



Knox County Stormwater Monitoring Plan

OPTION 2: JURISDICTION-SPECIFIC MONITORING PLAN

July 24, 2024

Knox County requested assistance from WK Dickson in developing a Stormwater Monitoring Plan to fulfill Option 2 requirements of a jurisdiction-specific monitoring plan per the County's 2022 NPDES permit requirements.

As required by the Tennessee NPDES MS4 Phase II general permit this plan contains:

- a. A justification for the stream selection(s);
- b. Identification and source determination of pollutant(s) of concern;
- c. Monitoring details;
- d. Records requirements;
- e. Description of how MS4 will evaluate stormwater impacts to receiving waters;
- f. Description of how data will be gathered to inform program decisions and prioritization of future activities related to the protection of water quality;
- g. Acknowledgement that division protocols will be used for instream monitoring or alternative protocols for division approval; and
- h. Provisions for an administratively continued small MS4 general permit.

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1 Background

Knox County employs a comprehensive approach to stormwater management, weaving together water quality and quantity foci through a variety of programs housed primarily within the Engineering and Public Works Department.

Knox County's National Pollutant Discharge Elimination System (NPDES) compliance program and the County's watershed improvement activities, which both focus on water quality improvement goals, are based on a continuous, iterative cycle of planning, implementation, monitoring and evaluation. This monitoring plan will gather data on water quality to serve both the needs of the NPDES permit compliance and the County's own watershed improvement goals.

2 Justification for Stream Selections

2.1 Monitoring Approach by Tier

Knox County has prioritized HUC 12 watersheds into three tiers of prioritization, providing opportunities to allocate available resources to the HUC 12 watersheds with the greatest need for monitoring and remediation. The three tiers are identified below.

- Tier 1: Focused Monitoring
- Tier 2: Background Monitoring
- Tier 3: Situational Monitoring

HUC 12 watersheds assigned to Tier 1 were identified to be studied through the County's prioritization efforts during this 2022-2027 NPDES permit cycle. Tier 2 prioritizes watersheds based on percent of the watershed area within Knox County's MS4 jurisdiction, impairment status of the watershed, and risk of future degradation within the watershed. Within the HUC 12 Tier 2 watersheds, Knox County has resources available to monitor and consider future watershed planning efforts and potential water quality improvement projects. Tier 3 watersheds are generally at a lower risk for degradation.

This Stormwater Monitoring Plan focuses on monitoring waterbodies identified on Tennessee's 2022 List of Impaired and Threatened Waters. These waterbodies will be referred to throughout this document as "impaired waterbodies" or "impaired waters."

2.2 Watershed Prioritization

There are 27 HUC 12 watersheds either partially or fully within the Knox County geographic boundary, prioritized into three tiers for this jurisdiction-specific monitoring plan. Seven HUC 12 watersheds within the Knox County geographic boundary have less than 5% of their watershed area within Knox County's MS4 jurisdiction. These HUC 12 watersheds were not included in the watershed prioritization because the watersheds are either low risk or are within an adjacent county, the City of Knoxville, or the Town of

Farragut’s jurisdiction. The seven HUC 12 watersheds not included in the tiered prioritization are French Broad River-Millican Creek, Third Creek, Second Creek, Richland Creek, Hinds Creek, Clinch River-Wolf Creek, and Tennessee River-Town Creek.

The remaining 20 watersheds were prioritized into three tiers as described in Appendix A. Knox County selected Clinch River-Conner Creek, First Creek, and Fort Loudoun Lake Middle as high-priority HUC 12 watersheds to collect data at a level that would support future watershed plans during the 2022-2027 NPDES permit cycle. These watersheds were selected by Knox County based on anticipated significant new expansion of development. Selecting these watersheds for a more focused approach for both monitoring and watershed improvements provides an opportunity for Knox County and the community to focus momentum on improving existing conditions and mitigate damage in advance of that development. These three watersheds were included in the prioritization ranking and assigned to Tier 1. The remaining 17 watersheds were ranked into Tier 2 and Tier 3 categories. Watersheds were prioritized based on the following data:

- Stream impairment classification
- Stream impairment cause
- Stream impairment source
- Percent of HUC 12 watershed within Knox County MS4 jurisdiction
- Projected Knox County population
- Impervious land cover
- Stream density
- Source water protection area
- Infrastructure within the 0.2% and 1% FEMA flood hazard zones

For the purposes of ranking and prioritization, impervious cover and the 20-year projected population growth rate were combined to assign an overall Development Impact Risk designation to the HUC 12 watersheds, as shown in Table 1. Assigning a Development Impact Risk provides an opportunity to evaluate current and future conditions and predict impact potential from projected future development and population change at the watershed level.

Table 1. Development Impact Risk Designations for HUC 12 Watersheds

Development Impact Risk	Impervious Cover	Projected Population Growth Rate
Active Degradation	≥ 20%	≥ 10%
High Risk	≥ 10%	≥ 10%
Medium Risk	< 10%	≥ 10%
Low Risk	< 10%	< 10%

2.3 Ranked Tiers

Each watershed was ranked using specific, weighted criteria, based on Knox County’s jurisdiction-specific priorities for stormwater monitoring, summarized below, and detailed in Appendix A. The assigned monitoring tiers for each HUC 12 watershed included in this Stormwater Monitoring Plan are listed below in Table 2 and shown in Figure 1.

- Watersheds with streams on the 303(d) List of Impaired or Threatened Waters with causes of impairment attributed to municipal sources due to urban density are weighted highest.
- The percentage of watershed within Knox County’s MS4 jurisdiction, percent of impervious land cover, and the projected population within each watershed as a percentage of Knox County’s total projected population growth are weighted second highest.
- Given Knox County’s desire to prioritize watersheds with high risk for degradation, watersheds assigned a High Development Impact Risk are weighted moderately important.
- The percentage of impaired streams, watershed stream density within Knox County, the percentage of TDEC designated Source Water Protection Area within each watershed, and the percentage of infrastructure in the 0.2% and 1% FEMA Flood Hazard zones are weighted lower. Infrastructure is defined as buildings, structures, and transportation areas in the KGIS data.

