432
Swanpond Cr.	3,892	303	833	604	121	36	4	79	240	232	457	65	285	7,151	499	19	0.30	52.2	215
Ten Mile Cr.	1,879	0	638	3,421	165	895	55	115	58	615	1,500	24	641	10,006	3,921	38	0.45	52.2	2,504
Third Cr.	1,757	79	436	3,003	406	512	184	124	225	443	1,252	98	220	8,739	8,417	37	0.45	52.2	5,329
TN River	7,197	503	2,269	4,681	2,910	403	187	72	170	238	990	121	1,113	20,854	8,232	22	0.33	52.2	3,819
Toll Cr.	535	69	154	222	42	26	1	0	37	4	93	42	4	1,229	767	22	0.32	52.2	351
Turkey Cr.	3,353	235	603	2,693	264	343	121	104	91	442	1,161	68	738	10,216	1,677	29	0.38	52.2	914
Whites Cr.	2,733	154	782	1,298	575	59	31	11	49	126	608	51	578	7,055	1,634	23	0.34	52.2	780
Williams Cr.	358	11	47	561	46	96	125	17	10	61	276	3	30	1,641	1,605	37	0.45	52.2	1,024
Woods Cr.	1,220	106	281	371	0	26	0	2	140	43	261	1	157	2,608	143	23	0.33	52.2	68
Sink-East	1,226	0		728	9	17	0	17	3	27	0	0	0	2,027	91	12	0.24	52.2	32
Beaver Cr	21,174	0	0	21,230	1,292	845	4	259	283	712	0	160	0	45,959	162	16	0.28	52.2	64
Tuckahoe	4,293	0	0	1,829	18	14	0	8	2	1	0	4	0	6,169	229	8	0.22	52.2	71
Fr.Broad riv	8,954	0	0	2,744	73	40	24	24	497	117	0	166	0	12,639	551	11	0.24	52.2	186
COK Total	73,949	2,306	10,088	58,007	9,422	5,211	1,160	1,610	3,012	6,052	14,865	1,182	5,664	192,528	64,357				39,489

The runoff from the major watersheds within the MS4 area was estimated by a formula in Camp Dresser & Mckee's Watershed Management Module. $Q = P \times C \times A$

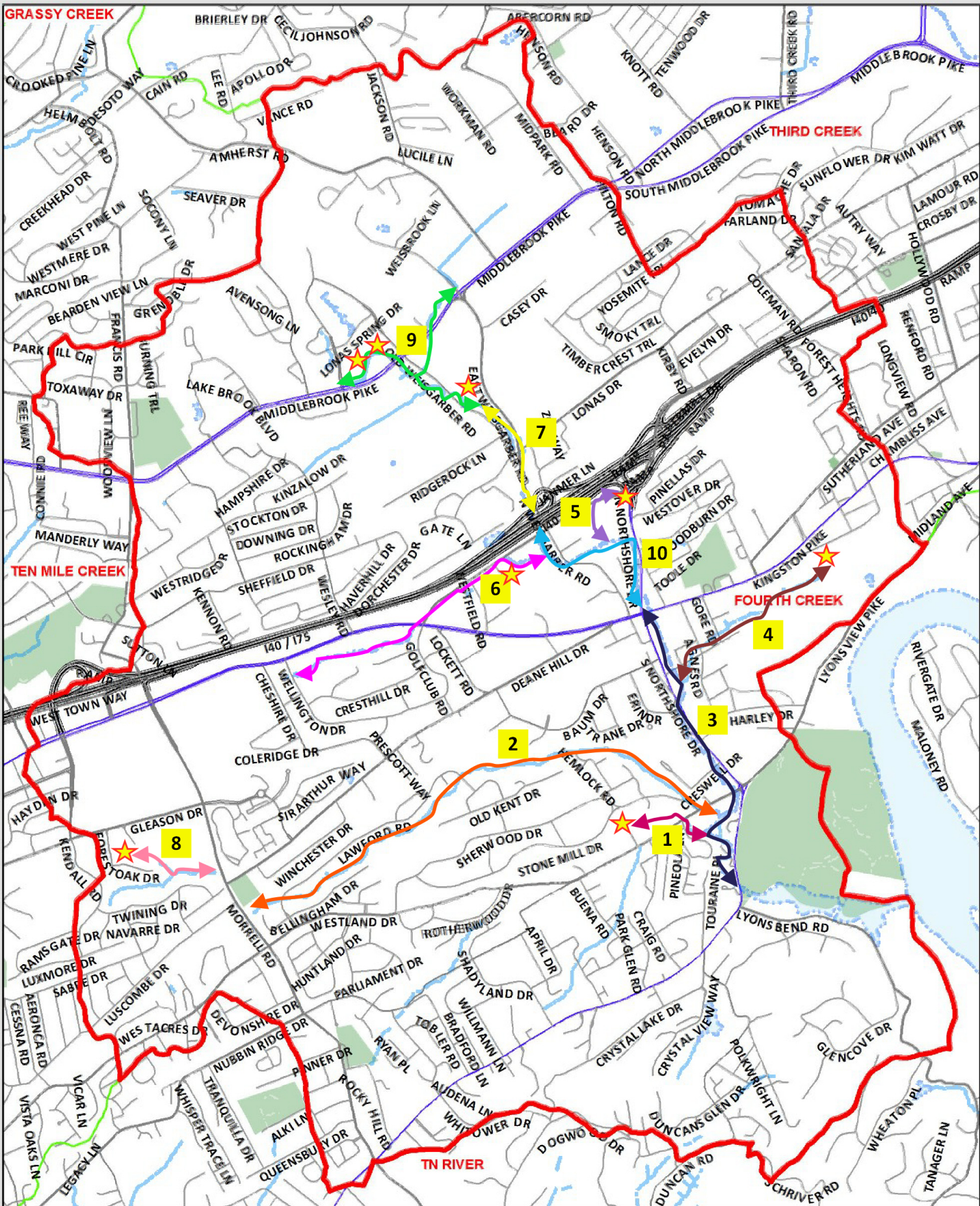
where, P = total precipitation (inches/year) = 52.2 in./yr = 4.3500 ft./yr
 C = land use area weighted runoff coefficient = $0.15 \times \text{pervious\%} + 0.95 \times \text{Impervious\%}$
 A = drainage area (acres) = acres in watershed $\times (4.35E4 \text{ ft}^2/\text{acre}) = A_1 \text{ ft}^2$
 Q = total runoff rate = sum of each watershed's Q_i .

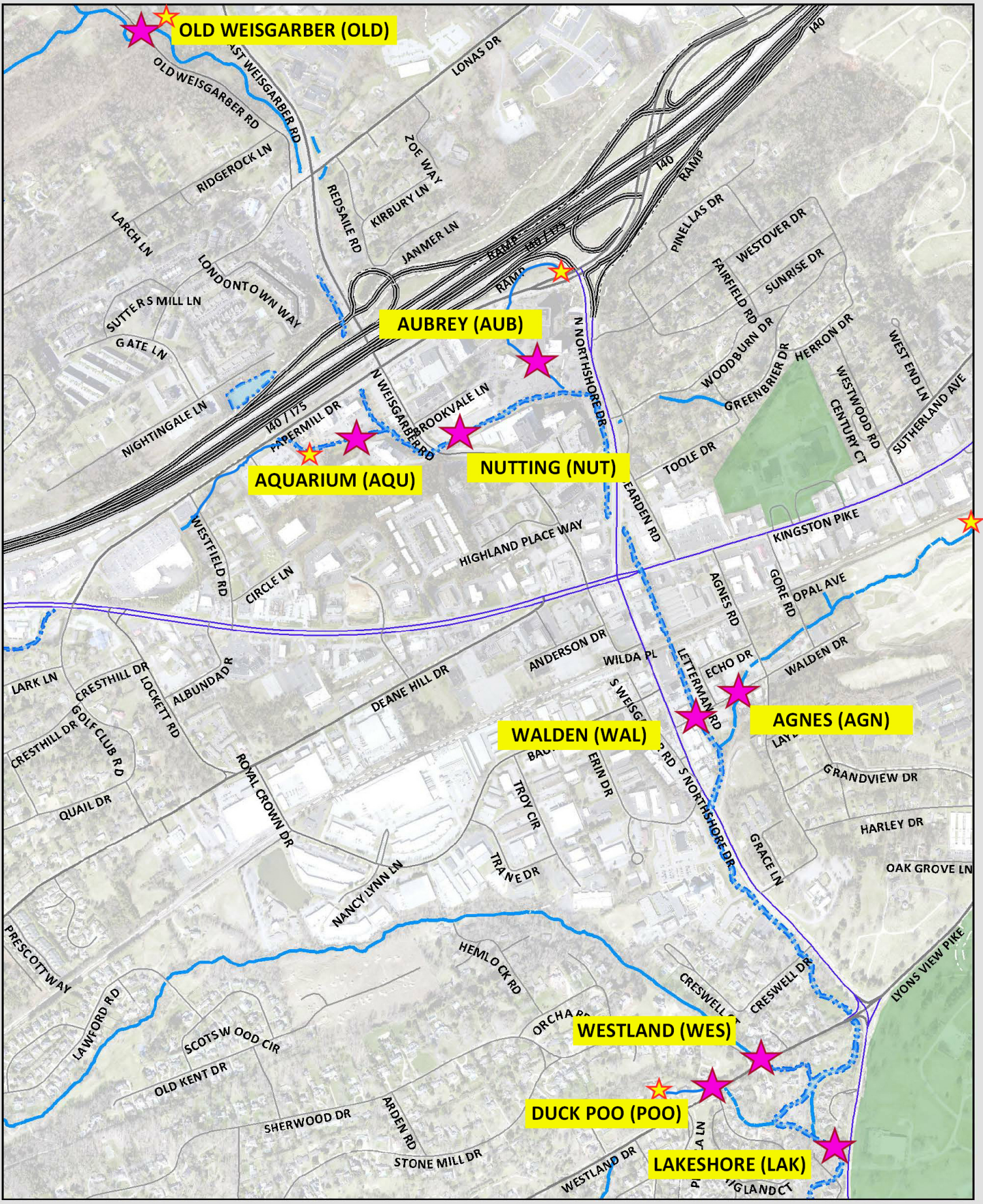
Total estimated runoff for 2022/2023 Reporting Period = 39,489 Mgal/yr

Approximate area and land use for each watershed was determined through the City's GIS. Total yearly rainfall amount was determined by averaging the amount of rain collected from the City's five monitoring stations located throughout the city (refer to map in Appendix E). Runoff coefficient (C) was calculated by adding 15 % of the pervious fraction to 95% of the impervious fraction in each watershed. This assumes that the fraction of rainfall producing runoff is 15% and 95% from pervious and impervious surfaces respectively. The summary of the runoff calculations are provided in the table above. Calculations for some of the watersheds were left out due to the insignificant amount of runoff that would be produced.

Appendix A

Fourth Creek Maps



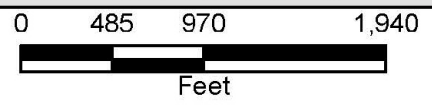


City of Knoxville
 Department of Engineering

Date: 7/26/2022



FOURTH CREEK SAMPLING MAP



Appendix B

Stream Surveys

COK Stream Survey Field Sheet

STREAM SURVEY INFORMATION (Revised COK 5/27/2021)

Project: Water Quality Monitoring (year)	Organization: City of Knoxville Stormwater
Watershed: Fourth Creek	Activity Type: Creek Walk
HUC12: 60102010204	Ecoregion: 67f

Reach:

Name: 1	Downstream Limits: 1020 Craigland Ct
Date: 9/14/2022	DS Elevation: 825
Time: 12:15	Upstream Limits: 6503 Westland Dr
Length: 1052	US Elevation: 838
Description / Notes: Residential spring fed tributary	

Weather:

Previous 48 hours Precipitation: None	Approx. Air Temperature (F°): 74
Last Precipitation Date: 9/12/2022	Approx. Water Temperature (F°): N/A

Physical Characteristics:

Gradient: Low	Avg. Stream Width: Small (1.5 - 3 yd.)
Slope: .012 ft/ft 1.20%	Max. Stream Depth: Medium (0.3 - 0.6 yd.)

Light Penetration:

% Canopy Cover Estimated for Reach: 35	Notes:
--	--------

Stream Bank Characteristics:

Bank Height: Varies	High Water Mark: feet			
	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4
LDB Bank Slope:	Steep Terrain	Bluff;Wall	Gentle Slope	
RDB Bank Slope:	Bluff;Wall	Steep Terrain	Gentle Slope	

Channel Characteristics:

Manmade Modifications:	Bridge	Channelized	Rip Rap	Dam
Sediment Deposits:	High	High	High	
Sediment Type:	Silt	Mud	Sludge	
Turbidity:	Milky	Notes: Upper portion of reach is muddy due to a man made dam / pond with ducks		
Foam/Surface Sheen:	Nutrient	Notes: Only apparent in one area		
Algae:	Moderate	Notes:		
Algae Type:	Green			

Dominate Substrate: (> 25%) Select up to 4:

	Riffle	Run	Pool
Dominate 1:	Boulders	Cobble	Silt
Dominate 2:	Cobble	Gravel	Clay
Dominate 3:	Gravel	Silt	Mud - Muck
Dominate 4:		Clay	Cobble

Surrounding Land Uses (Select up to 4):

Landuse 1	Landuse 2	Landuse 3	Landuse 4
Residential	Road;Hwy;RR		

If applicable, choose up to 4 disturbances from the dropdown boxes below the appropriate severity of the impact.

Observed Human Disturbances:	Slight	Moderate	High	Extreme
Disturbance 1:	Garbage;Trash	Riparian Loss	Channelization	
Disturbance 2:	Water Withdrawal	Impoundment	Sedimentation	
Disturbance 3:		Substrate Alteration		
Disturbance 4:		Habitat Alteration		

Other Stream Information and Stressors:

Bank heights in upper reach were commonly 18"-24", at bottom of reach they were 24" - 36". Upper limit of reach is spring fed, property owners have dammed the creek just downstream of the spring and created a pond that is occupied by ducks. These ducks appear to be causing siltated waters, extending further down the reach. Follow up visits during winter, ducks were not present and water was clear.