Table 2. Assigned Monitoring Tiers for HUC 12 Watersheds

Assigned Tier	Assigned Rank	HUC 12 Name	Development Impact Risk
1	1	Fort Loudoun Lake Middle	High
1	2	Clinch River – Conner Creek	Medium
1	3	First Creek	Active Degradation
2	4	Beaver Creek Lower	High
2	5	Beaver Creek Upper	High
2	6	Fort Loudoun Lake Upper	High
2	7	Holston River Outlet	High
2	8	Stock Creek	Medium
2	9	Turkey Creek	Active Degradation
2	10	Ten Mile Creek	Active Degradation
3	11	Bull Run Creek Lower	Low
3	12	Fort Loudoun Lake Lower	High
3	13	Holston River – Clift Creek	Medium
3	14	French Broad River Outlet	Medium
3	15	Little River – Roddy Branch	Low
3	16	Holston River – Beaver Creek	Low
3	17	Flat Creek	Low
3	18	Tuckahoe Creek	Low
3	19	Bull Run Creek Upper	Low
3	20	Little River Nails Creek	Low

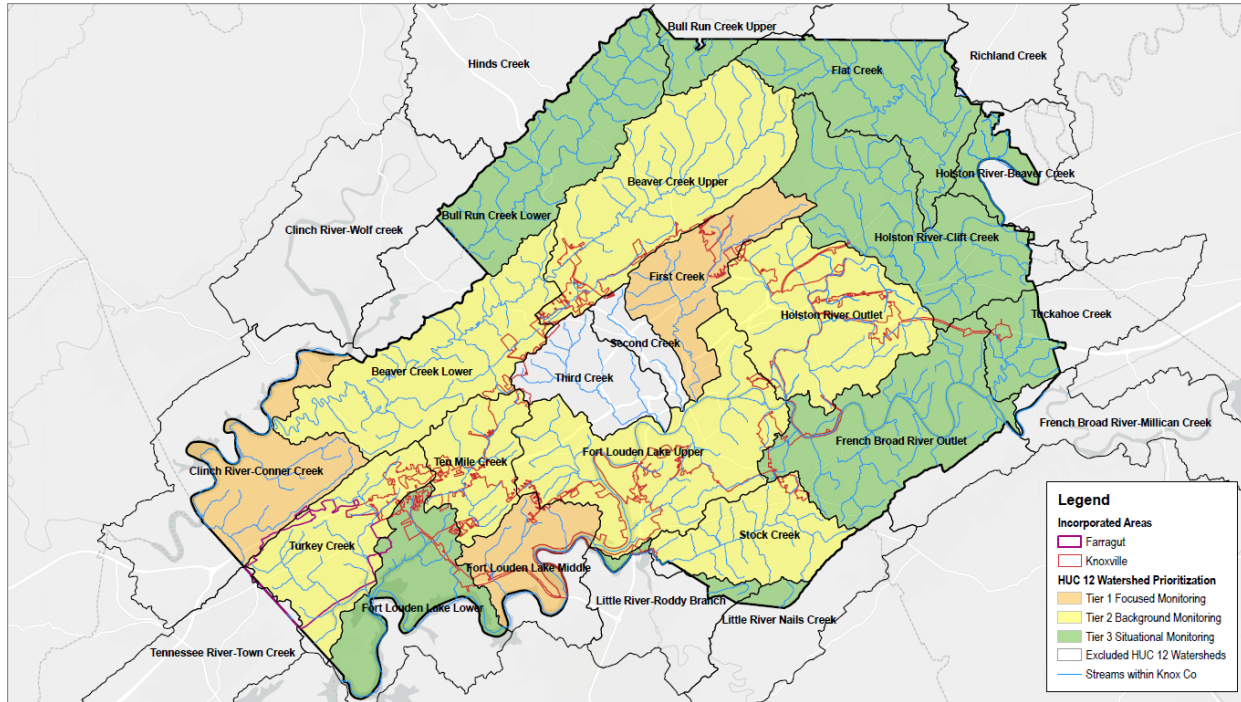


Figure 1. Assigned Monitoring Tiers for HUC 12 Watersheds in Knox County

2.4 Impaired Waterbodies Excluded from Monitoring

Within the Tier 1 and Tier 2 watersheds, six impaired waterbodies shown in Table 3 were identified to be outside Knox County’s MS4 jurisdiction and will be excluded from Knox County’s monitoring plan as those waterbodies are within the jurisdiction of either the City of Knoxville or the Town of Farragut. It is worth noting that there is a small, isolated stream segment labeled by TDEC as part of Little Turkey Creek which is in Knox County, however, this segment drains directly to Fort Loudoun Lake Lower and will also be excluded from this monitoring plan.

Table 3. Impaired Waterbodies Outside Knox County MS4 Jurisdiction

Tier	HUC 12 Name	Waterbody Name	MS4 Jurisdiction
1	First Creek	First Creek	City of Knoxville
2	Fort Loudoun Lake Upper	Baker Creek	City of Knoxville
2	Fort Loudoun Lake Upper	Fourth Creek	City of Knoxville
2	Fort Loudoun Lake Upper	Goose Creek	City of Knoxville
2	Fort Loudoun Lake Upper	Williams Creek	City of Knoxville
2	Turkey Creek	Little Turkey Creek	Town of Farragut

3 Pollutants of Concern

This jurisdiction-specific Stormwater Monitoring Plan for Knox County focuses on monitoring waterbodies identified on Tennessee’s 2022 List of Impaired and Threatened Waters within Knox County’s MS4 jurisdiction. These waterbodies are summarized below in Table 4 with their cause of impairment and potential source of impairment. Knox County’s pollutants of concern are sediment, nutrients, and E. coli. Knox County will monitor streams where these primary pollutants of concern exceed acceptable thresholds and build a database to aid in assessing the source of the pollutants of concern.

Knox County’s goal is to evaluate sources of sediment, nutrients, and E. coli in Tier 1 watersheds and perform background monitoring of Tier 2 watersheds. When pollutant sources are identified to be a result of discharges from Knox County’s MS4 and the source can be mitigated or enforced by Knox County Government, Knox County will initiate planning efforts to implement projects or programs to improve water quality in the identified watershed. After improvement projects are implemented, subsequent instream monitoring for the pollutants of concern will occur at locations selected to best represent the effectiveness of implemented projects, such as monitoring directly downstream of the project location rather than at the watershed outlet.

Table 4. Summary of Pollutants of Concern

Tier	HUC 12 Name	Impaired Waterbody Name	Cause of Impairment			Source of Impairment					
			Sedimentation	Nutrients	E. coli	Municipal	Channelization	Site Clearance	Livestock	SSOs	Septic Systems
1	Fort Loudoun Lake Middle	Sinking Creek			✓	☑					
1	Clinch River-Conner Creek	Conner Creek	✓			☑		☑	☑		
		Grable Branch	✓			☑	☑				
		Hickory Creek	✓			☑		☑	☑		
1	First Creek	Whites Creek	✓		✓	☑	☑				
2	Beaver Creek Lower	Beaver Creek	✓	✓	✓	☑			☑	☑	
		Grassy Creek	✓		✓	☑					
		Meadow Creek			✓	☑					
		Plumb Creek			✓	☑					
2	Beaver Creek Upper	Beaver Creek	✓		✓	☑			☑	☑	
		Hines Branch			✓	☑					
		Knob Fork	✓	✓	✓	☑					
		Mill Branch			✓				☑		
		Willow Fork	✓		✓	☑			☑		
2		Toll Creek	✓			☑					

Tier	HUC 12 Name	Impaired Waterbody Name	Cause of Impairment			Source of Impairment					
			Sedimentation	Nutrients	E. coli	Municipal	Channelization	Site Clearance	Livestock	SSOs	Septic Systems
	Fort Loudoun Lake Upper	Unnamed Trib to Flenniken Branch	✓			☑					
2	Holston River Outlet	Love Creek	✓	✓	✓	☑					
		Swanpond Creek			✓	☑					
2	Stock Creek	Casteel Branch	✓			☑			☑		
		Grandview Branch			✓				☑		
		Gunn Hollow Branch			✓				☑		
		High Bluff Branch			✓	☑					
		McCall Branch	✓			☑					
		Stock Creek			✓				☑		
2	Turkey Creek	Turkey Creek	✓		✓	☑					
2	Ten Mile Creek	Ten Mile Creek	✓		✓	☑					
3	Bull Run Creek Lower	Bull Run Creek	✓		✓	☑			☑		
3	Holston River-Clift Creek	Roseberry Creek			✓				☑	☑	
3	Little River-Roddy Branch	Roddy Branch	✓		✓		☑		☑		
3	Flat Creek	Flat Creek		✓	✓				☑	☑	
		Little Flat Creek			✓				☑		
3	Tuckahoe Creek	Tuckahoe Creek			✓				☑		
3	Bul Run Creek Upper	Bull Run Creek	✓		✓				☑		

4 Monitoring Details

4.1 Monitoring Activities

4.1.1 GIS Desktop Analysis

Knox County will perform GIS analysis across its MS4 jurisdiction at the initiation of each monitoring cycle associated with its NPDES permit to guide prioritization of streams for field monitoring within the County's MS4 jurisdiction. This desktop analysis will direct the location of the more time-intensive field monitoring activities such as field stream assessments. The GIS desktop analysis will include the following:

1. **Hydrology and Hydraulics.** Determine watershed parameters including, but not limited to, size of drainage area, soil permeability, peak-flow and bankfull geometry.
2. **Topographic Slope Layer.** Use a slope raster dataset from the LiDAR generated DEM to identify high slope areas and guide efforts to identify higher energy streams with potential bank erosion and prioritize areas for possible field stream assessments. Knox County is located within the Valley and Ridge physiographic region where high slope areas are not necessarily indicative of unstable, anthropogenically altered streams. High slope areas identified using LiDAR are intended to receive field verification to confirm conditions.
3. **Riparian Buffer Condition Survey.** Evaluate riparian buffer condition by digitizing and measuring forested buffer widths and percent canopy cover from the latest aerial imagery.
4. **Land Use and Land Cover (LULC) Dataset.** Characterize watersheds based on land cover.
5. **Reach Designation and Prioritization.** Assign stream reaches a preliminary GIS-based prioritization score based on severity of conditions to rank where field verification and stream assessments would be most useful.

Methods for GIS Desktop Analysis can be found in Appendix B.

4.1.2 Field Stream Assessments

Knox County will perform field stream assessments to waterbodies within its jurisdiction based on prioritized efforts within each monitoring tier.

Knox County plans to use the functional assessment approach within the pending revision of the Tennessee Stream Quantification Tool (TN SQT) as a foundation for its field stream assessment protocols. Using the revised TN SQT as a foundation for stream assessment methodology will support Knox County in collecting the appropriate data parameters and analyzing the data to produce actionable outcomes. This methodology is recommended to improve reproducibility between observers and many elements of the TN SQT can be evaluated efficiently with GIS desktop analysis.

The parameters of the revised TN SQT correspond to the stream functional pyramid categories that are key elements of a healthy, functioning stream: (1) Hydrology, (2) Hydraulics, (3) Geomorphology, and (4) Biology/Water Quality.

The SQT is designed to assess the stream conditions at the stream reach scale and each category within the functional pyramid has multiple parameters and corresponding field measurement methods that can be used to develop a condition score for each functional category. The specific parameters selected for monitoring to calculate an overall functional score will be based on monitoring goals for each watershed.

Field stream assessments will include identification of potential illicit discharges.

4.1.3 Dry Weather Screening

Dry weather screening allows Knox County to perform routine inspections of stormwater outfalls to identify potential illicit discharges and illicit connections. Knox County personnel have delineated subwatersheds within each HUC 12 watershed inside Knox County's MS4 jurisdiction and assigned each

subwatershed a High, Medium, or Low rating for Dry Weather Screening based on the subwatershed's potential for pollution. Methods for Dry Weather Screening Prioritization can be found in Appendix C.

Knox County will perform dry weather screening on outfalls within subwatersheds assigned a High or Medium rating at least once during the five-year monitoring period. Outfalls within subwatersheds assigned a Low rating will be inspected if Knox County is notified of a possible illicit discharge or other notification requiring a field inspection of outfalls.

4.1.4 Flow Monitoring

Knox County will perform flow monitoring in waterbodies within its jurisdiction based on prioritized efforts within each monitoring tier. Flow monitoring can be valuable to quantify changes in flows over time. Flow monitoring will be conducted from the six active USGS Stations in Knox County and two pressure transducers and data loggers.

4.1.5 Chemical and Bacteriological Stream Sampling

Knox County will perform chemical and bacteriological stream sampling within its jurisdiction based on prioritized efforts within each monitoring tier.

Ambient analytical monitoring and bacteriological stream sampling will include grab samples to analyze for Nitrate-Nitrite (NO₃-NO₂), Total Phosphorus (TP), and E. coli. The specific monitoring parameters selected for each impaired waterbody are recommended to vary according to the cause of impairment within identified streams as noted previously in Table 4. At the time grab sampling is performed, Knox County will use its Aqua TROLL data sonde to measure Temperature, pH, Conductivity, Dissolved Oxygen (DO) and Turbidity. Knox County will document the rainfall amount of the most recent rainfall and ensure at least 72 hours have passed since the last rainfall recorded at the nearest weather station.

Ambient monitoring of E. coli will include the collection of five samples within a thirty-day period (to establish a geometric mean) and be performed during the summer (March through November). At least one series of five E. coli samples will be collected within every five-year monitoring period for waterbodies whose cause of impairment is E. coli.

4.1.6 Biological Stream Sampling

Knox County will perform biological stream sampling from waterbodies within its jurisdiction based on prioritized efforts within the tiered monitoring approach.

Biological stream sampling and benthic macroinvertebrate surveys provide early indications that a watershed is at risk for impairment and water quality is beginning to degrade within the watershed. Benthic macroinvertebrates essentially monitor chronic water quality issues within the waterbody and because the population of benthic macroinvertebrates respond in predictable ways, they can serve as water quality indicators. Knox County intends to perform biological stream sampling within prioritized watersheds on three-year intervals.

TDEC performs biological stream sampling within Knox County waterbodies each year, with biological stream sampling performed at five-year intervals at monitoring locations. Knox County will schedule biological stream sampling within its MS4 jurisdiction to best align with TDEC's biological stream sampling activities to protect the benthic macroinvertebrate community and not over sample within the same waterbody.

4.2 Tier 1 Watersheds: Focused Monitoring

HUC 12 watersheds assigned to Tier 1 were identified to be studied through planning efforts, and thus are intended to receive the most in-depth monitoring including GIS desktop analysis, field stream assessments, dry weather screening, flow monitoring, and ambient monitoring for chemical and bacteriological parameters. Table 5 summarizes the monitoring activities planned for Tier 1 HUC 12 Watersheds.