STREAM SURVEY INFORMATION COK Stream Survey Photo Sheet

Project: Monitoring Year 2022-2023	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby
Name: REACH ONE	Participant 3:



Photo: F1AU
Description: Backyard

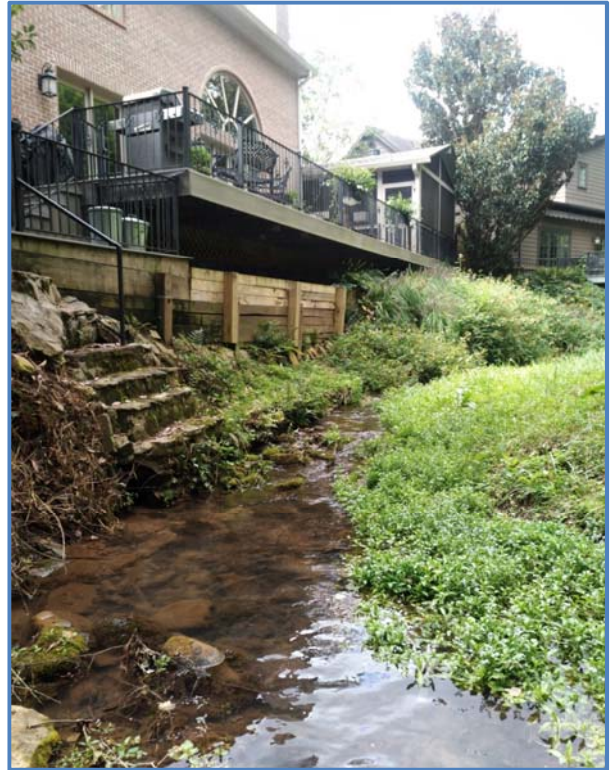


Photo: F1BU
Description: Backyard



Photo: F1ED

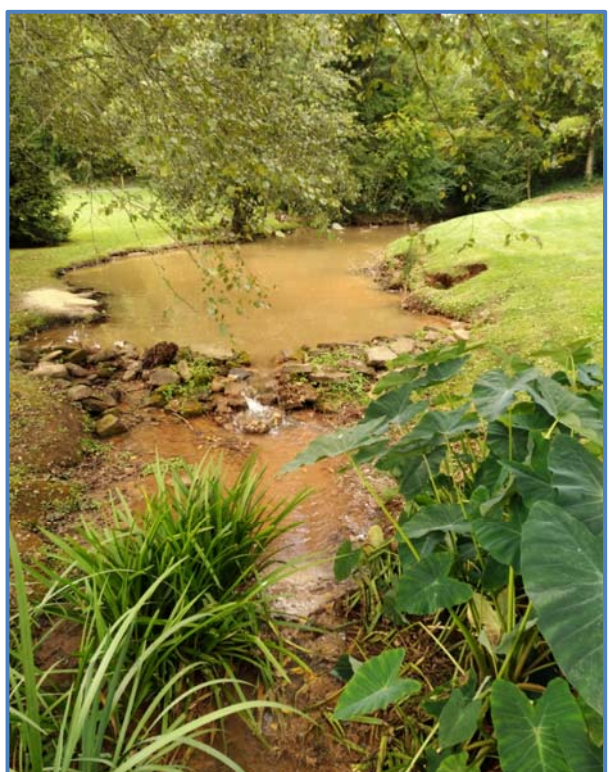


Photo: F1FU

COK Stream Survey Field Sheet

STREAM SURVEY INFORMATION (Revised COK 5/27/2021)

Project: Water Quality Monitoring (year)	Organization: City of Knoxville Stormwater
Watershed: Fourth Creek	Activity Type: Creek Walk
HUC12: 060102010204	Ecoregion: 67f

Reach:

Name: 2	Downstream Limits: 6304 Westland Dr
Date: 9/14, 9/22, & 10/5	DS Elevation: 830
Time: 13:30, 10:05, & 14:35	Upstream Limits: 7709 Westland Dr
Length: 11,952	US Elevation: 920
Description / Notes: Lawford Rd subdivision	

Weather:

Previous 48 hours Precipitation: Slight	Approx. Air Temperature (F°): 77, 75, & 72
Last Precipitation Date: 9/12 & 10/2	Approx. Water Temperature (F°): N/A

Physical Characteristics:

Gradient: Low	Avg. Stream Width: Small (1.5 - 3 yd.)
Slope: .007 ft/ft 0.70%	Max. Stream Depth: Medium (0.3 - 0.6 yd.)

Light Penetration:

% Canopy Cover Estimated for Reach: 90	Notes:
--	--------

Stream Bank Characteristics:

Bank Height: Varies	High Water Mark: Varies			
	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4
LDB Bank Slope:	Steep Terrain	Undercut	Bluff;Wall	Gentle Slope
RDB Bank Slope:	Steep Terrain	Undercut	Bluff;Wall	Gentle Slope

Channel Characteristics:

Manmade Modifications:	Channelized	Bridge	Cement	Dam
Sediment Deposits:	Moderate	Moderate	Slight	Slight
Sediment Type:	Sand	Silt	Clay	Mud
Turbidity:	Slight	Notes:		
Foam/Surface Sheen:	Nutrient	Notes:		
Algae:	Slight	Notes:		
Algae Type:	Green			

Dominate Substrate: (> 25%) Select up to 4:

	Riffle	Run	Pool
Dominate 1:	Boulders	Cobble	Cobble
Dominate 2:	Cobble	Gravel	Sand
Dominate 3:	Gravel	Bedrock	Clay
Dominate 4:	Bedrock	Sand	Mud - Muck

Surrounding Land Uses (Select up to 4):

Landuse 1	Landuse 2	Landuse 3	Landuse 4
Residential	Forest	Road;Hwy;RR	Commercial

If applicable, choose up to 4 disturbances from the dropdown boxes below the appropriate severity of the impact.

Observed Human Disturbances:	Slight	Moderate	High	Extreme
Disturbance 1:	Water Withdrawal	Sedimentation	Riparian Loss	Channelization
Disturbance 2:	Impoundment	Substrate Alteration	Habitat Alteration	
Disturbance 3:	Garbage;Trash			
Disturbance 4:				

Other Stream Information and Stressors:

Very long reach, bank height varies from 12" - 48"+. Left and right bank did vary high and low at multiple locations. Most of the reach meanders thru back yards. There were a lot of downed trees and natural debris blockages throughout, several acting as fish barriers. High water mark varied throughout reach due to channel width and obstructions. Base flow was approximately 12" most of the reach with deep pools. Adjacent commercial zone limited to north east bank. Majority of riparian buffer is residential property.

STREAM SURVEY INFORMATION COK Stream Survey Photo Sheet

Project: Monitoring Year 2022-2023	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby
Name: REACH TWO	Participant 3: Patrick Kontovich



Photo: F2PD

Description: Commerical and residential land use



Photo: F2UU

Description: Commerical and residential land use



Photo: F2KKU

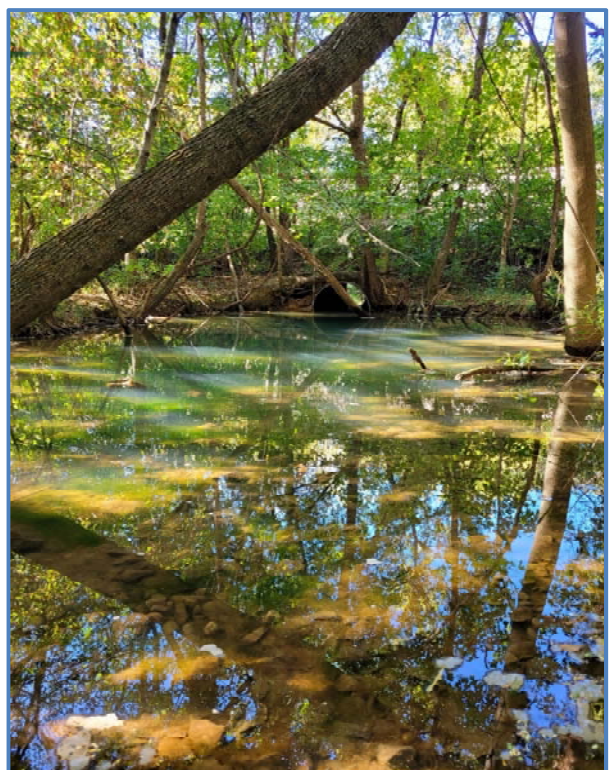


Photo: F2RRU

COK Stream Survey Field Sheet

STREAM SURVEY INFORMATION (Revised COK 5/27/2021)

Project: Water Quality Monitoring (year)	Organization: City of Knoxville Stormwater
Watershed: Fourth Creek	Activity Type: Creek Walk
HUC12: 060102010204	Ecoregion: 67f

Reach:

Name: 3	Downstream Limits: 6445 Cobblecreek Way
Date: 3/7/23 & 3/8/23	DS Elevation: 810
Time: 10:30	Upstream Limits: 204 S Northshore
Length: 5,927	US Elevation: 850
Description / Notes: Lower portion of main channel along Northshore	

Weather:

Previous 48 hours Precipitation: None	Approx. Air Temperature (F°): 58, 50
Last Precipitation Date: 3/3/2023	Approx. Water Temperature (F°): N/A

Physical Characteristics:

Gradient: Low	Avg. Stream Width: Medium (3-10 yd.)
Slope: 0.007 ft/ft 0.07%	Max. Stream Depth: Very Deep (>1 yd.)

Light Penetration:

% Canopy Cover Estimated for Reach: 20	Notes:
--	--------

Stream Bank Characteristics:

Bank Height: Varies	High Water Mark: Varies			
	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4
LDB Bank Slope:	Deeply Incised	Steep Terrain	Gentle Slope	Bluff; Wall
RDB Bank Slope:	Gentle Slope	Steep Terrain	Undercut	Bluff; Wall

Channel Characteristics:

Manmade Modifications:	Channelized	Bridge	Dam	Rip Rap
Sediment Deposits:	Slight	Slight		
Sediment Type:	Silt	Sand		
Turbidity:	Clear	Notes:		
Foam/Surface Sheen:	None	Notes:		
Algae:	Slight	Notes:		
Algae Type:	Green			

Dominate Substrate: (> 25%) Select up to 4:

	Riffle	Run	Pool
Dominate 1:	Bedrock	Bedrock	Boulders
Dominate 2:	Boulders	Cobble	Gravel
Dominate 3:	Cobble	Gravel	Sand
Dominate 4:	Gravel	Sand	Silt

Surrounding Land Uses (Select up to 4):

Landuse 1	Landuse 2	Landuse 3	Landuse 4
Residential	Road; Hwy; RR	Commercial	Impoundment

If applicable, choose up to 4 disturbances from the dropdown boxes below the appropriate severity of the impact.

Observed Human Disturbances:	Slight	Moderate	High	Extreme
Disturbance 1:	Sedimentation	Habitat Alteration	Channelization	
Disturbance 2:	Substrate Alteration	Impoundment	Riparian Loss	
Disturbance 3:	Water Withdrawal			
Disturbance 4:	Garbage; Trash			

Other Stream Information and Stressors:

High water mark varied throughout reach due to channel width and obstructions. Left and right bank did vary high and low at multiple locations, at the lower limits it is high bluffs and natural bedrock. Upper limit of reach is where commercial zone starts. Given the width and lack of mature canopy the substrate receives more light penetration than is ideal.

STREAM SURVEY INFORMATION COK Stream Survey Photo Sheet

Project: Monitoring Year 2022-2023	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby
Name: REACH THREE	Participant 3: Patrick Kontovich

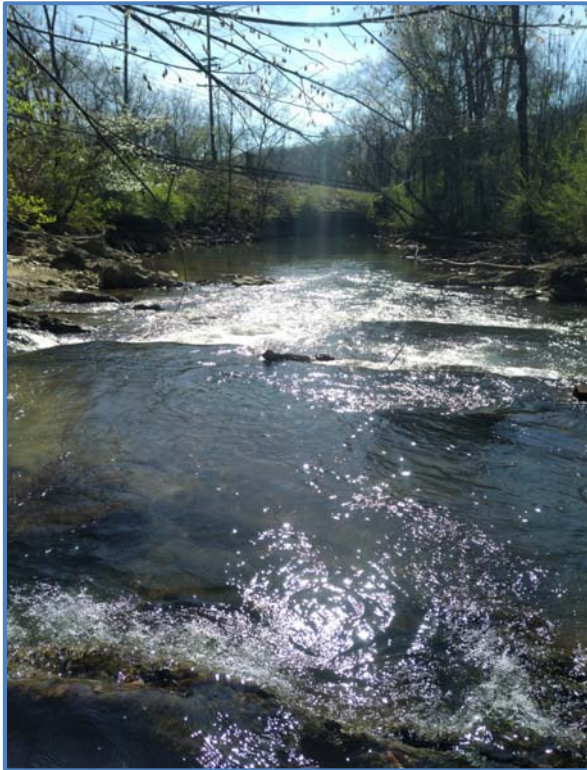


Photo: F3AD

Description: Downstream limits of reach

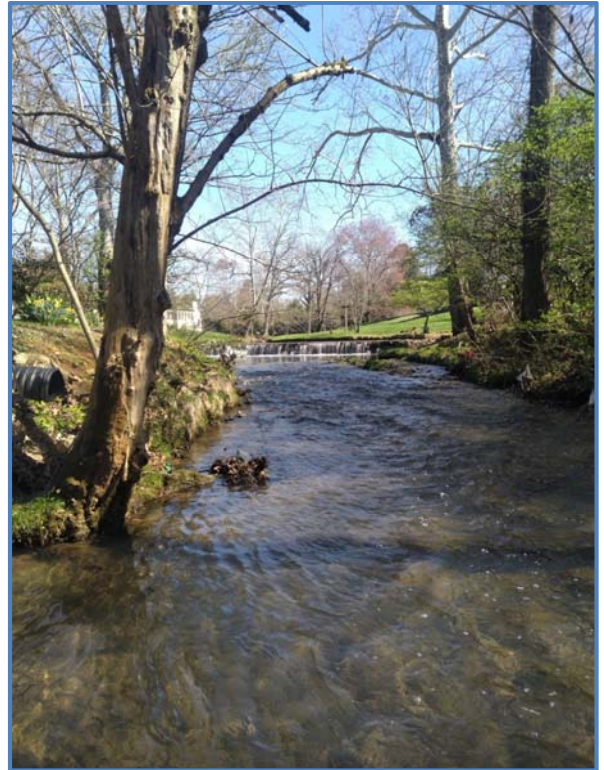


Photo: F3EU

Description: Dam



Photo: F3GD

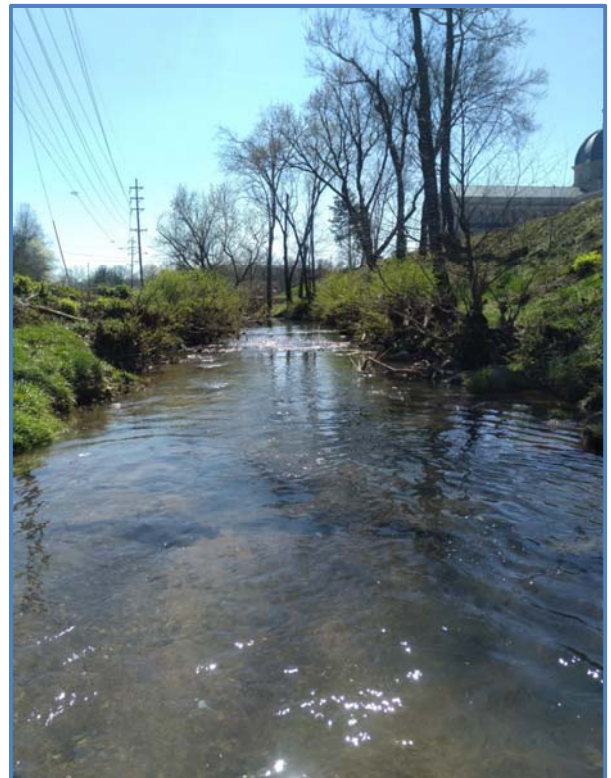


Photo: F3KD

COK Stream Survey Field Sheet

STREAM SURVEY INFORMATION (Revised COK 5/27/2021)

Project: Water Quality Monitoring (year)	Organization: City of Knoxville Stormwater
Watershed: Fourth Creek	Activity Type: Creek Walk
HUC12: 060102010204	Ecoregion: 67f

Reach:

Name: 4	Downstream Limits: 6004 Walden Dr
Date: 11/29/2022	DS Elevation: 846
Time: 12:25	Upstream Limits: 5707 Walden Dr
Length: 1,799	US Elevation: 862
Description / Notes: Walden commerical and golf course	

Weather:

Previous 48 hours Precipitation: Slight	Approx. Air Temperature (F°): 65
Last Precipitation Date: 11/27/2022	Approx. Water Temperature (F°): N/A

Physical Characteristics:

Gradient: Low	Avg. Stream Width: Small (1.5 - 3 yd.)
Slope: 0.009 ft/ft 0.90%	Max. Stream Depth: Medium (0.3 - 0.6 yd.)

Light Penetration:

% Canopy Cover Estimated for Reach: 76	Notes:
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Stream Bank Characteristics:

Bank Height: Varies	High Water Mark: Varies			
	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4
LDB Bank Slope:	Steep Terrain	Sloughing	Undercut	Bluff;Wall
RDB Bank Slope:	Steep Terrain	Sloughing	Undercut	

Channel Characteristics:

Manmade Modifications:	Channelized	Rip Rap	Bridge	
Sediment Deposits:	Slight	Slight		
Sediment Type:	Mud	Silt		
Turbidity:	Clear			
Foam/Surface Sheen:	None			
Algae:	Slight			
Algae Type:	Green	Filamentous		

Dominate Substrate: (> 25%) Select up to 4:

	Riffle	Run	Pool
Dominate 1:	Cobble	Gravel	Sand
Dominate 2:	Boulders	Cobble	Gravel
Dominate 3:	Gravel	Boulders	Silt
Dominate 4:		Silt	Detritus

Surrounding Land Uses (Select up to 4):

Landuse 1	Landuse 2	Landuse 3	Landuse 4
Commercial	Road;Hwy;RR	Golf Course	Forest

If applicable, choose up to 4 disturbances from the dropdown boxes below the appropriate severity of the impact.

Observed Human Disturbances:	Slight	Moderate	High	Extreme
Disturbance 1:	Garbage;Trash	Riparian Loss	Habitat Alteration	
Disturbance 2:		Substrate Alteration	Channelization	
Disturbance 3:				
Disturbance 4:				

Other Stream Information and Stressors:

Bank heights in upper reach were commonly 24"-36", at bottom of reach they were 18" - 24". Upper limit of reach is fed by a golf course with man made walls through a majority of it's length with multiple spring sources. The entirety of the reach is running through commercially zoned property.

STREAM SURVEY INFORMATION COK Stream Survey Photo Sheet

Project: Monitoring Year 2022-2023	Participant 1: Charissa Olglesby
Watershed: Fourth Creek	Participant 2: Trey Nennstiel
Name: REACH FOUR	Participant 3: Mark Dills



Photo: F4AU
Description: Start of reach

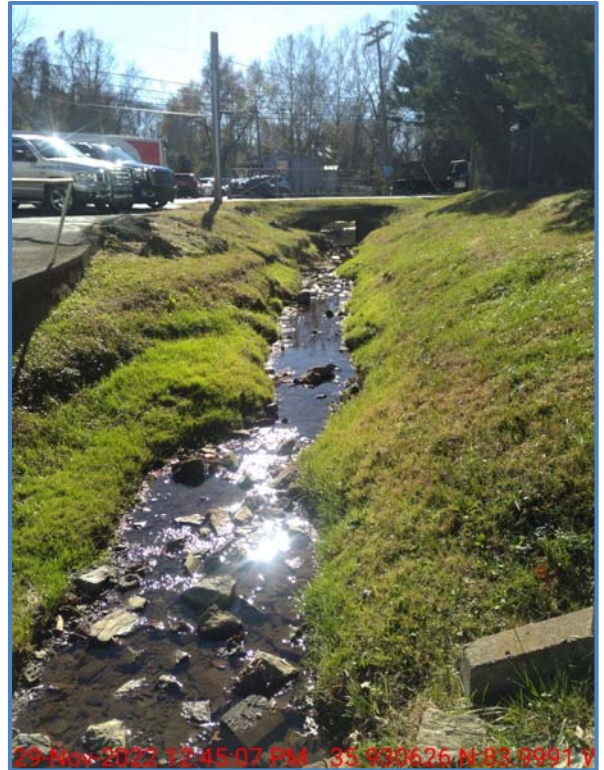


Photo: F4ED
Description: Commerical land use



Photo: F4ID

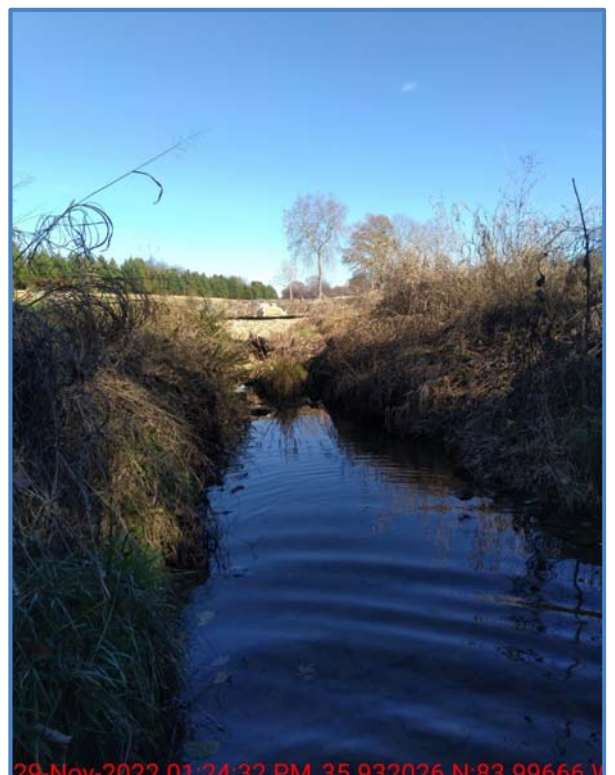


Photo: F4JU

COK Stream Survey Field Sheet

STREAM SURVEY INFORMATION (Revised COK 5/27/2021)

Project: Water Quality Monitoring 22/23	Organization: City of Knoxville Stormwater
Watershed: Fourth Creek	Activity Type: Creek Walk
HUC12: 060102010204	Ecoregion: 67f

Reach:

Name: 5	Downstream Limits: 6005 Brookvale Ln
Date: 9/14/2022	DS Elevation: 859
Time: 8:15	Upstream Limits: 6063 Papermill Dr
Length: 1,336	US Elevation: 868
Description / Notes: I-40 spring fed trib	

Weather:

Previous 48 hours Precipitation: None	Approx. Air Temperature (F°): 57
Last Precipitation Date: 9/12/2022	Approx. Water Temperature (F°): N/A

Physical Characteristics:

Gradient: Low	Avg. Stream Width:	Small (1.5 - 3 yd.)
Slope: .007ft/ft	Max. Stream Depth: 0.70%	Shallow (<0.3 yd.)

Light Penetration:

% Canopy Cover Estimated for Reach: 50	Notes:
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Stream Bank Characteristics:

Bank Height: Varies	High Water Mark: feet			
	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4
LDB Bank Slope:	Bluff;Wall	Steep Terrain	Undercut	
RDB Bank Slope:	Bluff;Wall	Steep Terrain	Undercut	

Channel Characteristics:

Manmade Modifications:	Channelized	Rip Rap	Cement	Bridge
Sediment Deposits:	Moderate	Moderate		
Sediment Type:	Silt	Mud		
Turbidity:	Slight	Notes:		
Foam/Surface Sheen:	None	Notes:		
Algae:	Moderate	Notes: Algae was mostly in the portions of reach without canopy		
Algae Type:	Green	Filamentous		

Dominate Substrate: (> 25%) Select up to 4:

	Riffle	Run	Pool
Dominate 1:	Cobble	Cobble	Silt
Dominate 2:	Gravel	Gravel	Clay
Dominate 3:	Boulders	Silt	Mud - Muck
Dominate 4:			

Surrounding Land Uses (Select up to 4):

Landuse 1	Landuse 2	Landuse 3	Landuse 4
Commercial	Road;Hwy;RR		

If applicable, choose up to 4 disturbances from the dropdown boxes below the appropriate severity of the impact.

Observed Human Disturbances:	Slight	Moderate	High	Extreme
Disturbance 1:		Impoundment	Garbage;Trash	Channelization
Disturbance 2:		Sedimentation	Substrate Alteration	Habitat Alteration
Disturbance 3:				Riparian Loss
Disturbance 4:				

Other Stream Information and Stressors:

Bank heights were commonly 12"-18" throughout the reach, but the riparian bank was steep and or man made in most of the reach. Upper reach has excessive trash deposits. Lower half of reach is mainly rip rap and poured concrete walls. Some sections of reach had deep sediment, while the riffle areas where relatively sediment free. Abundance of aquatic macro algae and grasses gives plenty of surface area for rich macroinvertebrate diversity. High water mark varied throughout reach due to channel width and obstructions.

STREAM SURVEY INFORMATION COK Stream Survey Photo Sheet

Project: Monitoring Year 2022-2023	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby
Name: REACH FIVE	Participant 3:

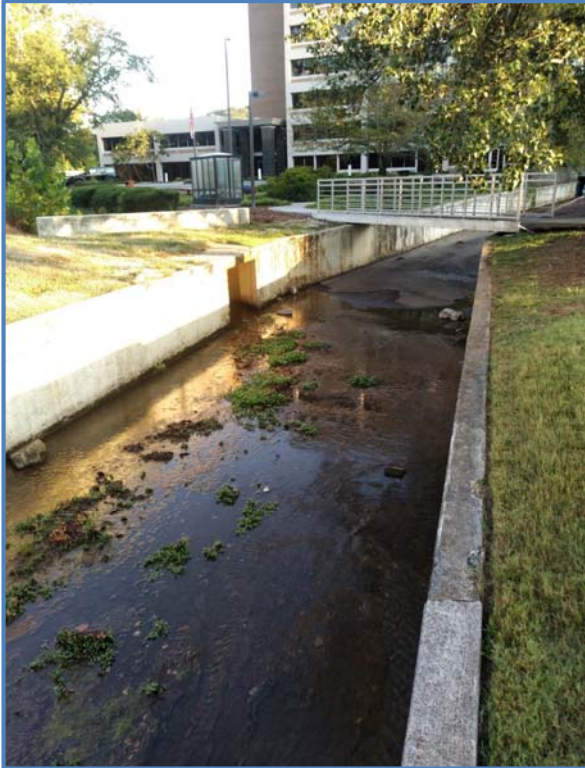


Photo: F5AU

Description: Beginning of reach



Photo: F5BD

Description: Through commercial parking area



Photo: F5DD



Photo: F5GD

COK Stream Survey Field Sheet

STREAM SURVEY INFORMATION (Revised COK 5/27/2021)

Project: Water Quality Monitoring (year)	Organization: City of Knoxville Stormwater
Watershed: Fourth Creek	Activity Type: Creek Walk
HUC12: 60102010204	Ecoregion: 67f

Reach:

Name: 6	Downstream Limits: 8324 Papermill Dr
Date: 9/14/2022	DS Elevation: 863
Time: 9:50	Upstream Limits: 231 Papermill Place Way
Length: 1313	US Elevation: 870
Description / Notes: Papermill commercial corridor	

Weather:

Previous 48 hours Precipitation:	Slight	Approx. Air Temperature (F°): 69
Last Precipitation Date:	9/12/2022	Approx. Water Temperature (F°): N/A

Physical Characteristics:

Gradient: Low	Avg. Stream Width:	Small (1.5 - 3 yd.)
Slope: .005ft/ft	0.50%	Max. Stream Depth: Medium (0.3 - 0.6 yd.)