Table 5. Monitoring Activities Planned for Tier 1 Watersheds

Tier	HUC 12 Name	Impaired Waterbody Name	GIS Desktop Analysis	Field Stream Assessments	Dry Weather Screening	Flow Monitoring	Chemical Monitoring	E. coli 5-in-30 Monitoring
1	Fort Loudoun Lake Middle	Sinking Creek	MS4-wide	1 per 5 years	MS4-wide	From 2026 ¹	Quarterly samples all years	1 per 5 years
1	Clinch River-Conner Creek	Conner Creek	MS4-wide	1 per 5 years	MS4-wide	All years	Quarterly samples all years	1 per 5 years
		Grable Branch	MS4-wide	1 per 5 years	MS4-wide	N/A	Quarterly samples all years	1 per 5 years
		Hickory Creek	MS4-wide	1 per 5 years	MS4-wide	N/A	Quarterly samples all years	1 per 5 years
1	First Creek	Whites Creek	MS4-wide	1 per 5 years	MS4-wide	All years	Quarterly samples all years	1 per 5 years

¹stage recorder only.

4.2.1 Tier 1 GIS Desktop Analysis

At the initiation of the monitoring period and prior to conducting field monitoring, Knox County intends to conduct GIS analysis across its MS4 jurisdiction, as described previously in Section 4.1.1, to capture HUC 12 watershed features such as riparian buffer conditions, LULC, and topographic data.

In addition to the county-wide GIS analyses, Knox County intends to perform additional analysis described below for Tier 1 watersheds included in IWP efforts.

- 1. Soil Erosion Risk Analysis.** Perform a stream bank erosion risk analysis to prioritize streams with high erosion risk for field assessment and evaluate as potential stream restoration candidates.
- 2. Geomorphology.** Measure geomorphic conditions such as average channel sinuosity and major planimetric alterations to determine the degree of channel alteration. Evaluate with USGS geologic GIS data and field verification because Valley and Ridge streams can flow on strike or down fault lines, meaning straighter channel pattern could be due to natural conditions.

- 3. Pollutant Loading Modeling.** Estimate pollutant loading based on the local LULC dataset and available source identification data within watersheds across Knox County.

4.2.2 Tier 1 Field Stream Assessments

Impaired waterbodies within Tier 1 HUC 12 watersheds will receive field stream assessments on selected stream reaches once every five-year monitoring period.

If flows are observed in stormwater outfalls within ephemeral or intermittent streams during dry weather, this will initiate Knox County's existing standard procedure for performing a Dry Weather Screening.

4.2.3 Tier 1 Dry Weather Screening

Outfalls within subwatersheds assigned a High or Medium rating based on the watershed's potential for pollution will be inspected in coordination with field stream assessments performed during the monitoring period. Outfalls within subwatersheds assigned a Low rating are inspected if Knox County is notified of a possible illicit discharge or other notification requiring a field inspection of outfalls.

4.2.4 Tier 1 Flow Monitoring

Each impaired waterbody within Tier 1 watersheds will include at least one monitoring location for stream flow and/or stage. Flow monitoring will continue through the permit monitoring cycle. Fort Loudoun Middle will have a stage recorder at Bluegrass Lake starting in 2026.

4.2.5 Tier 1 Chemical and Bacteriological Stream Sampling

Knox County will perform quarterly (one sample each season or four samples in a year) chemical monitoring on impaired waterbodies every year during the five-year monitoring period within Tier 1 watersheds identified with an IWP.

Chemical and bacteriological stream sampling will include quarterly grab samples to analyze for NO₃-NO₂, TP, and E. coli during ambient weather conditions. At the time grab sampling is performed, Knox County will measure Temperature, pH, Conductivity, DO, and Turbidity.

TDEC has identified the top ten HUC 10 watersheds in Tennessee that contribute the highest percentage of nitrogen and phosphorus from urban land uses. Impaired waterbodies within these Knox County watersheds identified by TDEC as contributing the largest percentage of nitrogen and phosphorus from urban land uses will be monitored for NO₃-NO₂ and/or TP. Fort Loudoun Lake Middle and First Creek are included in the top HUC 10 watersheds contributing the largest percentage of nitrogen from urban land uses. Clinch River – Conner Creek is included in the top HUC 10 watersheds contributing the largest percentage of nitrogen *and* phosphorus from urban land uses.

The monitoring parameters identified in Table 6 below have been selected for each watershed based on the cause and source of impairment as well as whether the watershed has been identified by TDEC as a leading source of nitrogen and/or phosphorus from urban land uses.

For E. coli monitoring within Teir 1 watersheds, one set of quarterly grab samples collected during ambient conditions within the five-year monitoring period is intended to be the collection of five samples within a thirty-day period to be performed between March and November. This 5-in-30 sample collection for E. coli is planned to occur once every five years.

Table 6. Frequency of Chemical and Bacteriological Monitoring in Tier 1 Watersheds

Tier	HUC 12 Name	Impaired Waterbody Name	Quarterly Chemical Monitoring Every Year in Monitoring Period				E. coli 5-in-30 Monitoring
			NO ₃ -NO ₂	TP	E. coli	Turbidity	
1	Fort Loudoun Lake Middle	Sinking Creek	✓		✓	✓	1 per 5 years
1	Clinch River – Conner Creek	Conner Creek	✓	✓	✓	✓	1 per 5 years
		Grable Branch	✓	✓	✓	✓	1 per 5 years
		Hickory Creek	✓	✓	✓	✓	1 per 5 years
1	First Creek	Whites Creek	✓		✓	✓	1 per 5 years

4.3 Tier 2 Watersheds: Background Monitoring

Within the HUC 12 Tier 2 watersheds, Knox County has resources available to monitor and consider future watershed planning efforts and potential water quality improvement projects. Tier 2 watersheds are intended to be monitored through GIS desktop analysis, field stream assessments, dry weather screening, and ambient weather monitoring for chemical and bacteriological parameters. Table 7 summarizes the monitoring activities planned for Tier 2 HUC 12 Watersheds.

Table 7. Monitoring Activities Planned for Tier 2 Watersheds

Tier	HUC 12 Name	Impaired Waterbody Name	GIS Desktop Analysis	Field Stream Assessments	Dry Weather Screening	Chemical Monitoring	E. coli 5-in-30 Monitoring
2	Beaver Creek Lower	Beaver Creek	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years
		Grassy Creek	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years
		Meadow Creek	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years
		Melton Hill Reservoir	MS4-wide	N/A	MS4-wide	N/A	N/A
		Plumb Creek	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years
2	Beaver Creek Upper	Beaver Creek	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years
		Hines Branch	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years
		Knob Fork	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years
		Mill Branch	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years

Tier	HUC 12 Name	Impaired Waterbody Name	GIS Desktop Analysis	Field Stream Assessments	Dry Weather Screening	Chemical Monitoring	E. coli 5-in-30 Monitoring
		Willow Fork	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years
2	Fort Loudoun Lake Upper	Fort Loudoun Reservoir	MS4-wide	N/A	MS4-wide	N/A	N/A
		Toll Creek	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	N/A
		Unnamed Trib to Flenniken Branch	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	N/A
2	Holston River Outlet	Love Creek	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years
		Swanpond Creek	MS4-wide	1 per 5 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years
2	Stock Creek	Casteel Branch	MS4-wide	1 per 10 years	MS4-wide	Quarterly samples for 1 year	N/A
		Grandview Branch	MS4-wide	1 per 10 years	MS4-wide	N/A	1 per 5 years
		Gunn Hollow Branch	MS4-wide	1 per 10 years	MS4-wide	N/A	1 per 5 years
		High Bluff Branch	MS4-wide	1 per 10 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years
		McCall Branch	MS4-wide	1 per 10 years	MS4-wide	Quarterly samples for 1 year	N/A
		Stock Creek	MS4-wide	1 per 10 years	MS4-wide	N/A	1 per 5 years
2	Turkey Creek	Turkey Creek	MS4-wide	1 per 10 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years
2	Ten Mile Creek	Ten Mile Creek	MS4-wide	1 per 10 years	MS4-wide	Quarterly samples for 1 year	1 per 5 years

4.3.1 Tier 2 GIS Desktop Analysis

At the initiation of the five-year monitoring period and prior to conducting field monitoring, Knox County plans to conduct GIS analysis across its MS4 jurisdiction, as described in Section 4.1.1, to capture HUC 12 watershed features such as riparian buffer conditions, LULC, and percent imperviousness. Developing average conditions per tributary, reach break, or at the HUC 12 watershed scale will be a useful measure for monitoring cumulative impacts to stream health.

4.3.2 Tier 2 Field Stream Assessments

For the purposes of ranking and prioritization, HUC 12 watersheds were assigned a Development Impact Risk designation to characterize the likelihood of negative impacts in the watershed attributed to current and future development in each watershed, as shown earlier in Table 1 .

Stream waterbodies identified on TDEC's 303(d) list of impaired waters and within Tier 2 HUC 12 watersheds with a Development Impact Risk of High (Impervious \geq 10% and Projected Population Growth Rate \geq 10%), are recommended to receive field stream assessments once during every five-year monitoring period. Impaired stream waterbodies within Tier 2 HUC 12 watersheds with a Development Impact Risk of Medium (Impervious $<$ 10% and Projected Population Growth Rate \geq 10%) or Active Degradation (Impervious \geq 20%) are recommended to receive field stream assessments once within every ten-year period.

If flows are observed at stormwater outfalls within ephemeral or intermittent streams during dry weather, then that is recommended to initiate Knox County's existing standard procedure for performing a Dry Weather Screening.

4.3.3 Tier 2 Dry Weather Screening

Outfalls within subwatersheds assigned a High or Medium rating based on the watershed's potential for pollution are planned to be inspected in coordination with field stream assessments performed during the monitoring period. Outfalls within subwatersheds assigned a Low rating are to be inspected if Knox County is notified of a possible illicit discharge or other notification requiring a field inspection of outfalls.

4.3.4 Tier 2 Chemical Monitoring and Bacteriological Stream Sampling

Within Tier 2 HUC 12 watersheds, ambient chemical and bacteriological stream sampling are planned to include quarterly grab samples (four samples per year) from streams with sedimentation, nutrients, or E. coli as the cause of impairment and the potential source of impairment identified as municipal for one year during the permit cycle. Chemical stream sampling is planned to include analysis for $\text{NO}_3\text{-NO}_2$, TP, and E. coli. At the time grab sampling is performed, Knox County will measure Temperature, pH, Conductivity, DO and Turbidity. The selected analyses for each waterbody vary, depending on the waterbody's identified cause of impairment on the List of Impaired Streams and presented earlier in Table 4. Waterbodies with the cause of impairment identified related to sedimentation are planned to be monitored for Turbidity. Waterbodies with the cause of impairment identified as E. coli are planned to be monitored for E. coli.

TDEC has identified the top ten HUC 10 watersheds in Tennessee that contribute the highest percentage of nitrogen and phosphorus from urban land uses. Impaired waterbodies within Knox County that are also within these watersheds identified by TDEC as contributing the largest percentage of nitrogen and phosphorus from urban land uses will be monitored for $\text{NO}_3\text{-NO}_2$ and/or TP. Beaver Creek Upper and Beaver Creek Lower are both included in the top HUC 10 watersheds contributing the largest percentage of nitrogen and phosphorus from urban land uses. The monitoring parameters identified in Table 8 below have been selected for each watershed based on the cause and source of impairment as well as whether the watershed has been identified by TDEC as a leading source of nitrogen and/or phosphorus from urban land uses.

To evenly distribute chemical monitoring across the five-year monitoring period, Knox County plans to collect quarterly grab samples from four waterbodies each year of the monitoring period with the intended objective to collect stream samples from four waterbodies quarterly for a full year before shifting to the next four waterbodies. At the conclusion of the five-year monitoring period, all impaired

streams within Tier 2 HUC 12 watersheds with the potential source of impairment attributed to municipal sources will have been monitored for chemical parameters for a year.

Knox County plans to collect a series of five samples within a 30-day period from each waterbody listing E. coli as a cause of impairment. This 5-in-30 series is planned to occur once every five years between March and November and would replace the one-time quarterly grab sample for that monitoring year.

Table 8. Frequency of Chemical and Bacteriological Stream Sampling in Tier 2 Watersheds

Tier	HUC 12 Name	Impaired Waterbody Name	Quarterly Chemical Monitoring for 1 Year in Monitoring Period				E. coli 5-in-30 Monitoring
			NO ₃ -NO ₂	TP	E. coli	Turbidity	
2	Beaver Creek Lower ¹	Beaver Creek	✓	✓	✓	✓	1 per 5 years
		Grassy Creek	✓	✓	✓	✓	1 per 5 years
		Meadow Creek	✓	✓	✓		1 per 5 years
		Plumb Creek	✓	✓	✓		1 per 5 years
2	Beaver Creek Upper	Beaver Creek	✓	✓	✓	✓	1 per 5 years
		Hines Branch	✓	✓	✓	✓	1 per 5 years
		Knob Fork	✓	✓	✓	✓	1 per 5 years
		Mill Branch	✓	✓			1 per 5 years
		Willow Fork	✓	✓	✓	✓	1 per 5 years
2	Fort Loudoun Lake Upper ²	Toll Creek				✓	N/A
		Unnamed Trib to Flenniken Branch				✓	N/A
2	Holston River Outlet	Love Creek			✓	✓	1 per 5 years
		Swanpond Creek			✓		1 per 5 years
2	Stock Creek	Casteel Branch				✓	N/A
		Grandview Branch					1 per 5 years
		Gunn Hollow Branch					1 per 5 years
		High Bluff Branch			✓		1 per 5 years
		McCall Branch				✓	N/A
		Stock Creek					1 per 5 years
2	Turkey Creek	Turkey Creek			✓	✓	1 per 5 years
2	Ten Mile Creek	Ten Mile Creek			✓	✓	1 per 5 years

4.4 Tier 3 Watersheds: Situational Monitoring

Tier 3 watersheds are generally at a lower risk for degradation and are intended to be primarily monitored through GIS desktop analysis, dry weather screening, and benthic and habitat assessments. Table 9 summarizes the monitoring activities planned for Tier 3 HUC 12 Watersheds.

¹ Melton Hill Reservoir was excluded from Chemical and Bacteriological Stream Sampling.

² Fort Loudoun Reservoir was excluded from Chemical and Bacteriological Stream Sampling.