Light Penetration:

% Canopy Cover Estimated for Reach:	45	Notes:
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Stream Bank Characteristics:

Bank Height: Varies	High Water Mark: Varies			
	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4
LDB Bank Slope:	Steep Terrain	Undercut		
RDB Bank Slope:	Steep Terrain	Undercut		

Channel Characteristics:

Manmade Modifications:	Channelized	Rip Rap	Cement	Bridge
Sediment Deposits:	Slight	Moderate	Slight	
Sediment Type:	Silt	Sand	Mud	
Turbidity:	Slight	Notes:		
Foam/Surface Sheen:	None	Notes:		
Algae:	Slight	Notes:		
Algae Type:	Green			

Dominate Substrate: (> 25%) Select up to 4:

	Riffle	Run	Pool
Dominate 1:	Gravel	Cobble	Cobble
Dominate 2:	Cobble	Gravel	Gravel
Dominate 3:	Boulders	Boulders	Sand
Dominate 4:		Sand	Silt

Surrounding Land Uses (Select up to 4):

Landuse 1	Landuse 2	Landuse 3	Landuse 4
Commercial	Road;Hwy;RR		

If applicable, choose up to 4 disturbances from the dropdown boxes below the appropriate severity of the impact.

Observed Human Disturbances:	Slight	Moderate	High	Extreme
Disturbance 1:	Sedimentation	Substrate Alteration	Habitat Alteration	Channelization
Disturbance 2:	Impoundment		Riparian Loss	
Disturbance 3:	Garbage;Trash			
Disturbance 4:				

Other Stream Information and Stressors:

Width of channel is uncharacteristically narrow in upper reaches. Creek also has an artificially altered depth in one section due to a large chunk of CMP that is diverting water flow. Bank heights were commonly 24"-36" throughout the reach and had a steep riparian zone. Halfway through reach a spring upwelling was located. Upper reach is also spring fed directly in channel. High water mark varied throughout reach due to channel width and obstructions.

STREAM SURVEY INFORMATION COK Stream Survey Photo Sheet

Project: Monitoring Year 2022-2023	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby
Name: REACH SIX	Participant 3:



Photo: F6BU

Description: Unused commercial land

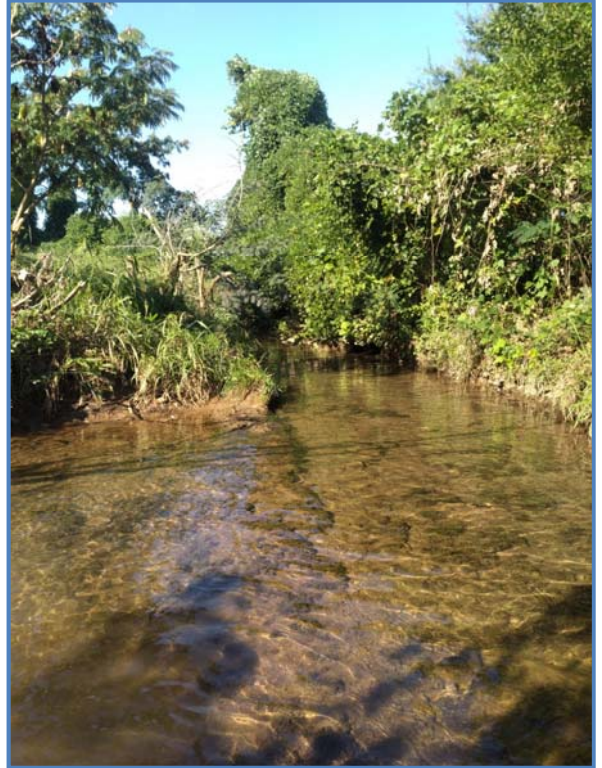


Photo: F6CU

Description: Unused commercial land



Photo: F6FD



Photo: F6HD

COK Stream Survey Field Sheet

STREAM SURVEY INFORMATION (Revised COK 5/27/2021)

Project: Water Quality Monitoring (year)	Organization: City of Knoxville Stormwater
Watershed: Fourth Creek	Activity Type: Creek Walk
HUC12: 60102010204	Ecoregion: 67f

Reach:

Name: 7	Downstream Limits: 801 N Weisgarber Rd
Date: 11/29/22 & 2/28/23	DS Elevation: 869
Time: 14:00 & 10:00	Upstream Limits: 1122 Old Weisgarber Rd
Length: 2,710	US Elevation: 902
Description / Notes: Weisgarber corridor	

Weather:

Previous 48 hours Precipitation: Slight	Approx. Air Temperature (F°): N/A
Last Precipitation Date: 2/27/2023	Approx. Water Temperature (F°): N/A

Physical Characteristics:

Gradient: Low	Avg. Stream Width: Medium (3-10 yd.)
Slope: .012 ft/ft 1.20%	Max. Stream Depth: Deep (0.6 - 1 yd.)

Light Penetration:

% Canopy Cover Estimated for Reach: 17	Notes:
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Stream Bank Characteristics:

Bank Height: Varies	High Water Mark: Varies			
	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4
LDB Bank Slope:	Steep Terrain	Bluff;Wall	Gentle Slope	
RDB Bank Slope:	Steep Terrain	Bluff;Wall	Gentle Slope	

Channel Characteristics:

Manmade Modifications:	Channelized	Rip Rap	Bridge	Dam
Sediment Deposits:	Slight			
Sediment Type:	Sand			
Turbidity:	Clear	Notes:		
Foam/Surface Sheen:	None	Notes:		
Algae:	Moderate	Notes: Observed Macroinvertebrate burrows/cases in the algae		
Algae Type:	Green			

Dominate Substrate: (> 25%) Select up to 4:

	Riffle	Run	Pool
Dominate 1:	Boulders	Boulders	Gravel
Dominate 2:	Cobble	Cobble	Sand
Dominate 3:	Bedrock	Gravel	Cobble
Dominate 4:		Bedrock	Silt

Surrounding Land Uses (Select up to 4):

Landuse 1	Landuse 2	Landuse 3	Landuse 4
Commercial	Road;Hwy;RR	Residential	

If applicable, choose up to 4 disturbances from the dropdown boxes below the appropriate severity of the impact.

Observed Human Disturbances:	Slight	Moderate	High	Extreme
Disturbance 1:	Garbage;Trash	Impoundment	Riparian Loss	Channelization
Disturbance 2:	Homeless Camps	Substrate Alteration	Habitat Alteration	
Disturbance 3:	Sedimentation			
Disturbance 4:				

Other Stream Information and Stressors:

Bank heights of this reach were around 4 feet tall, then transitioned to approximately 24" to 30" when the creek began to approach the start of reach 9, thru the undeveloped area. High water mark varied throughout reach due to channel width and obstructions. There were some small bedrock waterfalls, deep pools, with a base flow depth of about 18". Upper reach splits into "Y" shape.

STREAM SURVEY INFORMATION COK Stream Survey Photo Sheet

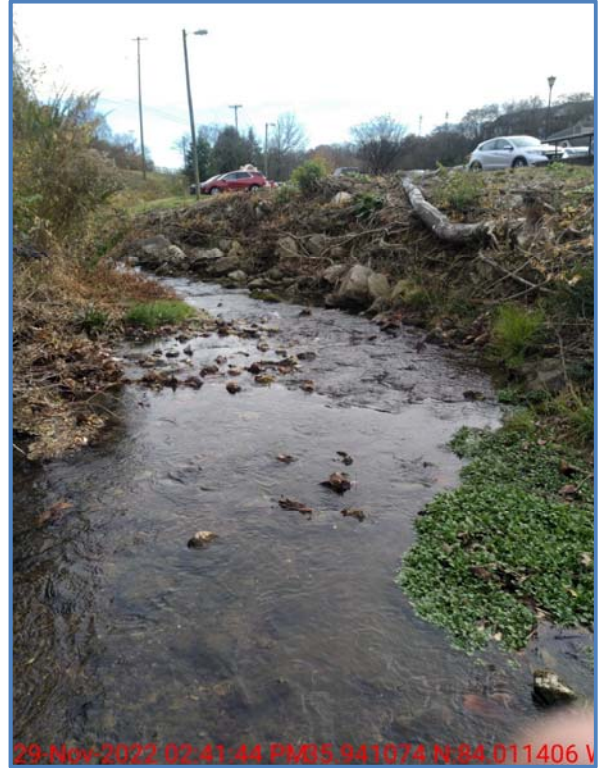
Project: Monitoring Year 2022-2023	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby
Name: REACH SEVEN	Participant 3: Mark Dills



29-Nov-2023 02:28:19 PM 35.93977 N 84.010826 W

Photo: F7CU

Description: Exposed bedrock in stream bed



29-Nov-2023 02:41:44 PM 35.941074 N 84.011406 W

Photo: F7ED

Description: Along Weisgarber

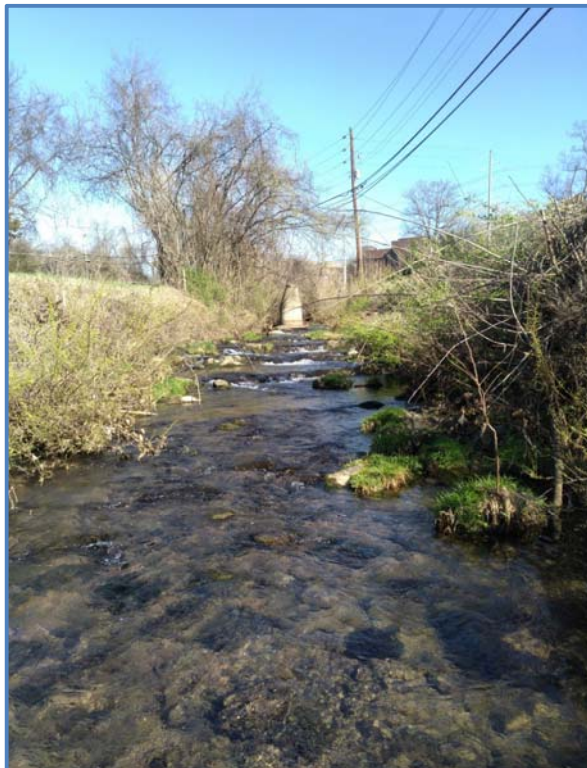


Photo: F7GU

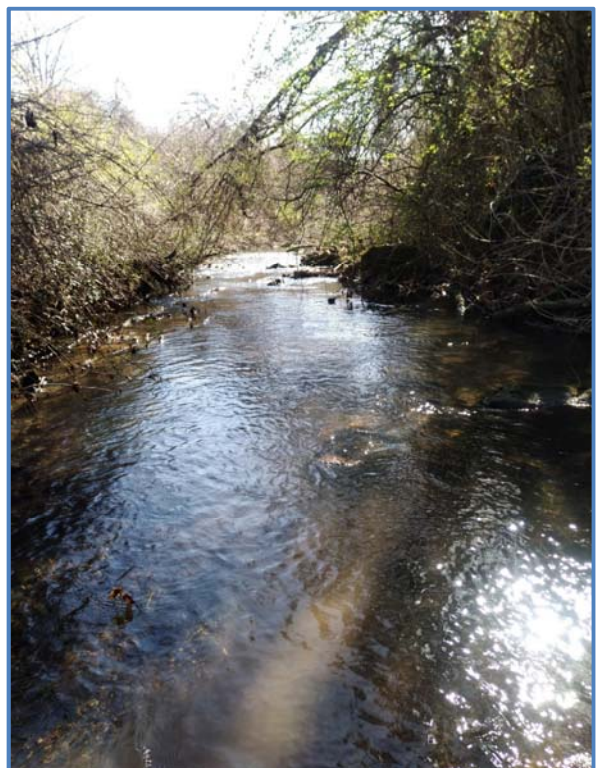


Photo: F7ID

COK Stream Survey Field Sheet

STREAM SURVEY INFORMATION (Revised COK 5/27/2021)

Project: Water Quality Monitoring (year)	Organization: City of Knoxville Stormwater
Watershed: Fourth Creek	Activity Type: Creek Walk
HUC12: 60102010204	Ecoregion: 67f

Reach:

Name: 8	Downstream Limits: 623 Morrell Rd
Date: 11/29/2022	DS Elevation: 935
Time: 10:45	Upstream Limits: 523 Morrell Rd
Length: 555	US Elevation: 939
Description / Notes: Morrell Rd spring fed trib	

Weather:

Previous 48 hours Precipitation:	Slight	Approx. Air Temperature (F°): 65
Last Precipitation Date:	11/27/2022	Approx. Water Temperature (F°): N/A

Physical Characteristics:

Gradient: Low	Avg. Stream Width:	Very Small (<1.5 yd.)
Slope: 0.007 ft/ft	0.70%	Max. Stream Depth: Shallow (<0.3 yd.)

Light Penetration:

% Canopy Cover Estimated for Reach:	50	Notes:
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Stream Bank Characteristics:

Bank Height: Varies	High Water Mark: Varies			
	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4
LDB Bank Slope:	Undercut	Gentle Slope		
RDB Bank Slope:	Undercut	Gentle Slope		

Channel Characteristics:

Manmade Modifications:	Bridge	Channelized		
Sediment Deposits:	High	Moderate		
Sediment Type:	Mud	Silt		
Turbidity:	Clear	Notes:		
Foam/Surface Sheen:	Bacteria	Notes: Found in a short offshoot of the main creek		
Algae:	Slight	Notes:		
Algae Type:	Green			

Dominate Substrate: (> 25%) Select up to 4:

	Riffle	Run	Pool
Dominate 1:	Gravel	Gravel	Detritus
Dominate 2:	Cobble	Cobble	Mud - Muck
Dominate 3:	Detritus	Detritus	Gravel
Dominate 4:	Boulders		Cobble

Surrounding Land Uses (Select up to 4):

Landuse 1	Landuse 2	Landuse 3	Landuse 4
Residential	Road;Hwy;RR		

If applicable, choose up to 4 disturbances from the dropdown boxes below the appropriate severity of the impact.

Observed Human Disturbances:	Slight	Moderate	High	Extreme
Disturbance 1:	Habitat Alteration			
Disturbance 2:	Sedimentation			
Disturbance 3:				
Disturbance 4:				

Other Stream Information and Stressors:

The bank was consistent and low with a maximum height of close to 12 inches. The whole area was mostly low land and marsh. The high water mark was not clearly defined, as it appears the entire low area floods, based on sediment deposits.