Table 9. Monitoring Activities Planned for Tier 3 Watersheds

Tier	HUC 12 Name	Waterbody Name	GIS Desktop Analysis	Dry Weather Screening	Benthic and Habitat Assessment Frequency
3	Bull Run Creek Lower	Bull Run Creek	MS4-wide	MS4-wide	1 per 5 years
3	Fort Loudoun Lake Lower	N/A	MS4-wide	MS4-wide	N/A
3	Holston River – Clift Creek	Roseberry Creek	MS4-wide	MS4-wide	1 per 5 years
3	French Broad River Outlet	Hines Creek	MS4-wide	MS4-wide	1 per 5 years
		Burnett Creek	MS4-wide	MS4-wide	1 per 5 years
3	Little River – Roddy Branch	Fort Loudoun Reservoir	MS4-wide	MS4-wide	N/A
		Roddy Branch	MS4-wide	MS4-wide	N/A
		Little River	MS4-wide	MS4-wide	N/A
3	Holston River – Beaver Creek	N/A	MS4-wide	MS4-wide	N/A
3	Flat Creek	Flat Creek	MS4-wide	MS4-wide	1 per 5 years
		Little Flat Creek	MS4-wide	MS4-wide	1 per 5 years
3	Tuckahoe Creek	Tuckahoe Creek	MS4-wide	MS4-wide	1 per 5 years
3	Bull Run Creek Upper	Bull Run Creek	MS4-wide	MS4-wide	1 per 5 years
3	Little River Nails Creek	N/A	MS4-wide	MS4-wide	N/A

4.4.1 Tier 3 GIS Desktop Analysis

At the initiation of the five-year monitoring period and prior to conducting field monitoring, Knox County plans to conduct GIS analysis across its MS4 jurisdiction, as described in Section 4.1.1, to capture HUC 12 watershed features such as riparian buffer conditions, LULC, and percent imperviousness. Developing average conditions per tributary, reach break, or at the HUC 12 watershed scale will be a useful measure for monitoring cumulative impacts to stream health.

4.4.2 Tier 3 Dry Weather Screening

Knox County will perform routine inspections of stormwater outfalls within Tier 3 watersheds to identify potential illicit discharges and illicit connections. Within HUC 12 watersheds, subwatersheds assigned a High or Medium rating based on the watershed’s potential for pollution will have outfalls inspected during the monitoring period, following protocols from Knox County’s Dry Weather Screening Program. Outfalls within subwatersheds assigned a Low rating are inspected if Knox County is notified of a possible illicit discharge or other notification requiring a field inspection of outfalls.

4.4.3 Tier 3 Biological Stream Sampling

Knox County plans to perform benthic macroinvertebrate collection and habitat assessments every five years on both waterbodies currently listed as impaired and waterbodies at risk for impairment within selected Tier 3 HUC 12 watersheds. Waterbodies at risk for impairment are currently not listed as impaired waters by TDEC, but are adjacent to watersheds with waterbodies listed as impaired.

Benthic macroinvertebrate collection allows Knox County to monitor the water quality of streams in Tier 3 watersheds that are not receiving field stream assessments or additional chemical or bacteriological monitoring. Knox County intends to coordinate benthic macroinvertebrate collection with TDEC to avoid duplicating collection from the same stream within a two-year monitoring period.

5 Records Requirements

Knox County will retain records of monitoring data collected in a database and/or in electronic file formats. Knox County will attach monitoring records to the annual report except where otherwise noted here. Data will be retained by Knox County for a minimum of five years.

5.1.1 Field Stream Assessment Data

Field stream assessment data will be collected and stored in a database managed by Knox County. Field stream assessment data will be available to TDEC upon request.

5.1.2 Dry Weather Screening Data

Dry weather screening data will be collected and stored in a database managed by Knox County. Dry weather screening data will be available to TDEC upon request.

5.1.3 Flow Monitoring Data

Flow monitoring data collected by the USGS is available directly from USGS and can be accessed through the individual station website pages or through the National Water Dashboard. Flow and stage data collected by Knox County will be available to TDEC upon request.

5.1.4 GIS Desktop Monitoring Data

Data derived from GIS analysis will be stored in a geodatabase either operated by KGIS or by Knox County. Data from this analysis will be available to TDEC upon request.

5.1.5 Chemical Monitoring Data

NO₃-NO₂ and TP grab sample data and associated Temperature, pH, Conductivity, DO, and Turbidity will be stored electronically and will be associated with an established or new DWS Station ID following DWS established naming conventions. Data will be stored in tabular format and attached to the annual report.

5.1.6 Bacteriological Monitoring Data

Bacteriological sample data will be recorded in the *TDEC E. coli and Field Water Parameter Report* - a Microsoft Excel workbook for reporting water parameters and E. coli results following the QSSOP for Chemical and Bacteriological Sampling of Surface Waters (rev. 12/2023).

The completed workbooks will be attached to the annual report.

5.1.7 Biological Monitoring Data

Habitat assessment and stream survey workbooks (also known as Electronic Data Deliverable or EDDs) will be completed concurrent with each biological survey.

Two electronic Excel workbooks titled *Field Stream Survey* and *Habitat Sheets and Macroinvertebrate Taxa Report* will be used to report complete taxa lists as well as habitat assessments and field survey sheets, including chemical/physical parameters recorded during the biosurvey.

The completed workbooks will be attached to the annual report.

6 Evaluation of Stormwater Impacts

Knox County's primary goal is to collect data to inform program decisions and demonstrate effectiveness within the NPDES compliance program.

Knox County Engineering and Public Works will collect monitoring data on the waterbodies identified in this jurisdiction-specific monitoring plan to document water quality and stream conditions over time. Knox County will identify trends in the water quality data and compare with other NPDES program elements or activities that could have a significant impact on the water quality data, such as Construction Site Runoff Controls and Pollution Prevention and Good Housekeeping. When a spike in pollutant levels is observed, Knox County will engage in a more focused field assessment to identify the pollutant source, such as a significant bank failure. Biological monitoring results will be compared with established recommendations from TDEC.

When sources of Knox County's pollutants of concern are identified and improvement programs and/or projects are identified and subsequently implemented, Knox County will monitor water quality to evaluate progress towards improving water quality and reducing stormwater impacts to stream health.

7 Program Decisions and Prioritization of Future Activities

Knox County has developed this monitoring plan with the intention that the data collected will inform program decisions and assist in prioritizing future activities. Knox County will review data collected annually to determine if program activities need to be adjusted. Furthermore, Knox County will use data collected to assist in prioritizing grant opportunities and capital projects. Knox County's data management structure will allow spatial and temporal data analysis which will further inform decisions and prioritization.

8 Instream Monitoring Protocols

Stream sampling for ambient weather conditions will utilize methods identified in TDEC's most current version of the Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water.

Biological stream sampling will be performed utilizing the Semi-Quantitative Single Habitat (SQSH) Method as identified in TDEC's most current version of the Quality System Standard Operating Procedure for Macroinvertebrate Stream Survey.

9 Administrative Provisions

If renewal of Knox County's NPDES permit is delayed, Knox County will continue to follow the latest monitoring plan approved by TDEC. Based on the results and experience with past monitoring activities, Knox County may submit an administrative request for TDEC to approve modifications to the monitoring plan.

10 Appendices

10.1 Appendix A: Watershed Prioritization Approach

Stormwater Monitoring Plan: Watershed Prioritization Approach

Revised, September 20, 2023

10.1.1 Background

The overarching goal of the monitoring program is to evaluate and document surface water quality and habitat condition in Knox County's Hydrologic Unit Code (HUC) 12 watersheds and satisfy National Pollutant Discharge Elimination System (NPDES) Phase II Municipal Separate Storm Sewer System (MS4) Permit requirements and Total Maximum Daily Load (TMDL) monitoring obligations. Monitoring data will support identification, prioritization, and design of water quality improvement projects.

There are 27 HUC 12 watersheds located either partially or fully within the Knox County geographic boundary. Categorizing the HUC 12 watersheds into tiers is the first step in prioritizing a level of effort for monitoring each watershed. This document summarizes the methodology used for prioritizing the HUC 12s into three tiers. Seven HUC 12 watersheds were excluded from this prioritization approach because less than 5% of their watershed area is within Knox County's MS4 jurisdiction. The seven watersheds excluded from the prioritization are French Broad River-Millican Creek, Third Creek, Second Creek, Richland Creek, Hinds Creek, Clinch River-Wolf Creek, and Tennessee River-Town Creek.

The remaining 20 watersheds were prioritized into three tiers with composite scores calculated to prioritize and rank each HUC 12. Knox County selected Clinch River-Conner Creek, First Creek, and Fort Loudoun Lake Middle as high-priority HUC 12 watersheds based on persistent flooding, infrastructure failures, sink holes, and high levels of projected growth. These three watersheds were included in the prioritization ranking; however, regardless of their composite score, they were assigned Tier 1. The remaining 17 watersheds were ranked into Tier 2 and Tier 3 categories, which will determine the monitoring protocols carried out for each watershed. Based on a natural break in the calculated composite scores, seven watersheds scoring over 14 points have been identified within Tier 2, and ten watersheds have been identified within Tier 3.

10.1.2 Prioritization Datasets

HUC 12 watersheds within Knox County were prioritized based on the available datasets shown in Table 1. The prioritization factors were weighted on a scale from zero to five and were used to develop a composite score for each HUC 12 watershed.

Table 10. Datasets included in prioritization calculation.

Dataset	Dataset Source
Stream Impairment Classification, Impairment Cause, Impairment Source	KGIS Dataset for HYDRO_WQA_MS4_KNO
Percent of HUC 12 Watershed within County MS4 Jurisdiction	KGIS datasets for HUC 12 watershed boundaries and municipal boundaries
Projected Knox County Population	Knox County Engineering & Public Works
Impervious Land Cover	Combined KGIS datasets for buildings, structures, and transportation area
Stream Density	KGIS Dataset for HYDRO_WQA_MS4_KNO
Source Water Protection Area	TDEC Source Water Protection Team
Infrastructure within the 0.2% and 1% FEMA Flood Hazard Zones	KGIS datasets for buildings, structures, and transportation area; FEMA flood hazard GIS layers

Locations of existing USGS Stations were not included in the prioritization calculation because the presence of USGS Station data should not influence where future monitoring efforts are prioritized. The factors behind the locations of the current USGS Stations are unknown and do not necessarily correlate with the presence of water quality concerns. Additionally, types of data collected by USGS Stations can vary. Incorporating the presence of existing USGS Stations into the watershed prioritization could suggest Knox County is prioritizing convenience of existing data sources over the necessity to collect water quality data in less-studied water bodies.

For this prioritization, stream density was evaluated only within the Knox County boundary and defined as the length of stream miles within the portion of the each HUC 12 watershed that occurs within the Knox County geographic boundary divided by the square mile area of the HUC 12 watershed portion within Knox County.

Higher stream density within a watershed typically indicates that the landscape can drain efficiently, meaning runoff reaches streams faster. However, this is largely because soil conditions do not support a high infiltration rate. Poor infiltration can be due to naturally occurring soils or due to urbanization and impervious surfaces. Less infiltration and more channelized flow usually result in higher pollutant loading if pollutant sources are present. Higher stream density means there are more opportunities for ecological impacts and thus more need for monitoring. Lower stream density typically indicates greater opportunities for infiltration into the soil in the upper reaches of the watershed, generating less runoff

and a greater likelihood of streams forming towards the lower part of the watershed. Overall, lower stream density is associated with less potential for impacts and less need for monitoring.

For the purposes of ranking and prioritization, the following metrics were combined to assign an overall Development Impact Risk designation. The Development Impact Risk is the likelihood of negative impacts in the watershed attributed to current and future development in each watershed.

- Active Degradation: Impervious \geq 20%
- High Risk: Impervious \geq 10% and Projected Population Growth Rate \geq 10%
- Medium Risk: Impervious $<$ 10% and Projected Population Growth Rate \geq 10%
- Low Risk: Impervious $<$ 10% and Projected Population Growth Rate $<$ 10%

Based on the predicted population growth rate over the next 20 years, watersheds were prioritized according to the level of risk for stream and water quality degradation. Widely accepted research shows streams begin to degrade and surface water quality declines when impervious land cover exceeds 10%. Stream health significantly declines as impervious land cover approaches and exceeds 25%. Assigning a Development Impact Risk provides an opportunity to evaluate current and future conditions and predict impact potential from projected future development and population change at the watershed level.

10.1.3 Watershed Prioritization and Ranking

Based on an understanding of Knox County's priorities driving monitoring efforts, a prioritization schema was utilized to rank each watershed based on specific, weighted criteria.

- Watersheds with streams on the 303(d) List of Impaired or Threatened Waters with causes of impairment attributed to municipal sources are weighted highest.
- The percentage of watershed within Knox County's MS4 jurisdiction, percent of impervious land cover, and the projected population within each watershed as a percentage of Knox County's total projected population growth are weighted second highest.
- Given Knox County's desire to prioritize watersheds with high risk for degradation, watersheds assigned a High Development Impact Risk are weighted moderately important.
- The percentage of impaired streams, watershed stream density within Knox County, the percentage of TDEC designated Source Water Protection Area within each watershed, and the percentage of infrastructure in the 0.2% and 1% FEMA Flood Hazard zones are weighted lower. Infrastructure is defined as buildings, structures, and transportation areas in the KGIS data.

Each prioritization factor has an equation shown in Table 2 to calculate a composite score developed for each watershed. The composite score is the sum of all the prioritization factor equations. Watersheds with less than 5% of area within Knox County's MS4 jurisdiction were removed from the analysis.

The population growth rate is a factor in assigning the development impact risk, but this should not be confused with the percent of Knox County Projected Population in Watershed, shown as a prioritization factor below in Table 2. The population growth rate is not used as a prioritization factor because it skews the ranking too heavily in favor of the watersheds with a high growth rate and does not evaluate the potential severity of the population change based on the current population level. For the prioritization approach, the percent of Knox County's projected population in each watershed is the most effective population metric for the purpose of ranking the HUC 12s.