STREAM SURVEY INFORMATION COK Stream Survey Photo Sheet

Project: Monitoring Year 2022-2023	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby
Name: REACH EIGHT	Participant 3:



Photo: F8AD

Description: Looking toward Morrell Rd



Photo: F8BU

Description: Marsh area and meander



Photo: F8CU



Photo: F8 SPRING

COK Stream Survey Field Sheet

STREAM SURVEY INFORMATION (Revised COK 5/27/2021)

Project: Water Quality Monitoring (year)	Organization: City of Knoxville Stormwater
Watershed: Fourth Creek	Activity Type: Creek Walk
HUC12: 60102010204	Ecoregion: 67f

Reach:

Name: 9	Downstream Limits: 1122 Old Weisgarber Rd
Date: 2/28/23 & 3/1/23	DS Elevation: 902
Time: 14:00 & 10:00	Upstream Limits: 11340 Dowel Springs BLVD
Length: 3141	US Elevation: 921
Description / Notes: Middlebrook spring fed tribs	

Weather:

Previous 48 hours Precipitation:	Slight	Approx. Air Temperature (F°): N/A
Last Precipitation Date:	2/27/2023	Approx. Water Temperature (F°): N/A

Physical Characteristics:

Gradient: Low	Avg. Stream Width:	Medium (3-10 yd.)
Slope: 0.006 ft/ft	0.60%	Max. Stream Depth: Deep (0.6 - 1 yd.)

Light Penetration:

% Canopy Cover Estimated for Reach:	75	Notes:
--	----	--------

Stream Bank Characteristics:

Bank Height: Varies	High Water Mark: feet			
	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4
LDB Bank Slope:	Undercut	Gentle Slope	Deeply Incised	
RDB Bank Slope:	Undercut	Gentle Slope	Deeply Incised	

Channel Characteristics:

Manmade Modifications:	Rip Rap	Channelized	Dam	Bridge
Sediment Deposits:	Excessive	Excessive		
Sediment Type:	Silt	Mud		
Turbidity:	Clear	Notes:		
Foam/Surface Sheen:	Bacteria	Notes: Orange iron bacteria and organic rainbow sheen		
Algae:	Moderate	Notes:		
Algae Type:	Diatoms	Green		

Dominate Substrate: (> 25%) Select up to 4:

	Riffle	Run	Pool
Dominate 1:	Cobble	Gravel	Silt
Dominate 2:	Gravel	Sand	Sand
Dominate 3:	Boulders	Cobble	Mud - Muck
Dominate 4:	Sand	Boulders	Gravel

Surrounding Land Uses (Select up to 4):

Landuse 1	Landuse 2	Landuse 3	Landuse 4
Commercial	Road;Hwy;RR		

If applicable, choose up to 4 disturbances from the dropdown boxes below the appropriate severity of the impact.

Observed Human Disturbances:	Slight	Moderate	High	Extreme
Disturbance 1:	Garbage;Trash	Impoundment	Riparian Loss	
Disturbance 2:	Homeless Camps	Channelization	Sedimentation	
Disturbance 3:			Substrate Alteration	
Disturbance 4:			Habitat Alteration	

Other Stream Information and Stressors:

Bank heights transitioned from approximately 24" to 30" until the upper reach where the springs were located. The spring and low gradient upper reach had minimal bank height. High water mark varied throughout reach due to channel width and obstructions. There were some riffles and shallow pools, with a base flow depth of about 12". Small patch of developing wetland just above Middlebrook Pike. Downstream of the wet weather conveyance there was a noticable amount of sediment from the point of it's connection to just before the bridge, due to extreme erosion of the conveyance channel.

STREAM SURVEY INFORMATION COK Stream Survey Photo Sheet

Project: Monitoring Year 2022-2023	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby
Name: REACH NINE	Participant 3: Patrick Kontovich



Photo: F9(7)KU

Description: Beginning of reach

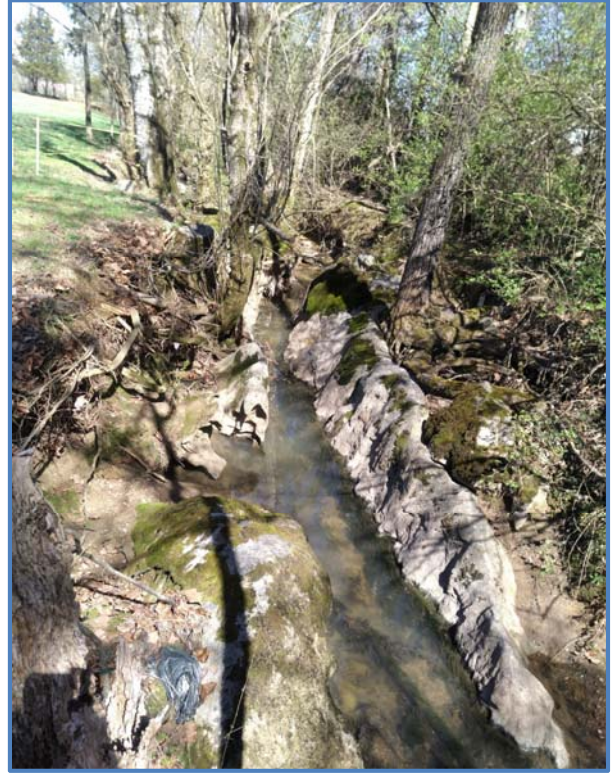


Photo: F9(7)RU

Description: Bedrock formations



Photo: F9(7)AAU



Photo: F9(7)CCU

COK Stream Survey Field Sheet

STREAM SURVEY INFORMATION (Revised COK 5/27/2021)

Project: Water Quality Monitoring (year)	Organization: City of Knoxville Stormwater
Watershed: Fourth Creek	Activity Type: Creek Walk
HUC12: 060102010204	Ecoregion: 67f

Reach:

Name: 10	Downstream Limits: 204 S Northshore
Date: 3/7/23 & 3/8/23	DS Elevation: 850
Time: 10:30 & 14:20	Upstream Limits: 6401 Nightingale Ln
Length: 5,041	US Elevation: 867
Description / Notes: Northshore and papermill commercial district	

Weather:

Previous 48 hours Precipitation:	None	Approx. Air Temperature (F°): N/A
Last Precipitation Date:	3/3/2023	Approx. Water Temperature (F°): N/A

Physical Characteristics:

Gradient: Low	Avg. Stream Width: Medium (3-10 yd.)
Slope: 0.003 ft/ft 0.03%	Max. Stream Depth: Very Deep (>1 yd.)

Light Penetration:

% Canopy Cover Estimated for Reach:	32	Notes:
-------------------------------------	----	--------

Stream Bank Characteristics:

Bank Height: Varies	High Water Mark: Varies			
	Characteristic 1	Characteristic 2	Characteristic 3	Characteristic 4
LDB Bank Slope:	Steep Terrain	Bluff;Wall	Sloughing	Undercut
RDB Bank Slope:	Steep Terrain	Bluff;Wall	Sloughing	Undercut

Channel Characteristics:

Manmade Modifications:	Channelized	Cement	Bridge	Rip Rap
Sediment Deposits:	Moderate	Moderate	Moderate	
Sediment Type:	Sand	Silt	Mud	
Turbidity:	Slight	Notes:		
Foam/Surface Sheen:	Oil Sheen	Notes: Also looked like there could be commercial washing from restaurants		
Algae:	Moderate	Notes: Algae growth was in all the sunlit areas		
Algae Type:	Green			

Dominate Substrate: (> 25%) Select up to 4:

	Riffle	Run	Pool
Dominate 1:	Bedrock	Cobble	Gravel
Dominate 2:	Cobble	Gravel	Sand
Dominate 3:	Gravel	Sand	Silt
Dominate 4:		Bedrock	Detritus

Surrounding Land Uses (Select up to 4):

Landuse 1	Landuse 2	Landuse 3	Landuse 4
Commercial	Road;Hwy;RR		

If applicable, choose up to 4 disturbances from the dropdown boxes below the appropriate severity of the impact.

Observed Human Disturbances:	Slight	Moderate	High	Extreme
Disturbance 1:	Impoundment	Sedimentation	Habitat Alteration	Garbage;Trash
Disturbance 2:			Substrate Alteration	Channelization
Disturbance 3:			Homeless Camps	
Disturbance 4:			Riparian Loss	

Other Stream Information and Stressors:

High water mark varied throughout reach due to channel width and obstructions. Bank heights of this reach were around 6 feet tall, then transitioned to approximately 24" to " Open area near Kingston Pike was the most effected by sediment. Lots of slabs of cut marble in the channel.

STREAM SURVEY INFORMATION COK Stream Survey Photo Sheet

Project: Monitoring Year 2022-2023	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby
Name: REACH TEN	Participant 3: Patrick Kontovich



Photo: F10(3)MU

Description:

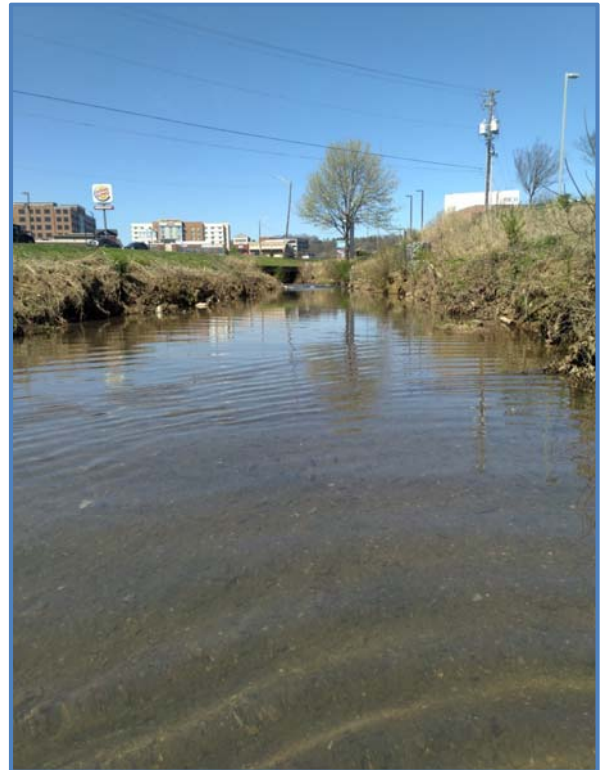


Photo: F10(3)OU

Description:



Photo: F10(3)RU

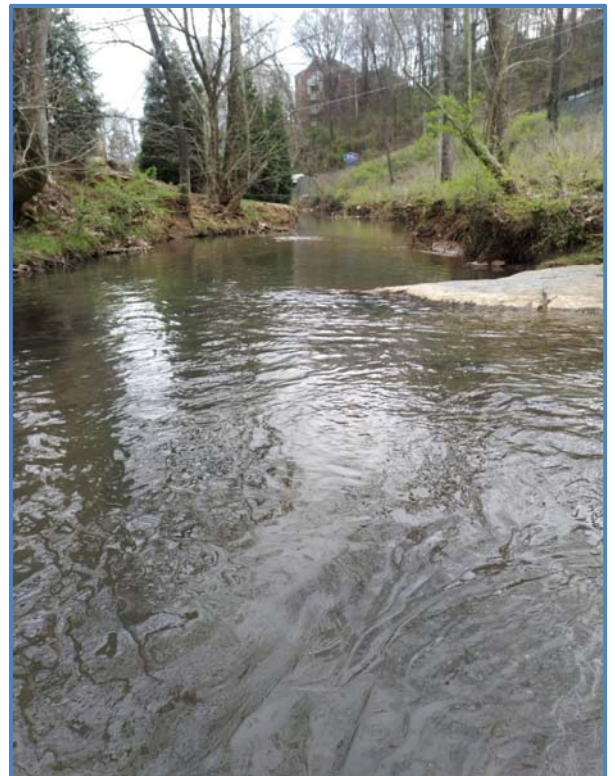


Photo: F10(3)TD

Appendix C

Invertebrate Surveys

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS

Complete this habitat assessment if **SQKICK** is collected.

(See Macroinvertebrate SOP - Protocol E for detailed descriptions and rank information)

DWR Station ID:					Habitat Assessment By:					
Monitoring Location Name:	Fourth Creek				Date:	7/28/2022		Time:		
Monitoring Location:	Nutting				Field Log Number:					
HUC:	60102010204	WS Group:		Ecoregion:	67f	QC:		<input type="checkbox"/>	Consensus	

Habitat Type: HG

If QA/QC 2 habitats are completed independently, check box above.

See most recent [Macroinvertebrate SOP](#) Protocol D-1 for specific instructions for completing this information.

For each habitat parameter, type score or select from blue dropdown box. Add comments if needed in row below score.

		Optimal					Suboptimal					Marginal					Poor				
1. Epifaunal Substrate/ Available Cover		Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.					Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.				
Score	13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
2. Embeddedness of Riffles		Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.					Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.				
Score	10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
3. Velocity/ Depth Regime		All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).					Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.				
Score	12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
4. Sediment Deposition	Does this rating match sed. desc. in SS?	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.					Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.				
Score	10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
5. Channel Flow Status		Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.					Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.				
Score	18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					

6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.	
Score	5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment	Commercial developments on both sides, zero sinuosity				
7. Frequency of re-oxygenation zones Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.	
Score	5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment	Upsream of dam, water surface elevation was consistent in sampling area				
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	
Score (Left Bank)	9	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	7	10 9	8 7 6	5 4 3	2 1 0
Comment					
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)	
Score (Left Bank)	5	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	5	10 9	8 7 6	5 4 3	2 1 0
Comment					
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.	
Score (Left Bank)	5	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	5	10 9	8 7 6	5 4 3	2 1 0
Comment					
Total Score:	109	Ecoregion:			Drainage Area:

Invertebrate Sampling COK Stream Sampling Photo Sheet

Project: 22/23	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby



Date: 7/28/2022
Location: Nutting sample point



Date: 7/28/2022
Location: Nutting sample point



Date: 7/28/2022



Date: 7/28/2022

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS

Complete this habitat assessment if **SQKICK** is collected.

(See Macroinvertebrate SOP - Protocol E for detailed descriptions and rank information)

DWR Station ID:					Habitat Assessment By:					
Monitoring Location Name:	Fourth Creek				Date:	8/25/2022		Time:		
Monitoring Location:	Aubrey's				Field Log Number:					
HUC:	60102010204	WS Group:		Ecoregion:	67f	QC:		<input type="checkbox"/>	Consensus	

Habitat Type: HG

If QA/QC 2 habitats are completed independently, check box above.

See most recent [Macroinvertebrate SOP](#) Protocol D-1 for specific instructions for completing this information.

For each habitat parameter, type score or select from blue dropdown box. Add comments if needed in row below score.

		Optimal					Suboptimal					Marginal					Poor				
1. Epifaunal Substrate/ Available Cover		Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.					Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.				
Score	16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
2. Embeddedness of Riffles		Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.					Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.				
Score	13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
3. Velocity/ Depth Regime		All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).					Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.				
Score	13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
4. Sediment Deposition	Does this rating match sed. desc. in SS?	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.					Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.				
Score	10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
5. Channel Flow Status		Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.					Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.				
Score	15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					

6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.	
Score	4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
7. Frequency of re-oxygenation zones Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.	
Score	16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	
Score (Left Bank)	8	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	8	10 9	8 7 6	5 4 3	2 1 0
Comment	Downstream sediment is stable, but riprap is present on both sides				
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)	
Score (Left Bank)	6	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	6	10 9	8 7 6	5 4 3	2 1 0
Comment	Upstrem and downstream sections are disparately vegitated				
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.	
Score (Left Bank)	2	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	2	10 9	8 7 6	5 4 3	2 1 0
Comment					
Total Score:	119	Ecoregion:			Drainage Area:

Invertebrate Sampling COK Stream Sampling Photo Sheet

Project: 22/23	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby



Date: 8/25/2022
Location: Aubrey sampling point



Date: 8/25/2022
Location: Aubrey sampling point



Date: 8/25/2022



Date: 8/25/2022

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS

Complete this habitat assessment if **SQKICK** is collected.

(See Macroinvertebrate SOP - Protocol E for detailed descriptions and rank information)

DWR Station ID:					Habitat Assessment By:					
Monitoring Location Name:	Fourth Creek				Date:	9/289/22		Time:		
Monitoring Location:	Old Weisgarber				Field Log Number:					
HUC:	60102010204	WS Group:		Ecoregion:	67f	QC:		<input type="checkbox"/>	Consensus	

Habitat Type: HG

If QA/QC 2 habitats are completed independently, check box above.

See most recent [Macroinvertebrate SOP](#) Protocol D-1 for specific instructions for completing this information.

For each habitat parameter, type score or select from blue dropdown box. Add comments if needed in row below score.

		Optimal					Suboptimal					Marginal					Poor				
1. Epifaunal Substrate/ Available Cover		Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.					Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.				
Score	18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment	Riffles, undercut banks, vegetation, logs, cobbles, and boulders are all present																				
2. Embeddedness of Riffles		Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.					Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.				
Score	15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
3. Velocity/ Depth Regime		All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).					Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.				
Score	16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
4. Sediment Deposition	Does this rating match sed. desc. in SS?	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.					Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.				
Score	10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
5. Channel Flow Status		Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.					Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.				
Score	17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					

6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.	
Score	14	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment	Bridge present, but does not appear to be channelized up and down stream				
7. Frequency of re-oxygenation zones Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.	
Score	16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	
Score (Left Bank)	8	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	8	10 9	8 7 6	5 4 3	2 1 0
Comment					
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)	
Score (Left Bank)	8	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	8	10 9	8 7 6	5 4 3	2 1 0
Comment					
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.	
Score (Left Bank)	9	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	9	10 9	8 7 6	5 4 3	2 1 0
Comment					
Total Score:	156	Ecoregion:			Drainage Area:

Invertebrate Sampling COK Stream Sampling Photo Sheet

Project: 22/23	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby



Date: 9/28/2022
Location: Old Weisgarber sampling point



Date: 9/28/2022
Location: Old Weisgarber sampling point



Date: 6/1/2023



Date: 6/1/2023

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS

Complete this habitat assessment if **SQKICK** is collected.

(See Macroinvertebrate SOP - Protocol E for detailed descriptions and rank information)

DWR Station ID:					Habitat Assessment By:					
Monitoring Location Name:	Fourth Creek				Date:	3/6/2023		Time:		
Monitoring Location:	Weigles				Field Log Number:					
HUC:	60102010204	WS Group:		Ecoregion:	67f	QC:		<input type="checkbox"/>	Consensus	

Habitat Type: HG

If QA/QC 2 habitats are completed independently, check box above.

See most recent [Macroinvertebrate SOP](#) Protocol D-1 for specific instructions for completing this information.

For each habitat parameter, type score or select from blue dropdown box. Add comments if needed in row below score.

		Optimal					Suboptimal					Marginal					Poor				
1. Epifaunal Substrate/ Available Cover		Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.					Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.				
Score	14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
2. Embeddedness of Riffles		Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.					Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.				
Score	14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment	Sampling area was primarily cobble and boulders over bedrock, no layering of cobble present																				
3. Velocity/ Depth Regime		All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).					Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.				
Score	10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment	This was a ver swift section, no slow velocity regimes present																				
4. Sediment Deposition	Does this rating match sed. desc. in SS?	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.					Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.				
Score	15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment	Minimal sediment present due to velocity of water																				
5. Channel Flow Status		Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.					Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.				
Score	16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					

6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.	
Score	3	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
7. Frequency of re-oxygenation zones Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.	
Score	15	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	
Score (Left Bank)	5	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	6	10 9	8 7 6	5 4 3	2 1 0
Comment					
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)	
Score (Left Bank)	2	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	2	10 9	8 7 6	5 4 3	2 1 0
Comment					
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.	
Score (Left Bank)	6	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	3	10 9	8 7 6	5 4 3	2 1 0
Comment					
Total Score:	111	Ecoregion:			Drainage Area:

Invertebrate Sampling COK Stream Sampling Photo Sheet

Project: 22/23	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby



Date: 3/6/2023
Location: Lonas Drive



Date: 3/6/2023
Location: Lonas Drive



Date: 3/6/2023



Date: 3/6/2023

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS

Complete this habitat assessment if **SQKICK** is collected.

(See Macroinvertebrate SOP - Protocol E for detailed descriptions and rank information)

DWR Station ID:					Habitat Assessment By:					
Monitoring Location Name:	Fourth Creek				Date:	5/4/2023		Time:		
Monitoring Location:	Agnes				Field Log Number:					
HUC:	60102010204	WS Group:		Ecoregion:	67f	QC:		<input type="checkbox"/>	Consensus	

Habitat Type: HG

If QA/QC 2 habitats are completed independently, check box above.

See most recent [Macroinvertebrate SOP](#) Protocol D-1 for specific instructions for completing this information.

For each habitat parameter, type score or select from blue dropdown box. Add comments if needed in row below score.

		Optimal					Suboptimal					Marginal					Poor				
1. Epifaunal Substrate/ Available Cover		Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.					Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.				
Score	15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
2. Embeddedness of Riffles		Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.					Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.				
Score	10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
3. Velocity/ Depth Regime		All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).					Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.				
Score	10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
4. Sediment Deposition	Does this rating match sed. desc. in SS?	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.					Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.				
Score	7	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
5. Channel Flow Status		Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.					Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.				
Score	15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					

6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.	
Score	7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
7. Frequency of re-oxygenation zones Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.	
Score	11	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	
Score (Left Bank)	5	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	4	10 9	8 7 6	5 4 3	2 1 0
Comment					
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)	
Score (Left Bank)	4	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	4	10 9	8 7 6	5 4 3	2 1 0
Comment					
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.	
Score (Left Bank)	4	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	4	10 9	8 7 6	5 4 3	2 1 0
Comment					
Total Score:	100	Ecoregion:			Drainage Area:

Invertebrate Sampling COK Stream Sampling Photo Sheet

Project: 22/23	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby



Date: 5/4/2023
Location: Agnes sampling point



Date: 5/4/2023
Location: Agnes sampling point



Date: 5/4/2023



Date: 5/4/2023

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS

Complete this habitat assessment if **SQKICK** is collected.

(See Macroinvertebrate SOP - Protocol E for detailed descriptions and rank information)

DWR Station ID:					Habitat Assessment By:					
Monitoring Location Name:	Fourth Creek				Date:	5/4/2023		Time:		
Monitoring Location:	Walden				Field Log Number:					
HUC:	60102010204	WS Group:		Ecoregion:	67f	QC:		<input type="checkbox"/>	Consensus	

Habitat Type: HG

If QA/QC 2 habitats are completed independently, check box above.

See most recent [Macroinvertebrate SOP](#) Protocol D-1 for specific instructions for completing this information.

For each habitat parameter, type score or select from blue dropdown box. Add comments if needed in row below score.

		Optimal					Suboptimal					Marginal					Poor				
1. Epifaunal Substrate/ Available Cover		Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.					Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.				
Score	16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
2. Embeddedness of Riffles		Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.					Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.				
Score	16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
3. Velocity/ Depth Regime		All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).					Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.				
Score	15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
4. Sediment Deposition	Does this rating match sed. desc. in SS?	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.					Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.				
Score	14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
5. Channel Flow Status		Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.					Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.				
Score	16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					

6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.	
Score	7	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
7. Frequency of re-oxygenation zones Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.	
Score	13	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	
Score (Left Bank)	6	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	8	10 9	8 7 6	5 4 3	2 1 0
Comment					
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)	
Score (Left Bank)	2	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	4	10 9	8 7 6	5 4 3	2 1 0
Comment					
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.	
Score (Left Bank)	2	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	3	10 9	8 7 6	5 4 3	2 1 0
Comment					
Total Score:	122	Ecoregion:			Drainage Area:

Invertebrate Sampling COK Stream Sampling Photo Sheet

Project: 22/23	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby



Date: 5/4/2023
Location: Walden sampling point



Date: 5/4/2023
Location: Walden sampling point



Date: 5/4/2023



Date: 5/4/2023

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS

Complete this habitat assessment if **SQKICK** is collected.

(See Macroinvertebrate SOP - Protocol E for detailed descriptions and rank information)

DWR Station ID:					Habitat Assessment By:					
Monitoring Location Name:	Fourth Creek				Date:	5/11/2023		Time:		
Monitoring Location:	Lawford				Field Log Number:					
HUC:	60102010204	WS Group:		Ecoregion:	67f	QC:		<input type="checkbox"/>	Consensus	

Habitat Type: HG

If QA/QC 2 habitats are completed independently, check box above.

See most recent [Macroinvertebrate SOP](#) Protocol D-1 for specific instructions for completing this information.

For each habitat parameter, type score or select from blue dropdown box. Add comments if needed in row below score.

		Optimal					Suboptimal					Marginal					Poor				
1. Epifaunal Substrate/ Available Cover		Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.					Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.				
Score	19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
2. Embeddedness of Riffles		Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.					Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.				
Score	16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
3. Velocity/ Depth Regime		All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).					Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.				
Score	17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
4. Sediment Deposition	Does this rating match sed. desc. in SS?	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.					Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.				
Score	15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
5. Channel Flow Status		Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.					Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.				
Score	14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					

6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.	
Score	17	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
7. Frequency of re-oxygenation zones Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.	
Score	18	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	
Score (Left Bank)	5	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	5	10 9	8 7 6	5 4 3	2 1 0
Comment					
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)	
Score (Left Bank)	9	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	9	10 9	8 7 6	5 4 3	2 1 0
Comment					
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.	
Score (Left Bank)	10	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	10	10 9	8 7 6	5 4 3	2 1 0
Comment					
Total Score:	164	Ecoregion:			Drainage Area:

Invertebrate Sampling COK Stream Sampling Photo Sheet

Project: 22/23	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby



Date: 5/11/2023
Location: Lawford tributary



Date: 5/11/2023
Location: Lawford tributary



Date: 5/11/2023



Date: 5/11/2023

HABITAT ASSESSMENT FIELD SHEET- MODERATE TO HIGH GRADIENT STREAMS

Complete this habitat assessment if **SQKICK** is collected.

(See Macroinvertebrate SOP - Protocol E for detailed descriptions and rank information)

DWR Station ID:					Habitat Assessment By:						
Monitoring Location Name:	Fourth Creek				Date:	6/1/2023		Time:			
Monitoring Location:	Dowel Springs				Field Log Number:						
HUC:	60102010204	WS Group:		Ecoregion:	67f	QC:		<input type="checkbox"/>	Consensus		

Habitat Type: HG

If QA/QC 2 habitats are completed independently, check box above.

See most recent [Macroinvertebrate SOP](#) Protocol D-1 for specific instructions for completing this information.

For each habitat parameter, type score or select from blue dropdown box. Add comments if needed in row below score.

		Optimal					Suboptimal					Marginal					Poor				
1. Epifaunal Substrate/ Available Cover		Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.					Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.				
Score	17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
2. Embeddedness of Riffles		Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.					Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.				
Score	11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
3. Velocity/ Depth Regime		All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).					Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.				
Score	15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
4. Sediment Deposition	Does this rating match sed. desc. in SS?	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.					Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.				
Score	6	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					
5. Channel Flow Status		Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.					Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.				
Score	16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comment																					

6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.	Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.	Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.	Over 80% of reach channelized, dredged or affected by 4-wheelers. Instream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.	
Score	16	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
7. Frequency of re-oxygenation zones Use frequency of riffle or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.	Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.	Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.	Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.	
Score	10	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comment					
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.	Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.	Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	
Score (Left Bank)	8	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	8	10 9	8 7 6	5 4 3	2 1 0
Comment					
9. Vegetative Protective (score each bank) includes vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.	70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%)	50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).	Less than 50% of the bank covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%)	
Score (Left Bank)	9	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	9	10 9	8 7 6	5 4 3	2 1 0
Comment					
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.	Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.	Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.	Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.	
Score (Left Bank)	9	10 9	8 7 6	5 4 3	2 1 0
Score (Right Bank)	9	10 9	8 7 6	5 4 3	2 1 0
Comment					
Total Score:	143	Ecoregion:			Drainage Area:

Invertebrate Sampling COK Stream Sampling Photo Sheet

Project: 22/23	Participant 1: George Nennstiel
Watershed: Fourth Creek	Participant 2: Charissa Oglesby



Date: 6/1/2023
Location: Dowell Springs tributary



Date: 6/1/2023
Location: Dowell Springs tributary



Date: 6/1/2023



Date: 6/1/2023

Appendix D

Full Suite – Goose Creek

City of Knoxville-SW Management

Sample Delivery Group: L1596237
Samples Received: 03/18/2023
Project Number: 22/23 FULL SUITE
Description: Stormwater Full Suite
Site: GOOSE CREEK
Report To: Charissa Oglesby
City-County Bldg 400 Main St
Room 303D
Knoxville, TN 37902

Entire Report Reviewed By:



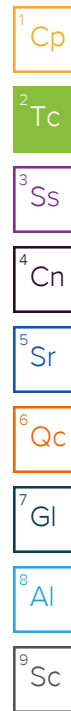
Stacy Kennedy
Project Manager

Results relate only to the items tested or calibrated and are reported as rounded values. This test report shall not be reproduced, except in full, without written approval of the laboratory. Where applicable, sampling conducted by Pace Analytical National is performed per guidance provided in laboratory standard operating procedures ENV-SOP-MTJL-0067 and ENV-SOP-MTJL-0068. Where sampling conducted by the customer, results relate to the accuracy of the information provided, and as the samples are received.