Table 11. Watershed Prioritization Factors

Prioritization Factor	Weighting Factor	Equation
On 303(d) List for MS4 Sources	5	If yes, = 5
Percent Watershed in MS4	4	% * 4
Percent of Knox County Projected Population in Watershed	4	% * 4
Percent Impervious Land Cover	4	% * 4
Percent Impaired Streams	3	% * 3
Watershed Stream Density in Knox County	2	* 2
Percent of Source Water Protection Area	2	% * 2
Percent Infrastructure in 1% Flood Hazard Area	2	% * 2
Percent Infrastructure in 0.2% Flood Hazard Area	1	% * 1
Development Impact Risk: High Risk	3	If yes, = 3
Development Impact Risk: Medium Risk	2	If yes, = 2
Development Impact Risk: Active Degradation	1	If yes, = 1
Development Impact Risk: Low Risk	0	If yes, = 0

Table 3 presents the prioritization factor data and composite scores for the 20 watersheds with more than 5% of their land area within Knox County’s MS4 jurisdiction. The watersheds are ranked by composite score, except for the pre-selected Tier 1 watersheds, and prioritized into Tier 2 and Tier 3 based on a natural break in the scores.

In general, Tier 2 represents watersheds on the 303(d) list with causes of impairment attributed to municipal sources, more watershed area within the MS4 jurisdictional boundary of Knox County, higher population growth projected within the watershed, more streams impaired, and more infrastructure located within the 0.2% or 1% FEMA flood hazard zones.

Table 3. Knox County Watersheds Prioritized for Monitoring Plan

Watershed Prioritization Factors and Assigned Rank														
Factor Weight	5	4	N/A	4	0, 1, 2, or 3	4	3	2		2	1			
HUC-12 Name	303(d) List for MS4 Causes	Knox Co. Projected Population in Watershed (%)	Projected Population Growth Rate (%)	Impervious Land Cover (%)	Watershed Development Impact Risk	Watershed Area in Knox Co. (%)	Impaired Streams in Knox Co. (%)	Stream Density in Knox Co. (stream mi/watershed sq mi)	Source Water Protection Area (%)	Infrastructure in 1% Flood Hazard Area (%)	Infrastructure in 0.2% Flood Hazard Area (%)	Composite Score	Assigned Rank	Assigned Monitoring Tier
Fort Loudoun Lake Middle	Y	4.3%	12%	11%	High Risk	58%	82%	1.4	54%	1%	9%	17.4	1	1
Clinch River-Conner Creek	Y	5.6%	165%	7%	Medium Risk	40%	97%	1.6	31%	1%	14%	16.2	2	1
First Creek	Y	3.7%	93%	21%	Active Degradation	32%	100%	1.2	0%	22%	40%	14.7	3	1
Beaver Creek Lower	Y	16.5%	22%	14%	High Risk	98%	71%	1.6	44%	5%	14%	19.7	4	2
Beaver Creek Upper	Y	16.2%	20%	11%	High Risk	94%	55%	1.5	41%	9%	20%	18.7	5	2
Fort Loudoun Lake Upper	Y	4.6%	16%	18%	High Risk	29%	83%	1.3	48%	4%	17%	16.4	6	2
Holston River Outlet	Y	6.9%	75%	11%	High Risk	67%	40%	1.6	3%	3%	8%	16.1	7	2
Stock Creek	Y	2.5%	12%	6%	Medium Risk	95%	43%	1.6	12%	1%	4%	16.0	8	2
Turkey Creek	Y	5.4%	15%	21%	Active Degradation	33%	100%	1.3	45%	3%	15%	15.2	9	2
Ten Mile Creek	Y	11.3%	7%	27%	Active Degradation	62%	63%	1.2	1%	9%	24%	14.9	10	2
Bull Run Creek Lower	Y	2.8%	6%	4%	Low Risk	72%	28%	1.6	47%	1%	5%	13.2	11	3
Fort Loudoun Lake Lower		5.7%	11%	13%	High Risk	56%	80%	1.3	58%	0.3%	4%	12.3	12	3
Holston River-Clift Creek		6.8%	86%	5%	Medium Risk	95%	28%	1.7	48%	2%	4%	11.5	13	3
French Broad River Outlet		3.7%	25%	6%	Medium Risk	81%	0%	1.6	43%	1%	15%	10.0	14	3
Little River-Roddy Branch		0.2%	0%	4%	Low Risk	10%	100%	2.4	64%	1%	4%	9.7	15	3
Holston River-Beaver Creek		0.2%	1%	2%	Low Risk	25%	0%	3.4	57%	0.3%	2%	9.1	16	3
Flat Creek		1.4%	0%	4%	Low Risk	46%	76%	1.7	49%	2%	3%	8.8	17	3
Tuckahoe Creek		0.5%	1%	4%	Low Risk	33%	39%	1.7	48%	1%	5%	7.1	18	3
Bull Run Creek Upper	Y	0.2%	0%	4%	Low Risk	9%	7%	1.4	1%	1%	6%	3.6	19	3
Little River Nails Creek		0.1%	0%	3%	Low Risk	7%	0%	0.8	30%	0%	0%	2.5	20	3

Y = Yes

10.2 Appendix B: GIS Methodology

The following methods will be used to accomplish the GIS desktop analysis described in the Knox County Stormwater Monitoring Plan. Knox County may substitute methodology which provides equivalent or improved results.

Methods applicable to all watersheds

1. Hydrology and Hydraulics
 - a. An export from USGS Stream Stats will be used to determine drainage area, soil permeability, peak-flow, and bankfull geometry. This will be done on TDEC designated streams as needed.
2. Topographic Slope Layer
 - a. A topographic slope layer of the county will be created using the DEM raster provided by KGIS. This can be rendered on the fly or as a separate raster dataset using the Surface Parameters tool (newer version of the Slope tool) that can be stored on a hard drive.
3. Riparian Buffer Condition Survey
 - a. The riparian buffer of TDEC streams will be identified using LiDAR data from KGIS. Using Esri Image Classification, areas identified as vegetated will be extracted and exported as a polygon. Quality of the buffer will be determined using a combination of GIS parameters and field assessments.
4. Land Use and Land Cover Dataset
 - a. Knox County will utilize the USGS National Land Cover Database as needed.
5. Reach Designation and Prioritization
 - a. TDEC streams will be split into reaches based on the boundaries of Knox County delineated sub-basins. Based on hydrology and hydraulics, slope, riparian buffer condition, and land use and land cover factors, a prioritization matrix will be created to rank streams.

Methods specific for Tier 1 Watersheds

6. Soil Erosion Risk Analysis
 - a. Slope and land use data will be used to determine streams with high erosion risk.
7. Geomorphology
 - a. Sinuosity of a stream will be calculated in GIS using length of stream and straight-line length of the stream. This will be compared against geologic data to verify that low sinuosity streams are the result of channelization as valley and ridge streams can sometimes have a straighter channel.
8. Pollutant Loading Modeling
 - a. The Pollutant Load Estimation Tool (PLET) from the EPA will be used for pollutant loading modeling. This is done at the HUC12 level.

10.3 Appendix C: Dry Weather Screening Subbasin Prioritization Methods

To request a copy of the Dry Weather Screening Subbasin Prioritization Methods email stormwater@knoxcounty.org