Pace Analytical National12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

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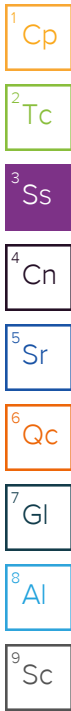


SAMPLE SUMMARY

GRAB L1596237-01 WW

Collected by: CCO/TREY
 Collected date/time: 03/17/23 08:40
 Received date/time: 03/18/23 09:35

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Gravimetric Analysis by Method 2540 C-2011	WG2027657	1	03/22/23 05:31	03/22/23 21:25	AS	Mt. Juliet, TN
Gravimetric Analysis by Method 2540 D-2015	WG2027879	1	03/22/23 15:30	03/22/23 15:33	TDW	Mt. Juliet, TN
Wet Chemistry by Method 1664A	WG2027000	1	03/21/23 13:55	03/22/23 10:23	RWT	Mt. Juliet, TN
Wet Chemistry by Method 350.1	WG2026187	1	03/20/23 14:27	03/20/23 14:27	BMD	Mt. Juliet, TN
Wet Chemistry by Method 351.2	WG2027195	1	03/23/23 11:07	03/23/23 20:30	LDT	Mt. Juliet, TN
Wet Chemistry by Method 353.2	WG2026496	1	03/21/23 12:41	03/21/23 12:41	BMD	Mt. Juliet, TN
Wet Chemistry by Method 365.4	WG2029095	1	03/23/23 11:07	03/23/23 20:47	LDT	Mt. Juliet, TN
Wet Chemistry by Method 410.4	WG2026175	1	03/19/23 18:00	03/19/23 23:25	WOS	Mt. Juliet, TN
Wet Chemistry by Method 420.4	WG2027179	1	03/22/23 16:06	03/22/23 23:12	LDT	Mt. Juliet, TN
Wet Chemistry by Method 4500CN E-2016	WG2027172	1	03/21/23 20:30	03/22/23 11:33	UNP	Mt. Juliet, TN
Wet Chemistry by Method 4500P E-2011	WG2025881	1	03/18/23 18:45	03/18/23 18:45	JAR	Mt. Juliet, TN
Wet Chemistry by Method 5210 B-2016	WG2029523	1	03/24/23 15:13	03/29/23 09:35	EAO	Mt. Juliet, TN
Mercury by Method 245.1	WG2025484	1	03/19/23 21:55	03/20/23 11:17	AKB	Mt. Juliet, TN
Metals (ICP) by Method 200.7	WG2026280	1	03/20/23 08:32	03/21/23 13:47	ABL	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 624.1	WG2026224	1	03/20/23 03:10	03/20/23 03:10	JAH	Mt. Juliet, TN
Pesticides (GC) by Method EPA 608.3	WG2026872	1	03/22/23 02:47	03/22/23 14:21	HMH	Mt. Juliet, TN
Polychlorinated Biphenyls (GC) by Method EPA-608.3	WG2026872	1	03/22/23 02:47	03/22/23 14:21	HMH	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 625.1	WG2027587	1	03/23/23 08:34	03/24/23 01:50	AED	Mt. Juliet, TN



CASE NARRATIVE

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



Stacy Kennedy
Project Manager

Project Narrative

BOD sample initially analyzed within holding time with a result of <10 mg/l. Sample was reset past holding time. SK 3/23/23

¹ Cp

² Tc

³ Ss

⁴ Cn

⁵ Sr

⁶ Qc

⁷ Gl

⁸ Al

⁹ Sc

Additional Information - Results for field analyses are not accredited to ISO 17025

Analyte	Result	Units
pH (On Site)	8	su
Temperature (on-site)	53.6	Deg. F

Gravimetric Analysis by Method 2540 C-2011

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Dissolved Solids	224		10.0	1	03/22/2023 21:25	WG2027657

Gravimetric Analysis by Method 2540 D-2015

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Suspended Solids	42.6		5.00	1	03/22/2023 15:33	WG2027879

Wet Chemistry by Method 1664A

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Oil & Grease (Hexane Extr)	ND		5.44	1	03/22/2023 10:23	WG2027000

Wet Chemistry by Method 350.1

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Ammonia Nitrogen	ND		0.250	1	03/20/2023 14:27	WG2026187

Wet Chemistry by Method 351.2

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Kjeldahl Nitrogen, TKN	0.601		0.250	1	03/23/2023 20:30	WG2027195

Wet Chemistry by Method 353.2

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Nitrate-Nitrite	1.04		0.100	1	03/21/2023 12:41	WG2026496

Wet Chemistry by Method 365.4

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Phosphorus, Total	ND		0.100	1	03/23/2023 20:47	WG2029095

Wet Chemistry by Method 410.4

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
COD	ND		20.0	1	03/19/2023 23:25	WG2026175

Wet Chemistry by Method 420.4

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Total Phenol by 4AAP	ND		0.0400	1	03/22/2023 23:12	WG2027179

Wet Chemistry by Method 4500CN E-2016

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Wet Chemistry by Method 4500CN E-2016

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Cyanide	ND		0.00500	1	03/22/2023 11:33	WG2027172

Wet Chemistry by Method 4500P E-2011

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Phosphate,Ortho	ND		0.0300	1	03/18/2023 18:45	WG2025881

Wet Chemistry by Method 5210 B-2016

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
BOD	4.33	H K9 Q	1.50	1	03/29/2023 09:35	WG2029523

Mercury by Method 245.1

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Mercury	ND		0.000200	1	03/20/2023 11:17	WG2025484

Metals (ICP) by Method 200.7

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Antimony	ND		0.0100	1	03/21/2023 13:47	WG2026280
Arsenic	ND		0.0100	1	03/21/2023 13:47	WG2026280
Beryllium	ND		0.00200	1	03/21/2023 13:47	WG2026280
Cadmium	ND		0.00200	1	03/21/2023 13:47	WG2026280
Chromium	ND		0.0100	1	03/21/2023 13:47	WG2026280
Copper	ND		0.0100	1	03/21/2023 13:47	WG2026280
Lead	ND		0.00500	1	03/21/2023 13:47	WG2026280
Nickel	ND		0.0100	1	03/21/2023 13:47	WG2026280
Selenium	ND		0.0100	1	03/21/2023 13:47	WG2026280
Silver	ND		0.00500	1	03/21/2023 13:47	WG2026280
Thallium	ND		0.0100	1	03/21/2023 13:47	WG2026280
Zinc	ND		0.0500	1	03/21/2023 13:47	WG2026280

Volatile Organic Compounds (GC/MS) by Method 624.1

Analyte	Result	Qualifier	RDL	Dilution	Analysis date / time	Batch
Acrolein	ND	J4	0.0500	1	03/20/2023 03:10	WG2026224
Acrylonitrile	ND		0.0100	1	03/20/2023 03:10	WG2026224
Benzene	ND		0.00100	1	03/20/2023 03:10	WG2026224
Bromodichloromethane	ND		0.00100	1	03/20/2023 03:10	WG2026224
Bromoform	ND		0.00100	1	03/20/2023 03:10	WG2026224
Bromomethane	ND		0.00500	1	03/20/2023 03:10	WG2026224
Carbon tetrachloride	ND		0.00100	1	03/20/2023 03:10	WG2026224
Chlorobenzene	ND		0.00100	1	03/20/2023 03:10	WG2026224
Chlorodibromomethane	ND		0.00100	1	03/20/2023 03:10	WG2026224
Chloroethane	ND		0.00500	1	03/20/2023 03:10	WG2026224
2-Chloroethyl vinyl ether	ND		0.0500	1	03/20/2023 03:10	WG2026224
Chloroform	ND		0.00500	1	03/20/2023 03:10	WG2026224
Chloromethane	ND		0.00250	1	03/20/2023 03:10	WG2026224
1,2-Dichlorobenzene	ND		0.00100	1	03/20/2023 03:10	WG2026224
1,3-Dichlorobenzene	ND		0.00100	1	03/20/2023 03:10	WG2026224
1,4-Dichlorobenzene	ND		0.00100	1	03/20/2023 03:10	WG2026224
Dichlorodifluoromethane	ND		0.00500	1	03/20/2023 03:10	WG2026224
1,1-Dichloroethane	ND		0.00100	1	03/20/2023 03:10	WG2026224

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Volatile Organic Compounds (GC/MS) by Method 624.1

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
1,2-Dichloroethane	ND		0.00100	1	03/20/2023 03:10	WG2026224
1,1-Dichloroethene	ND		0.00100	1	03/20/2023 03:10	WG2026224
trans-1,2-Dichloroethene	ND		0.00100	1	03/20/2023 03:10	WG2026224
1,2-Dichloropropane	ND		0.00100	1	03/20/2023 03:10	WG2026224
cis-1,3-Dichloropropene	ND		0.00100	1	03/20/2023 03:10	WG2026224
trans-1,3-Dichloropropene	ND		0.00100	1	03/20/2023 03:10	WG2026224
Ethylbenzene	ND		0.00100	1	03/20/2023 03:10	WG2026224
Methylene Chloride	ND		0.00500	1	03/20/2023 03:10	WG2026224
1,1,2,2-Tetrachloroethane	ND		0.00100	1	03/20/2023 03:10	WG2026224
Tetrachloroethene	ND		0.00100	1	03/20/2023 03:10	WG2026224
Toluene	ND		0.00100	1	03/20/2023 03:10	WG2026224
1,1,1-Trichloroethane	ND		0.00100	1	03/20/2023 03:10	WG2026224
1,1,2-Trichloroethane	ND		0.00100	1	03/20/2023 03:10	WG2026224
Trichloroethene	ND		0.00100	1	03/20/2023 03:10	WG2026224
Trichlorofluoromethane	ND		0.00500	1	03/20/2023 03:10	WG2026224
Vinyl chloride	ND		0.00100	1	03/20/2023 03:10	WG2026224
Total Xylenes	ND		0.00300	1	03/20/2023 03:10	WG2026224
(S) Toluene-d8	113		80.0-120		03/20/2023 03:10	WG2026224
(S) 4-Bromofluorobenzene	103		80.0-120		03/20/2023 03:10	WG2026224
(S) 1,2-Dichloroethane-d4	99.9		70.0-130		03/20/2023 03:10	WG2026224

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Pesticides (GC) by Method EPA 608.3

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
Aldrin	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Alpha BHC	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Beta BHC	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Delta BHC	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Gamma BHC	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Chlordane	ND		0.00500	1	03/22/2023 14:21	WG2026872
4,4-DDD	ND		0.0000500	1	03/22/2023 14:21	WG2026872
4,4-DDE	ND		0.0000500	1	03/22/2023 14:21	WG2026872
4,4-DDT	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Dieldrin	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Endosulfan I	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Endosulfan II	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Endosulfan sulfate	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Endrin	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Endrin aldehyde	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Endrin ketone	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Heptachlor	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Heptachlor epoxide	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Hexachlorobenzene	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Methoxychlor	ND		0.0000500	1	03/22/2023 14:21	WG2026872
Toxaphene	ND		0.000500	1	03/22/2023 14:21	WG2026872
gamma-Chlordane	ND		0.0000500	1	03/22/2023 14:21	WG2026872
alpha-Chlordane	ND		0.0000500	1	03/22/2023 14:21	WG2026872
(S) Decachlorobiphenyl	51.8		10.0-144		03/22/2023 14:21	WG2026872
(S) Tetrachloro-m-xylene	70.8		10.0-135		03/22/2023 14:21	WG2026872

Polychlorinated Biphenyls (GC) by Method EPA-608.3

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/l		mg/l		date / time	
PCB 1016	ND		0.000500	1	03/22/2023 14:21	WG2026872
PCB 1221	ND		0.000500	1	03/22/2023 14:21	WG2026872
PCB 1232	ND		0.000500	1	03/22/2023 14:21	WG2026872
PCB 1242	ND		0.000500	1	03/22/2023 14:21	WG2026872
PCB 1248	ND		0.000500	1	03/22/2023 14:21	WG2026872
PCB 1254	ND		0.000500	1	03/22/2023 14:21	WG2026872
PCB 1260	ND		0.000500	1	03/22/2023 14:21	WG2026872
Total PCBs	ND		0.000500	1	03/22/2023 14:21	WG2026872
(S) Decachlorobiphenyl	48.7		10.0-144		03/22/2023 14:21	WG2026872
(S) Tetrachloro-m-xylene	71.4		10.0-135		03/22/2023 14:21	WG2026872

Semi Volatile Organic Compounds (GC/MS) by Method 625.1

Analyte	Result	Qualifier	RDL	Dilution	Analysis	Batch
	mg/l		mg/l		date / time	
Acenaphthene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Acenaphthylene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Anthracene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Benizidine	ND		0.0100	1	03/24/2023 01:50	WG2027587
Benzo(a)anthracene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Benzo(b)fluoranthene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Benzo(k)fluoranthene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Benzo(g,h,i)perylene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Benzo(a)pyrene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Bis(2-chlorethoxy)methane	ND		0.0100	1	03/24/2023 01:50	WG2027587
Bis(2-chloroethyl)ether	ND		0.0100	1	03/24/2023 01:50	WG2027587
2,2-Oxybis(1-Chloropropane)	ND		0.0100	1	03/24/2023 01:50	WG2027587
4-Bromophenyl-phenylether	ND		0.0100	1	03/24/2023 01:50	WG2027587
2-Chloronaphthalene	ND		0.00100	1	03/24/2023 01:50	WG2027587
4-Chlorophenyl-phenylether	ND		0.0100	1	03/24/2023 01:50	WG2027587
Chrysene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Dibenz(a,h)anthracene	ND		0.00100	1	03/24/2023 01:50	WG2027587
3,3-Dichlorobenzidine	ND		0.0100	1	03/24/2023 01:50	WG2027587
2,4-Dinitrotoluene	ND		0.0100	1	03/24/2023 01:50	WG2027587
2,6-Dinitrotoluene	ND		0.0100	1	03/24/2023 01:50	WG2027587
1,2-Diphenylhydrazine	ND	<u>N2</u>	0.0100	1	03/24/2023 01:50	WG2027587
Fluoranthene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Fluorene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Hexachlorobenzene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Hexachloro-1,3-butadiene	ND		0.0100	1	03/24/2023 01:50	WG2027587
Hexachlorocyclopentadiene	ND		0.0100	1	03/24/2023 01:50	WG2027587
Hexachloroethane	ND		0.0100	1	03/24/2023 01:50	WG2027587
Indeno(1,2,3-cd)pyrene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Isophorone	ND		0.0100	1	03/24/2023 01:50	WG2027587
Naphthalene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Nitrobenzene	ND		0.0100	1	03/24/2023 01:50	WG2027587
n-Nitrosodimethylamine	ND		0.0100	1	03/24/2023 01:50	WG2027587
n-Nitrosodiphenylamine	ND		0.0100	1	03/24/2023 01:50	WG2027587
n-Nitrosodi-n-propylamine	ND		0.0100	1	03/24/2023 01:50	WG2027587
Phenanthrene	ND		0.00100	1	03/24/2023 01:50	WG2027587
Benzylbutyl phtalate	ND		0.00300	1	03/24/2023 01:50	WG2027587
Bis(2-ethylhexyl)phtalate	ND		0.00300	1	03/24/2023 01:50	WG2027587
Di-n-butyl phtalate	ND		0.00300	1	03/24/2023 01:50	WG2027587
Diethyl phtalate	ND		0.00300	1	03/24/2023 01:50	WG2027587
Dimethyl phtalate	ND		0.00300	1	03/24/2023 01:50	WG2027587
Di-n-octyl phtalate	ND		0.00300	1	03/24/2023 01:50	WG2027587
Pyrene	ND		0.00100	1	03/24/2023 01:50	WG2027587

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

7 Gl

8 Al

9 Sc

Semi Volatile Organic Compounds (GC/MS) by Method 625.1

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
1,2,4-Trichlorobenzene	ND		0.0100	1	03/24/2023 01:50	WG2027587
4-Chloro-3-methylphenol	ND		0.0100	1	03/24/2023 01:50	WG2027587
2-Chlorophenol	ND		0.0100	1	03/24/2023 01:50	WG2027587
2,4-Dichlorophenol	ND		0.0100	1	03/24/2023 01:50	WG2027587
2,4-Dimethylphenol	ND		0.0100	1	03/24/2023 01:50	WG2027587
4,6-Dinitro-2-methylphenol	ND		0.0100	1	03/24/2023 01:50	WG2027587
2,4-Dinitrophenol	ND		0.0100	1	03/24/2023 01:50	WG2027587
2-Nitrophenol	ND		0.0100	1	03/24/2023 01:50	WG2027587
4-Nitrophenol	ND		0.0100	1	03/24/2023 01:50	WG2027587
Pentachlorophenol	ND		0.0100	1	03/24/2023 01:50	WG2027587
Phenol	ND		0.0100	1	03/24/2023 01:50	WG2027587
2,4,6-Trichlorophenol	ND		0.0100	1	03/24/2023 01:50	WG2027587
(S) Nitrobenzene-d5	57.0		15.0-314		03/24/2023 01:50	WG2027587
(S) 2-Fluorobiphenyl	47.1		22.0-127		03/24/2023 01:50	WG2027587
(S) p-Terphenyl-d14	43.7		29.0-141		03/24/2023 01:50	WG2027587
(S) Phenol-d5	14.6		8.00-424		03/24/2023 01:50	WG2027587
(S) 2-Fluorophenol	19.4		10.0-120		03/24/2023 01:50	WG2027587
(S) 2,4,6-Tribromophenol	39.1		10.0-153		03/24/2023 01:50	WG2027587

1 Cp

2 Tc

3 Ss

4 Cn

5 Sr

6 Qc

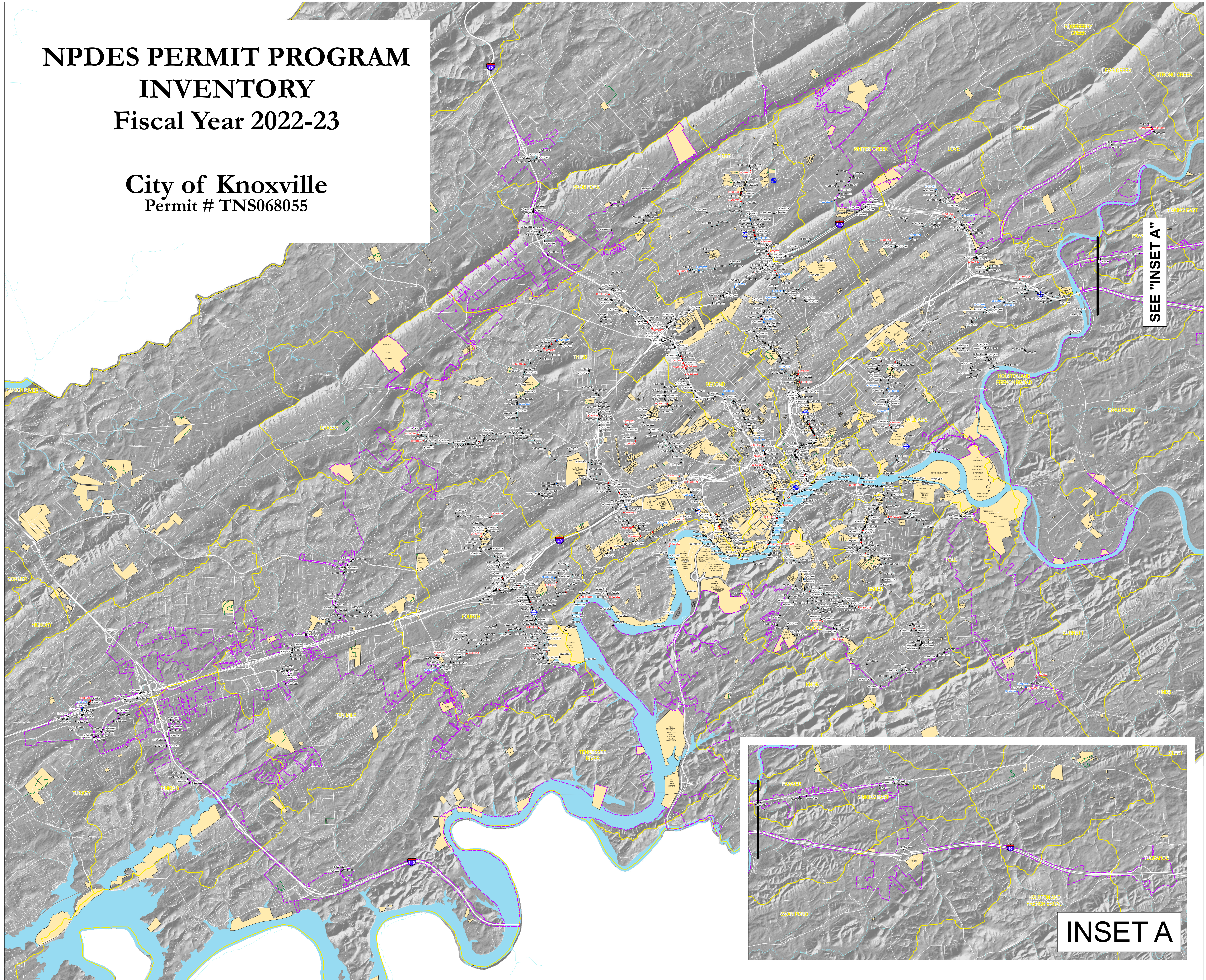
7 Gl

8 Al

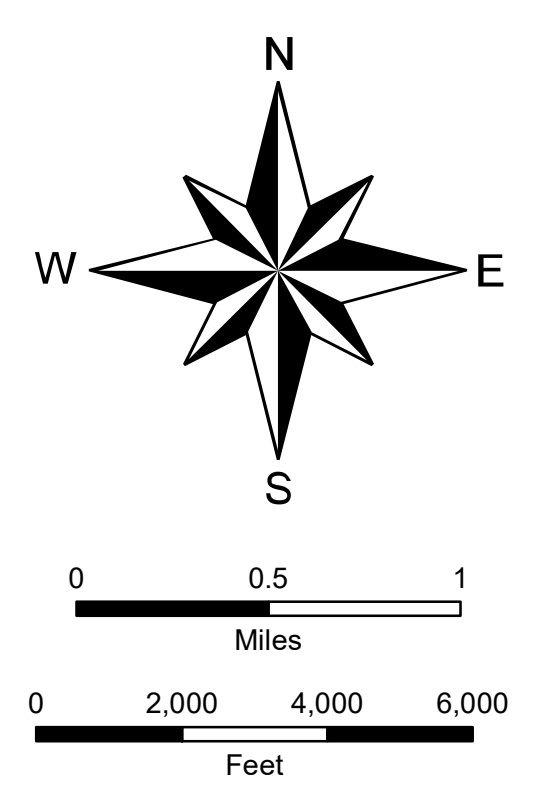
9 Sc

NPDES PERMIT PROGRAM INVENTORY Fiscal Year 2022-23

City of Knoxville
Permit # TNS068055



- Dry
- Wet
- Not Sampled
- Sampling Station
- Rain Gauge
- Knoxville Corporate Limits
- Watershed Basins
- Public Lands
- Waterbodies
- Creeks & Streams
- Knox County Boundary

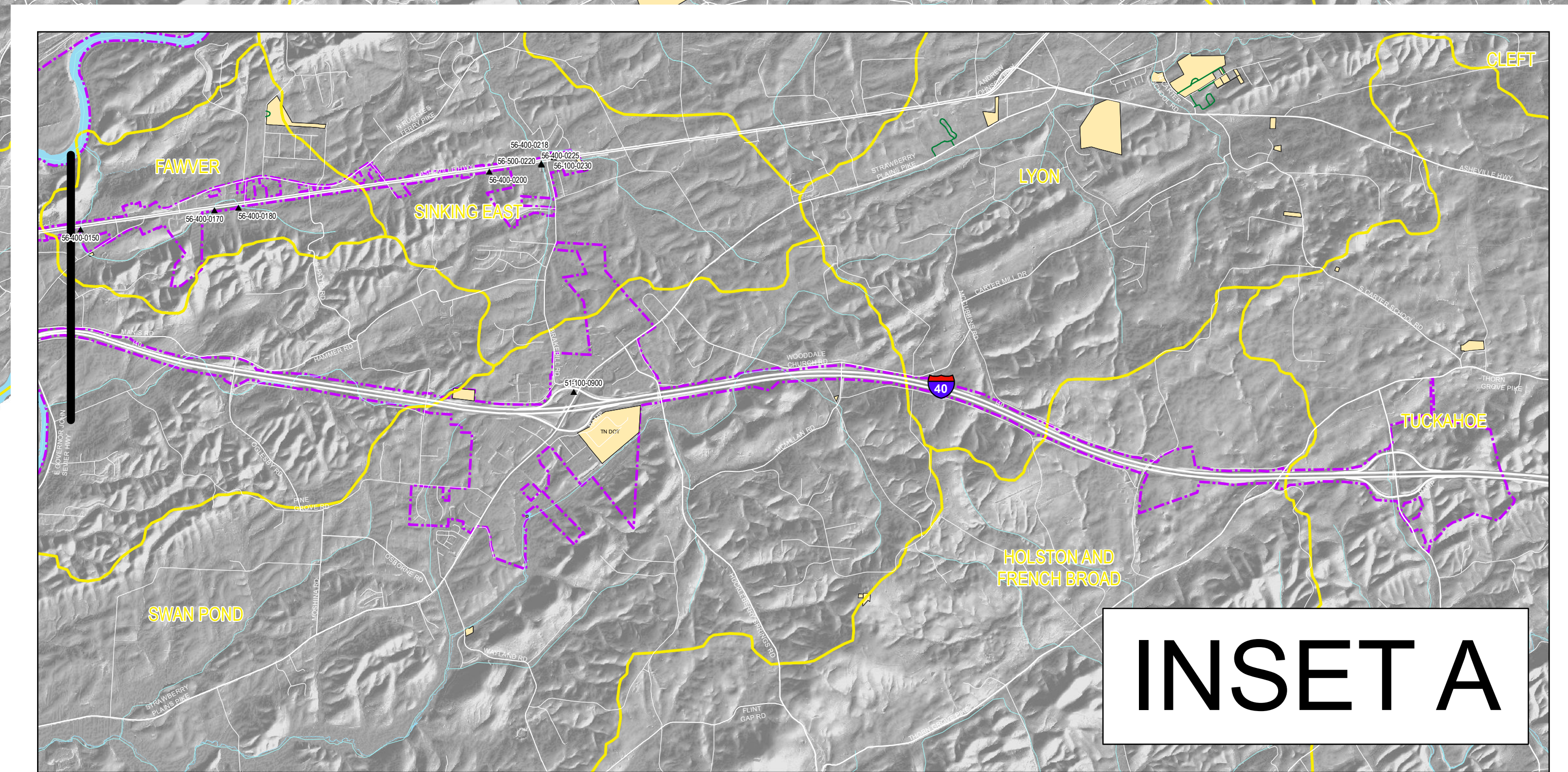


Date Created: 10/11/2023
Created By: R. Taylor

MAP DATA TAKEN FROM
AERIAL SURVEY OF KNOXVILLE
AND KNOX COUNTY. THIS MAP IS
INTENDED TO MEET NATIONAL MAP
ACCURACY STANDARDS AT THE
COMPILATION SCALE.

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INSET A